1st International Conference on Nanotechnologies and Bionanoscience (NanoBio 2018)

ABSTRACT BOOK

The Organizing Committee

Prof. E. Kymakis

Dr. E Stratakis

TEI of Crete
Technological Educational Institute of Crete

FORTH

WELCOME to NanoBio 2018

We would like to welcome you to the **1st International Conference on Nanotechnologies and Bionanoscience (NanoBio 2018)** (https://nanobioconf.com/) taking place in Aquila Atlantis Hotel, at the heart of Heraklion City, Crete in **24-28 September 2018**.

The 1st International conference on Nanotechnologies and Bionanoscience (NanoBio 2018) – aims to capitalize on the rapid growing and interconnected fields of Nanotechnology and Bioscience, drawing in and providing an interdisciplinary forum for scientists and engineers from academia and industry.

Among the main objectives is to discuss on the forefront of research and to address the theory, design and development of advanced materials and nanotechnologies in relation to the field of energy and health applications.

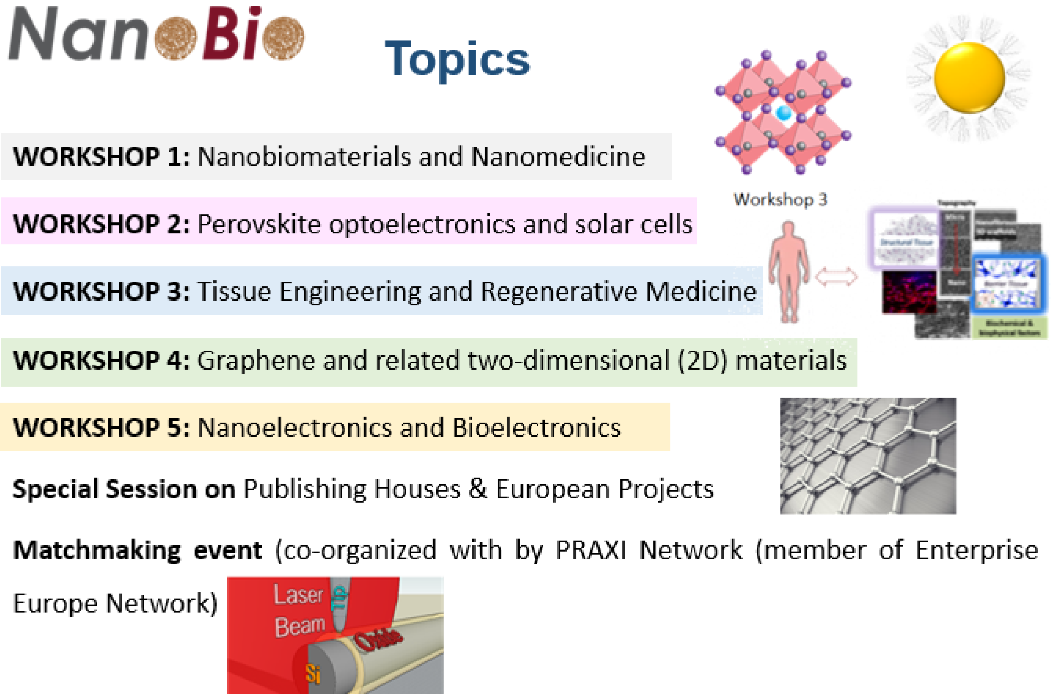
The conference comprises five workshops focusing on the development of novel nanomaterials, bionanosystems for tissue engineering and healthcare, innovative solar cells, nanophotonics, nanomedicine, bioelectronics and lab-on-chip systems.

WORKSHOP 1: Nanobiomaterials and Nanomedicine
WORKSHOP 2: Perovskite optoelectronics and solar cells
WORKSHOP 3: Tissue Engineering and Regenerative Medicine
WORKSHOP 4: Graphene and related two-dimensional (2D) materials
WORKSHOP 5: Nanoelectronics and Bioelectronics
Special Session on Publishing Houses & European Projects
Matchmaking event (co-organized with by PRAXI Network (member of Enterprise Europe Network)

NanoBio 2018 will include world leading Invited Speakers together with experts and stakeholders from academia and industry. Their talks will be a platform for innovation from early-career researchers, young investigators and entrepreneurs. We envisage that the conference will provide an ideal environment to develop new collaborations and opportunities to meet the experts and stakeholders of the rapidly growing fields of Nanotechnology and Bionanoscience. Looking forward to meeting you in Heraklion.

The Organizing Committee
Dr E. Stratakis, IESL-FORTH, Greece
Prof. E Kymakis, TEI of Crete, Greece

How to read the NanoBio2018 program and where to go!



Topics

WORKSHOP 1: Nanobiomaterials and Nanomedicine

WORKSHOP 2: Perovskite optoelectronics and solar cells

WORKSHOP 3: Tissue Engineering and Regenerative Medicine

WORKSHOP 4: Graphene and related two-dimensional (2D) materials

WORKSHOP 5: Nanoelectronics and Bioelectronics

Special Session on Publishing Houses & European Projects

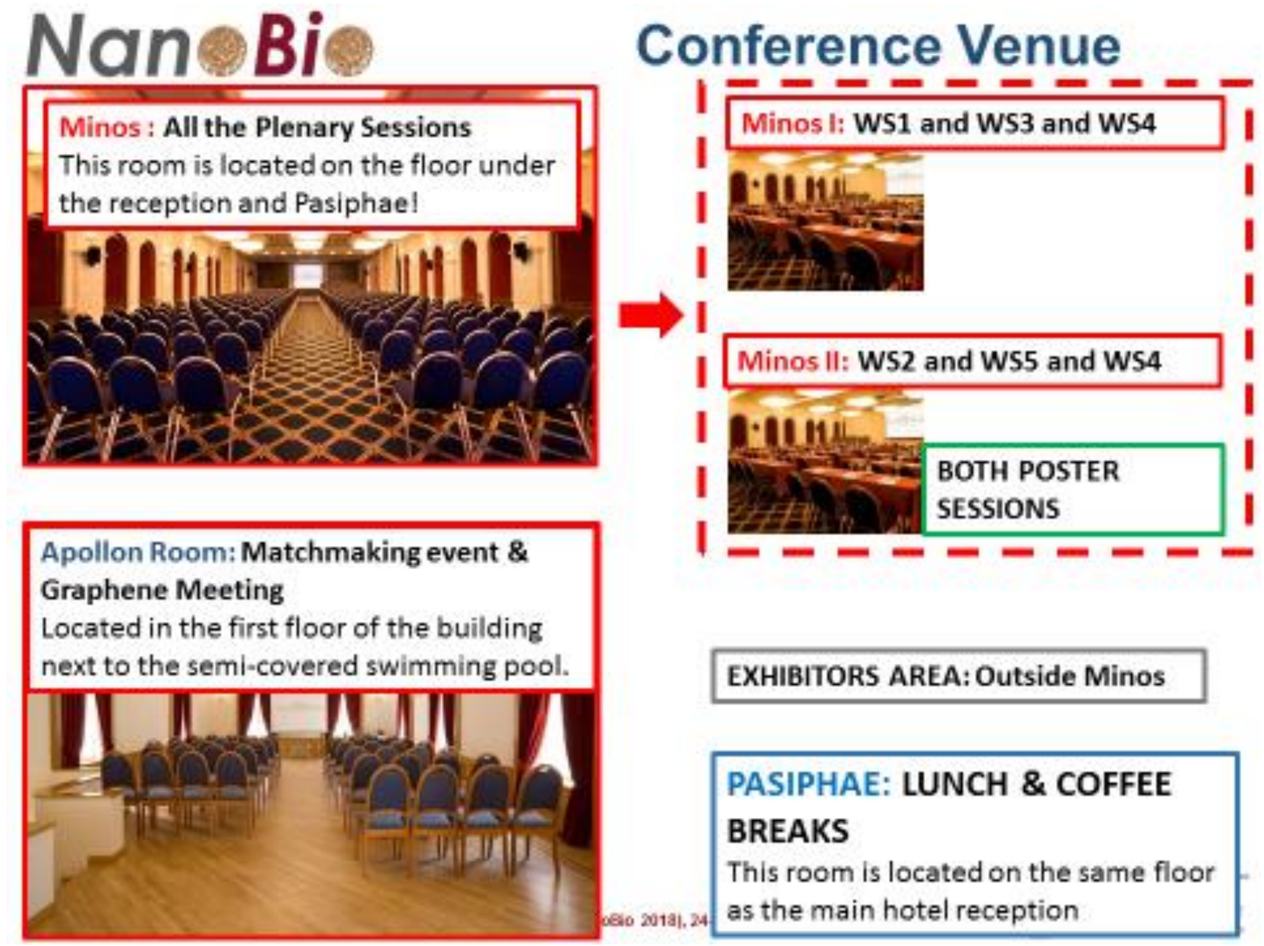
Matchmaking event (co-organized with by PRAXI Network (member of Enterprise Europe Network)

- All the Workshops are colour coordinated!
- The Special Session are in white backround!
- There are Plenary Sessions every day in the morning in Minos conference room (except Wednesday, 26th September)
- There are two Parallel Workshops running every day in the two Minos rooms (Minos I and II) (except Thursday, 27th September, which there are three rooms)
- There are two Poster sessions at 18:00 -20:00 on Tuesday, 25th and Wednesday, 26th September in Minos II.

FOR ANY QUERIES: There will be people from the Organizing team that will help you at all times during the sessions. Please do not hesitate to ask them!

AQUILA ATLANTIS CONFERENCE VENUE – RELEVANT ROOMS

AQUILA
ATLANTIS HOTEL



NanoBio

Conference Venue

Minos : All the Plenary Sessions
This room is located on the floor under the reception and Pasiphae!

Apollon Room: Matchmaking event & Graphene Meeting
Located in the first floor of the building next to the semi-covered swimming pool.

Minos I: WS1 and WS3 and WS4

Minos II: WS2 and WS5 and WS4

BOTH POSTER SESSIONS

EXHIBITORS AREA: Outside Minos

PASIPHAE: LUNCH & COFFEE BREAKS
This room is located on the same floor as the main hotel reception

MONDAY, 24TH SEPTEMBER 2018 – 1ST DAY OF NANOBIO2018

TIME	**Monday 24th September**	
8:00-all day	**REGISTRATION** (at the Registration Desk in Atlantis Aquila Hotel)	
09:00-9:30	**Conference Opening Ceremony (Room: Minos)**	
09:30-10:15	*Plenary Session I on WS2:* Perovskite optoelectronics & solar cells - *Chair: E. Kymakis & E. Stratakis - Room*: Minos (WS2-Plenary) Molecular Photovoltaics and Perovskite Solar Cells **Michael Graetzel*** **Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland**	
10:15-10:45	**COFFEE BREAK (PASIPHAE ROOM)**	
10:45-11:15	*WS1 Session II – Chairs: I. Choi* *Room*: Minos I (WS1-Invited) 3D- structures from nano-assembled multilayers for biomedicine **João F. Mano*, Dept. of Chemistry, CICECO – Aveiro Institute of Materials, University of Aveiro, Aveiro, Portugal**	*WS2 Session III – Chairs: Y. Galagan (Sub: K.Petridis)* *Room*: Minos II (WS2-Invited) Understanding and Designing Interfaces and Defects in Perovskite Solar Cells **Juan-Pablo Correa-Baena*, MIT, USA**
11:15-11:30	**Bio-nanotechnology: a bridge between Nano and Biomaterials towards personalized medicine and intelligent therapeutic solutions** D. Dragatogiannis*, D. Brasinika, C.A. Charitidis* Laboratory of Advanced, Composite, Nano-Materials and Nanotechnology, School of Chemical Engineering, National Technical University of Athens, Athens, Greece	(WS2-Invited) Developing a scale-up route for all printed carbon perovskite solar cells from laboratory to factory **Trystan Watson*, Swansea University, UK**
11:30-11:45	**Biomaterial micro/nano 3D printing via two-photon lithography** Qin Hu[1,2]*, Derek Irvine[1], Chris Tuck[1], Richard Hague[1], Morgan R Alexander[2] and Ricky Wildman[1] [1]Centre for Additive Manufacturing, Faculty of Engineering, University of Nottingham, UK; [2]School of Pharmacy, University of Nottingham, UK	
11:45-12:00	**Multifunctional magnetic nanoparticles fabricated by nano-imprint lithography as probes for label-free biosensing** Stefan Schrittwieser[1]*, Joerg Schotter[1], Martin Bauch[1], Theodoros Dimopoulos[1], Michael J. Haslinger[2], Tina Mitteramskogler[2], Michael Muehlberger[2], Astrit Shoshi[3], Hubert Brueckl[3] [1]AIT Austrian Institute of Technology, Vienna, Austria; [2]PROFACTOR GmbH, Steyr-Gleink, Austria; [3]Danube University Krems, Wiener Neustadt, Austria	**Semiconductor Self-Assembled Monolayers as Selective Contact for Efficient PiN Perovskite Solar Cells** E. Yalcin,[1] M. Can,[2] C. Rodriguez-Seco,[3] E. Aktas,[3] R. Pudi,[3] W. Cambarau,[3] S. Demic[1] and E. Palomares[3,4]* [1] Izmir Katip Celebi University, Dept of Material Science and Engineering, Turkey; [2] Izmir Katip Celebi University, Dept of Engineering Sciences, Turkey; [3] Institute of Chemical Research of Catalonia (ICIQ), Barcelona Institute of Science and Technology; [4] ICREA, Passeig Lluis Companys Barcelona, Spain.
12:00-12:15	**Laser micro-structured topographies for screening mammalian cell response towards the development of multifunctional biointerfaces** V. Dinca[1]*, L. Rusen[1], L. E. Sima[2], M. Icriverzi[2,3], M. Uta[2], N. Nichita-Branza[2], A. Roseanu[2], V. Malheiro[4] E. C. Sirigim[4], P. Hoffmann[4] and M. Dinescu[1] [1]National Institute for Lasers, Plasma and radiation Physics, Bucharest, Romania; [2]Institute of Biochemistry of the Romanian Academy IBAR, Bucharest, Romania; [3]University of Bucharest, faculty of Biology, Bucharest, Romania; [4]EMPA, Switzerland	**Investigation of charge-carrier trap distribution and energy disorder in hybrid organic-inorganic perovskite films** Andrey Kadashchuk[1,2]*, Alexander Vakhnin[1], Joao Bastos[2], Guillaume Croes[2], Weiming Qiu[2] [1]Institute of Physics of NASU, Prospect Nauky 46, 03028 Kyiv, Ukraine’[2]IMEC, Kapeldreef 75, 3001 Leuven, Belgium
12:15-12:30	**Laser synthesized nanoparticles with tuned optical properties for therapeutic drug monitoring** P.M. Ossi[1], M. Tommasini[1], C. Zanchi[1], A. Lucotti[1], E. Fazio[2], M. Santoro[2], S. Spadaro[2], F. Neri[2], S. Trusso[3]*, M. Casazza[4], E. Ciusani[4], U. de Grazia[4] [1]Politecnico di Milano, Milano, Italy; [2]Università di Messina, Messina, Italy; [3]IPCF-CNR, Messina, Italy; [4]Fondazione IRCCS Istituto Neurologico Carlo Besta, Milano, Italy	**Perovskites for solid state lighting devices** M. Bidikoudi*, E. Fresta and R.D. Costa IMDEA Materials, Madrid, Spain
12:30-12:45	**Layer-by-Layer Surface Modification of Nanoparticles for Highly Efficient Multifunctional Drug Delivery Systems** Beatrice Fortuni[1]*, Tomoko Inose[2], Indra Van Zundert[1], Monica Ricci[1], Susana Rocha[1] and Hiroshi Uji-i[1,2] [1]KU Leuven, Leuven, Belgium; [2]RIES Hokkiado University, Sapporo, Japan	**Efficient Non-Polymeric Heterojunctions in Ternary Organic Solar Cells** Cristina Rodríguez Seco,[1] Anton Vidal Ferran,[1,2]* Emilio Palomares,[1,2]* Rajnish Misra,[3] Ganesh D. Sharma[4] [1]Institute of Chemical Research of Catalonia. The Barcelona Institute of Science and Technology (ICIQ-BIST), Spain; [2]ICREA. Spain; [3]Department of Chemistry, Indian Institute of Technology, Indore (MP), India; [4]Deparment of Physics. The LMN Institute of Information Technology, Jamdoli. India
12:45-13:00	**Antibacterial and Antibiofouling Nanostructured Biomaterials** Lucia Podhorska[1]*, Shauna P. Flynn[1,2]*, Fabian Bayer[1], Graham Reid[1], Laura Quinn[2], Olivier Habimana[2], Jenny Lawlor[3], Eoin Casey[2], and Susan M. Kelleher[1] [1]School of Chemistry, University College Dublin, Belfield, Dublin 4, Ireland; [2]School of Chemical and Bioprocessing Engineering, University College Dublin, Belfield, Dublin 4, Ireland; [3]School of Biotechnology, Dublin City University, Glasnevin, Dublin 9, Ireland	**END OF SESSION**

Plenary Session I on WS2: Perovskite optoelectronics & solar cells

PLENARY TALK

Molecular Photovoltaics and Perovskite Solar Cells

Michael Graetzel

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Molecular photovoltaics has emerged as credible contenders to conventional p-n junction photovoltaics [1-3]. Mimicking light harvesting and charge carrier generation in natural photosynthesis, dye sensitized solar cells (DSCs) were the first to use three-dimensional mesoscopice junctions for solar electricity production, reaching currently a power conversion efficiency (PCE) of over 14% in standard air mass 1.5 sunlight. Remarkably, using judiciously designed organic donor-acceptor sensitizers in conjunction with Cu(II/I) bipyridyl complexes as charge transporters the PCE attains 32% in ambient light, exceeding the performance of the best conventional photovoltaic. By now, large-scale DSC production and commercial sales have been launched on the multi-megawatt scale for application in building integrated PV and light-weight flexible power sources. Recently, the DSC has engendered perovskite solar cells (PSCs) whose meteoric rise has stunned the scientific community. Certified power conversion efficiencies currently attain 23.3 %, exceeding that of polycrystalline silicon solar cells. PSCs show high photovoltages rendering them attractive for applications in tandem cells and for the generation of fuels from sunlight [8]. Recent progress in attaining long term operational stability with PSCs employing inorganic hole conductors in combination with graphene oxide as hole selective layer will be prsented [9].

[1] B.O'Regan and M. Grätzel, Nature 353, 7377-7381 (1991).
[2] M. Grätzel, Nature 414, 332-344 (2001)
[3] A.Yella, H.-W. Lee, H. N. Tsao, C. Yi, A.Kumar Chandiran, Md.K. Nazeeruddin, EW-G .Diau,,C.-Y Yeh, S. M. Zakeeruddin and M. Grätzel, Science 629, 334-341 (2011).
[4] M. Grätzel Nature Mat 13, 838-842 (2014)
[5] J. Burschka, N. Pellet, S.-J. Moon, R.Humphry-Baker, P. Gao1, M K. Nazeeruddin and M. Grätzel Nature 499, 316-3199 (2013).
[6] X. Li, D. Bi, C. Yi, J.-D. Décoppet, J. Luo, S.M. Zakeeruddin, A. Hagfeldt, M. Grätzel, Science 353, 58-62 (2016).
[7] A.Ummadisingu, L. Steier, J.-Y. Seo, T. Matsui, A. Abate1, W. Tress and M.Grätzel Nature 545, 208-212 (2017).
[8] J. Luo, J.-H. Im, M.T. Mayer, M. Schreier, Md.K. Nazeeruddin, N.-G. Park, S.D.Tilley, H.J. Fan, M. Grätzel, Science, 345, 1593-1596 (2014).
[9] N. Arora, , M.I. Dar, A.Hinderhofer, N. Pellet, F. Schreiber, S.M. Zakeeruddin, M. Grätzel, Science 358, 768-771 (2017)

PARALLEL SESSIONS - WS1 Session II on Minos I

Invited Talk

3D- structures from nano-assembled multilayers for biomedicine

João F. Mano

Department of Chemistry, CICECO – Aveiro Institute of Materiails, University of Aveiro, Aveiro, Portugal
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The design of implantable hybrid devices in a variety of biomedical applications is often inspired by the composition and complexity of native tissues. At the lowest level of such organization, one should select the adequate nanobiomaterials to be used as the building block of the structure that will support cells and control their behaviour towards the production of new tissue. We have been proposing the use of multilayered based arrangements prepared by the layer-by-layer technique (LbL) that could be then integrated in more complex porous macroscopic devices, often exhibiting a multi-scale organization. Using adequate templates, non-flat coatings can be fabricated with tuned compositions along the build-up assembly, including porous devices. This enables the production of very well controlled multifunctional and structural devices using mild processing conditions that could be useful in biomedicine, including in tissue engineering. In particular, we have been interested in developing more complex/hierarchical porous structures using natural-based polymers that could fulfil specific requirements in such kind of applications. Often multiple cell types should be integrated in such hybrid devices to recapitulate relevant biological features necessary to trigger the regeneration process. Methodologies developed in our group will be exemplified, permitting the production of: (i) Flat or patterned membrane-like devices able to support the attachment and organization of cells; (ii) 3-dimensional (open) porous nanostructured scaffolds for tissue engineering, enabling the support of cells, by combining LbL and rapid prototyping technology; and (iii) multi-scale spherical objects to encapsulate cells, acting as “living” injectable or (closed porous) implantable devices.

Bio-nanotechnology: a bridge between Nano and Biomaterials towards personalized medicine and intelligent therapeutic solutions

D. Dragatogiannis, D. Brasinika, C.A. Charitidis*

Laboratory of Advanced, Composite, Nano-Materials and Nanotechnology, School of Chemical Engineering, National Technical University of Athens, 9 Heroon Polytechniou st., Zografou Campus, Athens, GR-157 80, Greece
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Nanotechnology has been identified as a key enabling technology (KET) providing the basis for further innovation in the field of nanomedicine and leading to materials with a new level of performance. Nanomaterials and nanostructured composite materials can be employed in different bioinspired processes to produce nano-sized materials for biomedical applications, such as nanostructured scaffolds for tissue engineering, personalized medicine, biosensing, intelligent drug design and targeted drug delivery. In this context, the understanding of the nanomaterials' interactions with biomolecules, cells, tissues and ultimately real patients is crucial to fully exploit the possibilities arising from the use of novel Bio-nanotechnology solutions. Specifically, in the field of tissue engineering, the development of nanostructured scaffolds, mimicking the complex architecture of natural tissues, significantly improves the cytocompatibility of the scaffolds, providing a suitable microenvironment for cell proliferation and differentiation, and thus leading to enhanced osteointegration of the produced implant. These structures could serve as a 3D template to guide the regeneration process of tissues, while maintaining mechanical integrity until the tissue regenerates naturally.

Nanobiomechanics is one of the most promising technologies in characterizing scaffolds, bio-materials, hydrogels and understanding of the fundamental behaviour of living cells and biomolecules. There are unique challenges associated with both experimental testing and modeling of the mechanical integrity of biological tissues and scaffolds. Nanoindentation of these materials has not been examined in depth, especially the inverse problem of material characterization from load-depth indentation curve. One of the difficulties of this approach for such materials is that the unknown property is a function, the elastic energy density function in the case of hyperelastic soft materials.

As well both physicochemical and toxicological properties may also result in a distinctive hazard profile, their development must be complemented with a scientifically valid identification of their potential hazards to human health. Current knowledge on the safety aspects of many nanomaterials is still incomplete and the information describing the relative health risk assessment of engineered nanomaterials is severely lacking. It is thus crucial to identify and gather all the health and environment risks posed by the use of nanostructured composites and put safety concerns in perspective, as the potential risks arising from their use may be present in many different sectors and work activities.

Biomaterial micro/nano 3D printing via two-photon lithography

Qin Hu[1,2]*, Derek Irvine[1], Chris Tuck[1], Richard Hague[1],
Morgan R Alexander[2] and Ricky Wildman[1]
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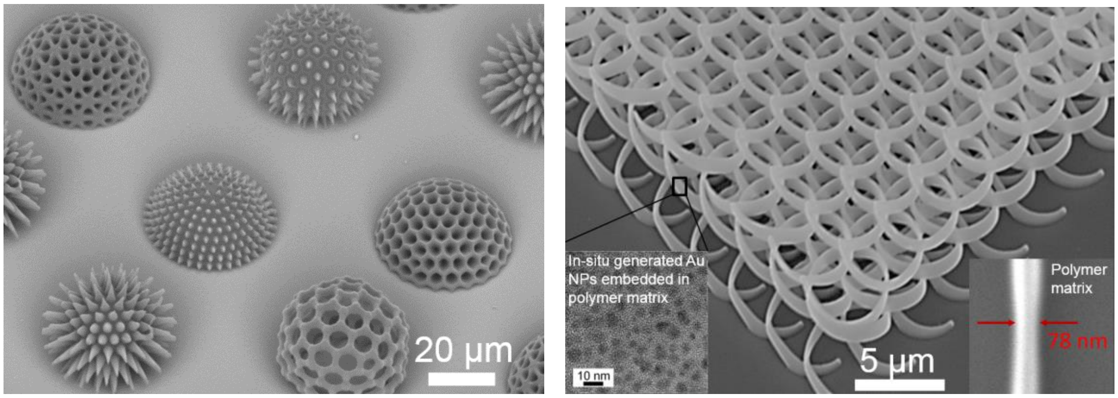
Polymeric biomaterials are widely used to form indwelling medical devices such as catheters and as implants such as artificial joints. Unfortunately, these all carry a risk of device centered infection and with the rising incidence of antimicrobial resistance such infections are more likely to lead to serious complications, extended hospital stays or even death. It has been shown that chemistry, stiffness, topography and shape can control the response of cells to materials. The current technologies in biomaterial processing are mainly limited to 2D, which lack the capability to produce the complex architecture know to be of importance in *in vivo* environment. Two-photon lithography based 3D Printing can overcome this limitation and fabricate complex 3D micro/nano structures without a mask in a fast and cost-efficient way with great design freedom, achieving a resolution close to 100 nm. In this talk, the capability of this technology will be introduced, followed by an overview of the latest development at the University of Nottingham [1-3], including using this technology to screen biomaterials, produce complex 3D architecture, and fabricate nano-composites. Finally, the associated challenges will be discussed.



SEM image of 3D polymeric and composites structures fabricated by two-photon lithography.

[1] Q Hu, X Sun, C Parmenter, M Fay, E Smith, G Rance, Y He, F Zhang, Y Liu, D Irvine, C Tuck, R Hague and R Wildman, Scientific Reports 7, 17150 (2017)

[2] F Zhang, Q Hu, A Castanon, Y He, Y Liu, B Paul, C Tuck, R Hague and R Wildman, Additive Manufacturing 16, 206 (2017)

[3] Y Liu, Q Hu, F Zhang, C Tuck, D Irvine, R Hague, Y He, M Simonelli, G Rance, E Smith and R Wildman, Polymers 8, 325 (2016)

Multifunctional magnetic nanoparticles fabricated by nano-imprint lithography as probes for label-free biosensing

Stefan Schrittwieser[1]*, Joerg Schotter[1], Martin Bauch[1], Theodoros Dimopoulos[1], Michael J. Haslinger[2], Tina Mitteramskogler[2], Michael Muehlberger[2], Astrit Shoshi[3], Hubert Brueckl[3]
[1]*AIT Austrian Institute of Technology, Vienna, Austria*
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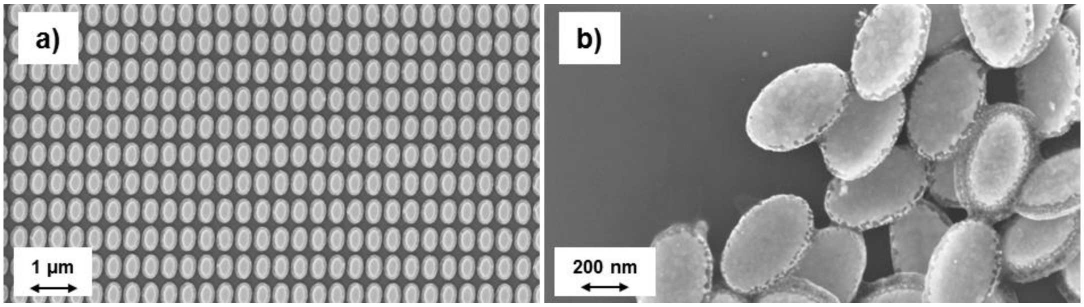
We recently introduced a label-free method for the detection of biomarkers directly in the sample solution [1]. The measurement principle is based on magnetic nanoparticles that can be detected optically in solution. By a top-down nanofabrication superior control over their shape, size distribution and composition can be achieved and plasmonic and magnetic properties can be designed. To that end, we are applying nano-imprint lithography from flexible stamps, UV-curing and reactive ion etching to produce regular arrays of nanoscale holes within a resist layer [2]. Next, we fill these holes by a sputter-deposited multilayer stack comprising Al-doped Zn-oxide (AZO) as sacrificial layer, Au as plasmonic material and NiFe as magnetic material. Following resist lift-off, this process results in regular arrays of multifunctional plasmon-magnetic nano-ellipses on their Si-wafer substrate (see Figure a), which can be transferred to solution following wet-chemical etching of the AZO-layer (see Figure b).
We will present the current status and foreseen functionalization routes for the nanoparticles and will discuss alternative possible applications of these nanostructures.



SEM images of NIL-fabricated multifunctional nanoparticles. a) before removal from their Si-wafer substrate. b) after removal and re-deposition from solution onto a Si-wafer substrate (for imaging).

[1] S. Schrittwieser, et al. ACS Nano 6, 791-801 (2012); S. Schrittwieser, et al. ACS Appl. Mater. Interfaces 8, 8893-8899 (2016); S. Schrittwieser, et al. Sci. Rep.7, 66-70 (2017)
[2] M. J. Haslinger, et al. Microelectron. Eng. 153, 66-70 (2016)

Acknowledgments: This research received funding from European Commission FP7 NAMDIATREAM project (EU NMP4-LA-2010−246479 and from the Austrian Research and Promotion Agency (project LAMPION, #861414).

Laser micro-structured topographies for screening mammalian cell response towards the development of multifunctional biointerfaces

V. Dinca[1]*, L. Rusen[1], L. E. Sima[2], M. Icriverzi[2,3], M. Uta[2], N. Nichita-Branza[2], A. Roseanu[2], V. Malheiro[4]
E. C. Sirigim[4], P. Hoffmann[4] and M. Dinescu[1]
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The design and processing of instructive surfaces with synergic mechanical, chemical or topographical properties capable of directing cell behaviour represents both the main challenge and the main strategy to guarantee the long-term success of a biomedical device or implant. Nevertheless, the design must take in consideration the correlation between cell type, material characteristics and the specific function to be accomplished for the aimed application.

In this work, laser processing of micro-structured biomaterials (i.e ceramics, polymers) with convex and concave topographies for evaluating the role of materials surface topography on different mammalian cell lines (Mesenchymal Stem Cells-MSCs, macrophages, modified hepotocites - HepaRGDsRed cells) responses are presented. Various laser systems were used with half-tone masks to produce convex and concave topographies in ceramics and polymers, with controlled surface dimensional parameters to be used as substrates and/or matrices for PDMS replicated substrates. All the surfaces were analysed by Atomic Force Microscopy, Scanning Electron Microscopy and contact angle measurements revealing a direct correlation with the material type and morphology of the sample.

Mesenchymal stem cells in convex and concave topographies compared to planar surfaces showed different behaviour from alignment to stretching depending on the topography and material stiffness while, although the macrophage shape and size was dependent on concave and convex PDMS replicated surfaces, no significant impact on the macrophages polarization state was observed. Moreover, when PDMS replica starting from laser processed surfaces were used for *in vitro* studies as models for hepatocite like cells differentiation, the regulated expression of the DsRed reporter proved a valuable tool not only for rapid screening of novel cell growth substrates favouring cell differentiation, but also, to enrich the hepatocyte-like cell population by fluorescence-activated cell sorting to investigate liver-specific processes *in vitro.* The physico-chemical characteristics of the microstructured surfaces, along with the *in vitro* analyses, suggest that our designed biointerfaces represent an efficient way to tackle the design of implant surfaces or smart interfaces for wide range of biomedical applications.

Laser synthesized nanoparticles with tuned optical properties for therapeutic drug monitoring

P.M. Ossi[1]*, M. Tommasini[1], C. Zanchi[1], A. Lucotti[1], E. Fazio[2], M. Santoro[2], S. Spadaro[2],
F. Neri[2], S. Trusso[3], M. Casazza[4], E. Ciusani[4], U. de Grazia[4]
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Therapeutic Drug Monitoring (TDM) is a clinical practice to determine the drug concentration in a biological fluid, usually blood plasma. TDM is critically important for Narrow Therapeutic Index (NTI) drugs, including Anti-Epileptic Drugs (AEDs), with small differences between therapeutic and toxic doses. Blood concentration of AEDs is performed in the lab via immunoassay tests, or High-Performance Liquid Chromatography coupled to Mass Spectrometry (HPLC-MS). Both techniques are time consuming and costly. We discuss the use of light scattering with ad hoc engineered plasmonic substrates as a fast and comparatively inexpensive TDM approach for AEDs, complementary to the existing ones. Noble metal (Au) nanoparticles (NPs), grown by pulsed laser ablation of a high purity target are synthesized along two possible paths. If ablation is carried out in a transparent liquid a colloidal solution of Au NPs is obtained, if it is performed in a high-density inert, massive gas (Ar) NPs form in the expanding plasma plume and are deposited on an inert support (100-Si). We illustrate the role of the few relevant process parameters on the size, size distribution, shape and optical properties of the NPs and of the NP arrays self-assembled on the support. Such parameters are ambient gas pressure and laser pulse number for gas-phase synthesis as well as pulse duration and laser energy density for liquid-phase ablation. In particular it is possible to adjust the position (wavelength) of the Surface Plasmon Resonance (SPR) peak. This opens the way to Surface Enhanced Raman Scattering (SERS) measurements on samples of different origin with various AEDs at concentrations of clinical interest. The results of the first investigation on the SERS response of the new-generation AED Perampanel (EISAI) of relevant clinical interest, are critically discussed.

Layer-by-Layer Surface Modification of Nanoparticles for Highly Efficient Multifunctional Drug Delivery Systems

Beatrice Fortuni[1]*, Tomoko Inose[2], Indra Van Zundert[1], Monica Ricci[1], Susana Rocha[1] and Hiroshi Uji-i[1,2]
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Most targeting strategies of anticancer drug delivery systems (DDSs) rely on the surface functionalization of nanocarries with specific ligands for receptors, which are overexpressed in cancer cells [1]. In such a way, DDSs are internalized in cancer cells via endocytosis, which implies their accumulation inside the acidic compartments (endosomes and lysosomes) and their eventual ejection by exocytosis. This endocytic process is known to be the main drawback of DDSs because it reduces the bioavailability of the drug in the intracellular environment, hindering the therapeutic efficiency at low drug dose [2]. In order to develop highly efficient DDSs and minimize the chemotherapy side effects, it is imperative to induce an endosomal escape of the drug nanocarriers from this intrinsic endocytic cycle. Polyethylenimine (PEI) is well-known in DNA transfection techniques to promote the escape of the genetic materials from the endo-lysosomes [3]. The same effect can be ideally obtained by applying PEI on DDSs, however no clear evidence of PEI-functionalized particle endosomal escape have been reported so far.

In this contribution, we functionalized mesoporous silica nanoparticles (MSNPs) with PEI and we provide a detailed study of their intracellular location over time, reporting an evident proof of their endosomal escape. Additionally, for a more suitable application as anticancer DDSs, we combined this function with the cancer targeting capability of hyaluronic acid towards CD44, a tumor marker cell-surface glycoprotein, and we load the particles with an anticancer drug, *e.g.* doxorubicin. The combination of HA and PEI enables high rate internalization in cancer cells and longer retention of particles in the cytoplasm, respectively, maximizing the therapeutic efficiency of doxorubicin. This novel strategy is extremely promising for designing next-generation DDSs, as being applicable to a wide range of nanocarriers for the delivery of any drug into cancer cells with high selectivity and long intracellular retention.

[1] C. Kwangjae, et al. Clin. Cancer Res. 14, 1310-1316 (2008)
[2] K.H. Shete, et al. Journal of Nanoscience and Nanotechnology 14, 460-474 (2014)
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Antibacterial and Antibiofouling Nanostructured Biomaterials

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In recent years, there has been a drive for the development of surfaces capable of killing microbes present surfaces. To prevent biofilm formation and the spreading of bacterial infections, these surfaces are generally chemically or structurally modified. One significant issue with chemical modification, reliant on antimicrobial agents, is that the surfaces can become ineffective against microbes such as antibiotic-resistant bacteria, and in some instances even promote the growth of such strains over time [1]. Research has also shown that biofilm formation can be inhibited if bacterial adhesion is prevented at the initial stage [2]. Therefore, surfaces which inhibit the growth/ promote the death of bacteria, without relying on a chemical mode of bactericidal action are of significant interest. One key finding in this field is the bactericidal activity of nanostructured bioinspired/ natural surfaces [3,4]. The antibacterial phenomenon is understood to be a result of the presence of nanoscale features on the surface, typically ranging from 50nm – 250nm, which ultimately causes the rupture of the bacterial cell membrane [5].

Our group has studied the antibacterial activity of nanostructured cicada wings. In this work, the ability of the wings of three different species of cicadas, with different nanoscale dimensions, to kill *Pseudomonas fluorescens* was investigated. Moreover, the work demonstrated that there is a direct correlation between the level of bactericidal activity and nanopillar size and structure [6]. Moving on from this, we have demonstrated high-resolution replica molding of the nanostructured wing to prepare poly(ethylene glycol) gels which have also shown this antibacterial effect compared to unpatterned controls. Inspired by the surface structure of cicada wings, we also have a key focus on fabricating silicon nanopillar arrays with controlled feature dimensions using block copolymer lithography. These surfaces have also been replica molded using polymeric materials, and the antibacterial and antibiofouling properties have been carried out. Finally, we also present the fabrication of nanostructured poly(sulfone) membranes using electrospinning techniques, which have applications in nanofiltration.

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PARALLEL SESSIONS – WS2 Session III on Minos II

Invited Talk

Understanding and Designing Interfaces and Defects in Perovskite Solar Cells

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Perovskite solar cells promise to yield efficiencies beyond 30% by further improving the quality of the materials and devices. Electronic defect passivation, and suppression of detrimental charge-carrier recombination at the different device interfaces has been used as a strategy to achieve high performance perovskite solar cells.

In this presentation, I will discuss the role of electronic defects and how these can be passivated to improve charge-carrier lifetimes and to achieve high open-circuit voltages. I will discuss the characterization of 2D and 3D defects, such as grain boundaries, crystal surface defects, and precipitate formation within the films, by synchrotron-based characterization techniques. The importance of interfaces and their contribution to detrimental recombination will also be discussed. As a result of these contributions to better understanding 2D and 3D defects, the perovskite solar cell field has been able to improve device performance. Albeit the rapid improvements in performance, there is still a need to improve these defects to push these solar cells beyond the current state-of-the-art.

Invited Talk

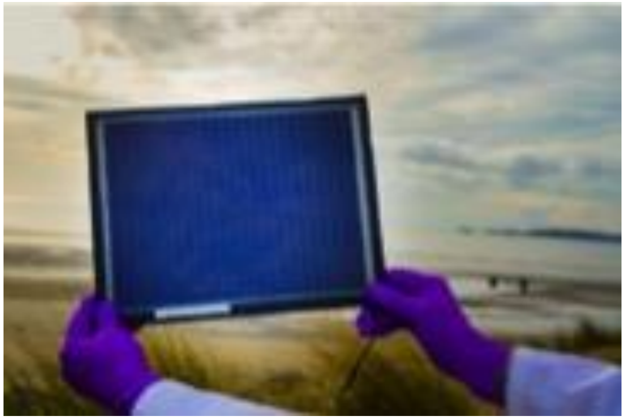
Developing a scale-up route for all printed carbon perovskite solar cells from laboratory to factory

Trystan Watson
SPECIFIC, Swansea University, United Kingdom
t.m.watson@swansea.ac.uk

Whilst the photovoltaic performance of perovskite solar cells continues to increase, technology developments are also progressing in the area of printing and processing in order to realise large scale manufacture. Possible methods for both depositing the layer stack and its subsequent heating are numerous; to deliver a working and scalable device stack can require a hybrid approach where multiple techniques are employed.

This talk will introduce a series of technology developments required to enable the continuous fabrication of perovskite solar cells at commercial scale. These include (i) achieving appropriate crystallisation dynamics of the perovskite layer by tuning the printing process, substrate temperature and post processing and (ii) addressing the bottlenecks in manufacture such as reducing annealing times to seconds instead of hours to ensure compatibility with a continuous manufacturing environment and (iii) Developing interconnection processes appropriate to the substrate and capital cost point using printing registration, mechanical or laser scribing methods.

The talk will also discuss recent research challenges with the “hole-conductor free” fully printable perovskite solar cell or triple mesoscopic carbon perovskite solar cell (C-PSC) as it is sometimes known. This triple layered device structure comprising mesoporous TiO_2, ZrO_2 and Carbon deposited and sintered sequentially is likely to be one of the forerunners for early commercial adoption because the manufacturing method used, screen printing, requires low capital investment and delivers uniform large area deposition using inexpensive materials. The talk will also present the recent challenges overcome in fabrication of C-PSC; from patterning of the glass, screen printing of multiple layers, infiltration of the perovskite into the device stack and interconnection processes to deliver modules up to $200cm^2$.



Semiconductor Self-Assembled Monolayers as Selective Contact for Efficient PiN Perovskite Solar Cells

E. Yalcin[1], M. Can[2], C. Rodriguez-Seco[3], E. Aktas[3], R. Pudi[3], W. Cambarau[3], S. Demic[1] and E. Palomares[3,4]*

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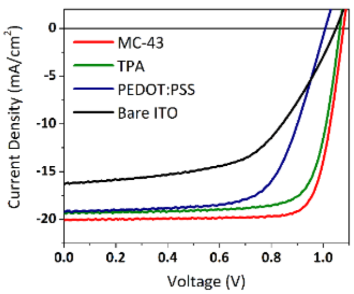
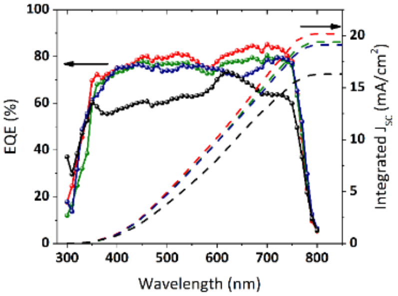
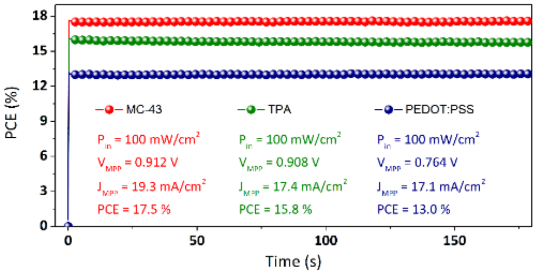
Herein, we studied the use of two different Self Assembled Monolayers (SAMs) made of semiconductor hole transport organic molecules to replace the most common p-type contact; the PEDOT:PSS in PiN methyl ammonium lead iodide perovskite solar cells (PSC's). The SAM (MC-43) leads to a solar to energy conversion efficiency of η=17.3±0.3 %, which among the highest efficiencies reported to date for PiN perovskite solar cells. The present finding highlights the potential of semiconductor based SAMs to fabricate stable and high performing planar PSCs.







Investigation of charge-carrier trap distribution and energy disorder in hybrid organic-inorganic perovskite films

Andrey Kadashchuk[1,2]*, Alexander Vakhnin[1], Joao Bastos[2], Guillaume Croes[2], Weiming Qiu[2]
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Hybrid organic–inorganic perovskites have drawn tremendous research interest as the most promising semiconductors for next-generation photovoltaic technologies. Thin-film perovskite solar cells have already demonstrated outstanding performance with power conversion efficiency exceeding 22% which is comparable to traditional Si technologies. Further improvement of the efficiency and stability of hybrid perovskite-based optoelectronic devices requires a deeper understanding of their intrinsic photophysical properties and nature of defect states. In particular, an accurate picture of the density of states associated to traps and energetic disorder in such films is important as these have a direct influence on charge-carrier mobility, lifetime, and eventually limit the photovoltaic efficiency.

In this work, low-temperature fractional thermally-stimulated-luminescence (TSL) techniques is employed for the first time to study charge-carrier traps and energetic disorder in hybrid perovskite materials. This method is purely optical tool, which allows for separation of interface/contact effects and does not require fabrication of a complex device. Moreover, the fractional TSL applies when different groups of traps are not well separated in energy or are continuously distributed, which is of special relevance for disordered solids. In this study we have identified charge-carrier traps and determine their energy distributions in a range of mixed halide hybrid perovskite materials upon varying film fabrication conditions. Perovskite chemical composition, annealing temperature and film crystallinity was found to have a strong impact on the trap depth and trap concentration. We further demonstrate a clear correlation between optoelectronic device performance, crystallization dynamics in spin-coated perovskite films and trap densities in them. Our study has also provided a direct evidence for existence of continuum of trap energy levels associated with disorder rather than discrete trap energy levels in these films. These results indicate that the TSL can be used as an efficient method for probing the energy distribution of charge traps in hybrid perovskite semiconductors.

Acknowledgements: This research was supported by the Volkswagen Foundation and by Ministry of Education and Science of Ukraine.

Perovskites for solid state lighting devices

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Hybrid organic/inorganic and all-inorganic metal halide perovskites have recently emerged as a game-changer material in optoelectronics [1-2]. On the one hand, nearly defect-free, crystalline films prepared using solvent-based techniques at low temperature, exhibit a broad absorption spectrum, a long-range ambipolar transport, and efficient charge collection upon excitation, yielding solar cells with a verified record efficiency of 22.1% [3]. On the other hand, perovskite materials also show efficient charge injection regardless of the type of electrode and/or charge injection layers, a high charge carrier diffusion length, and efficient electron-hole recombination process [4-6]. What is more, the photoluminescence quantum yield (PLQY) of metal halide perovskites has significantly been enhanced, reaching values of up to 40 % and 90 % in bulk thin films [7-8] and nanoparticles (NPs) [9-10], along with a narrow emission and easy emission tunability covering the whole entire visible range [11]. This work presents the most significant advances towards white emission in the field of perovskite based SSL involving PeLEDs and HLEDs. The main intention is to complement recent reviews focused on the synthesis and characterization of perovskites, as well as their application to monochromatic lighting devices. To this end, this contribution is divided into four sections including i) a brief description of monochromatic and white emitting perovskites, ii) a part focused on white PeLEDs, where the device architecture and mechanism is briefly introduced and the importance of developing blue PeLEDs and the strategy towards white PeLEDs is highlighted, iii) the recent advances in white HLEDs using perovskite color down-converting filters, and iv) a conclusion and outlook based on the main results acquired from literature up to this moment.

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Efficient Non-Polymeric Heterojunctions in Ternary Organic Solar Cells

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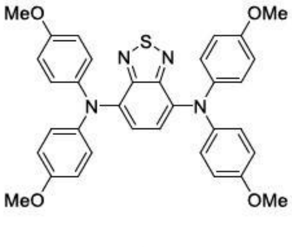
We describe the use of a near IR non-fullerene low molecular weight organic semiconductor 2,5-dihydropyrrolo[3,4-c]pyrrole-1,4-dione-based molecule, as electron acceptor, in combination with a wide-band gap carbazole-based organic semiconductor electron donor [1], in efficient bulk heterojunction organic solar cells. The optimized photo-active layer shows power conversion efficiency of 7.44% with an estimated energy loss as low as 0.55 eV. Identical solar cells, but using fullerene derivative, PC71BM, results in lower efficiency values (PCE = 5.07 %) and greater energy losses (0.86 eV). The better performance of the non-fullerene based small molecule organic solar cells is due to the higher LUMO energy level for the electron acceptor. To improve further the efficiency of the solar cell, we carried out the study of mixing both electron acceptors and the electron donor [2,3] and a solvent vapor treatment, showing a power conversion efficiency of 8.94% due to the efficient light harvesting, improved energy levels alignment and better charge balance of electronic holes and electrons.



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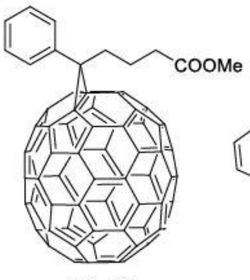
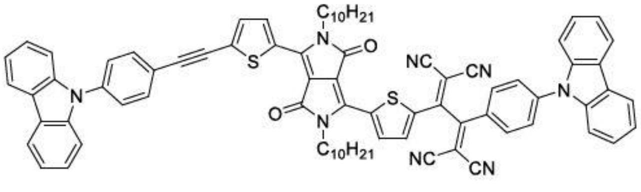


$PC_{71}BM$



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	WS1 & WS3 Sessions IV – Chairs: J. Mano (Sub: A. Kanaras) *Room*: Minos I	*WS4 Session V – Chairs: A. Turchanin (Sub: E. Lidorikis)* *Room*: Minos II
15:00-15:30	(WS1-Invited)Self-assembling amyloid building blocks as scaffolds for rational bionanomaterial design **Anna Mitraki*, University of Crete, Greece**	(WS4-Invited) 2D Materials: Crystal Growth for Future Device Structures **Luigi Colombo*, University of Texas at Dallas,USA**
15:30-16:00	(WS3-Invited) Engineered cellular vesicles as targeted drug carriers: towards the development of a new generation of liposomes for efficient targeted drug delivery? **Sophia G. Antimisiaris[1,2]*** **[1]Department of Pharmacy, University of Patras, Patras 26504, Greece** **[2]Institute of Chemial Engineering Science, FORTH/ICE-HT, Patras, Greece**	**Spin-valley polarization in WS2 heterostructures: The effect of the dielectric environment** I. Paradisanos[1,2], L. Mouchliadis[1], A.T. Hanbicki[3], K. McCreary[3], B.T. Jonker[3], E. Stratakis[1,4] and G. Kioseoglou[1,4],* [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Heraklion Crete 71110, Greece [2]Department of Physics, University of Crete, Heraklion Crete 71003, Greece [3]Naval Research Laboratory, Washington DC, 20375, USA [4]Dept of Materials Science and Technology, University of Crete, Greece
16:00-16:15	**Cross linked enzyme aggregates as versatile tool for enzyme delivery: application to polymeric nanoparticles** Marianna Galliani[1,2]*, Melissa Santi[1,2], Ambra Del Grosso[2], Lucia Angella[2], Marco Cecchini[2] and Giovanni Signore[1,2] [1]Center of Nanotechnology Innovation@NEST, Istituto Italiano di Tecnologia, Pisa, Italy; [2]NEST, Scuola Normale Superiore and Istituto Nanoscienze-CNR, Pisa, Italy	**High-Performance Supercapacitors Based on a Zwitterionic Network of Covalently Functionalized Graphene with Iron Tetraaminophthalocyanine** Demetrios D. Chronopoulos[1]*, Aristides Bakandritsos[1], Petr Jakubec[1], Martin Pykal[1], Klára Čépe[1], Theodore Steriotis[2], Sergii Kalytchuk[1], Martin Petr[1], Radek Zbořil,[1] Michal Otyepka[1] [1]Regional Centre for Advanced Technologies and Materials, Department of Physical Chemistry, Faculty of Science, Palacký University Olomouc,Olomouc, Czech Republic; [2]Institute of Nanoscience and Nanotechnology, NCSR “Demokritos”, Athens, Greece
16:15-16:30	**Thermo-responsive iron oxide nanocubes for an effective clinical translation of magnetic hyperthermia and heat-mediated chemotherapy** Binh T. Mai[1, 2]*, Preethi B. Balakrishnan[1, 2], Markus J. Barthel[1], Federica Piccardia[1], Dina Niculaes[1, 2], Federica Marinaro[1], Soraia Fernandes[1], Alberto Curcio[1], Hamilton Kakwere[1], Gwennhael Autrete[3], Roberto Cingolania[1], Florence Gazeau[4] and Teresa Pellegrino[1] [1]Istituto Italiano di Tecnologia, via Morego 30, 16145, Genova, Italy; [2]Dipartimento di Chimica e Chimica Industriale, Università di Genova, Via Dodecaneso, 31, 16146 Genova, Italy; [3]Centre de Recherche Cardiovasculaire de Paris 56, rue Leblanc75737 PARIS Cedex 15, France; [4]Laboratoire Matière et Systèmes Complexes, UMR 7057, CNRS and University Paris Diderot, 75205 Paris Cedex 13, France	**Gas sensing elements based on graphene related and hybrid perovskite materials** S. Papazoglou[1]*, K. Petridis[2,3]*, G. Kakavelakis[3], E. Gagaoudakis[4,5], V. Binas[4,5], S. Chatzandroulis[6], Y. S. Raptis[1], E. Kymakis[3] and I. Zergioti[1] [1] School of Applied Physical and Mathematical Sciences, National Technical University of Athens, Athens, Greece; [2] Department of Electronic Engineering, School of Applied Sciences, Technological Educational Institute of Crete, Chania, Crete, Greece[3]Center of Materials Technology & Photonics, Department of Electrical Engineering, Technological Educational Institute of Crete, Heraklion, Crete, Greece; [4]University of Crete, Department of Physics, Heraklion, Crete, Greece; [5] Institute of Electronic Structure & Laser (IESL), Foundation for Research and Technology (FORTH) Hellas, Crete, Greece; 6Institute of Nanoscience and Nanotechnology, E.K.E.F.E. Demokritos, Athens, Greece
16:30-16:45	**Ulvan, a Marine Sulfated Polysaccharide as a Versatile Biocompatible Material for the Production of Bioactive Nanoscaffolds** Leto-Aikaterini Tziveleka, Stefanos Kikionis, Efstathia Ioannou and Vassilios Roussis* Section of Pharmacognosy and Chemistry of Natural Products, Department of Pharmacy, National and Kapodistrian University of Athens, Athens, Greece	**Large-Area Nanoelectronic Devices Based on 2D Transition Metal Dichalcogenides Enabled via Adhesion Lithography** Emre Yengel*[1], Hendrik Faber[1], Ali Han[1], Areej Aljarb[1], Dimitra G. Georgiadou[2], James Semple[2], Thomas D. Anthopoulos[1,2] [1] King Abdullah University of Science and Technology (KAUST), KAUST Solar Center (KSC), Division of Physical Science and Engineering (PSE), Kingdom of Saudi Arabia; [2]Department of Physics and Centre for Plastic Electronics Blackett Laboratory, Imperial College London, London, United Kingdom
16:45-17:00	**Self-Propelled Synthetic Nanobots in Drug Delivery** Marina Fernández Medina[1]*, Ondrej Hovorka[2] and Brigitte Städler[1] [1]Aarhus University, Aarhus, Denmark; [2]University of Southampton, Southampton, United Kingdom	**Highly efficient and stable perovskite solar cells using Graphene-related-materials as dopants and interlayers** Konstantinos Rogdakis* and Emmanuel Kymakis 1Center of Materials Technology and Photonics, Electrical Engineering Department, School of Applied Technology, Technological Educational Institute (TEI) of Crete, Heraklion, Greece
17:00-17:15	**Studying cell penetrating peptides as possible drug delivery vectors using acoustic biosensors** Dimitra Milioni[1]*, Sophie Cribier,[2] Sandrine Sagan[2] and Electra Gizeli [1,3] [1]IMBB-FORTH; [2]Department of Chemistry, Sorbonne Universités, UPMC Univ Paris 06, PSL Research University, Ecole Normale Supérieure, CNRS, Laboratoire des Biomolécules (LBM), Paris, France; [3]Biology Department, University of Crete	**END OF SESSION**
17:15-17:30	**Nanoparticle based non-invasive ocular delivery for the treatment of Retinoblastoma** Ritika* and Rinti Banerjee Indian Institute of Technology Bombay, Mumbai, India	

PARALLEL SESSIONS – WS1&WS3 Session IV on Minos I

WS1 Invited Talk

Self-assembling amyloid building blocks as scaffolds for rational bionanomaterial design

A. Mitraki[1,2] * , C. Kokotidou[1,2], S. V. R. Jonnalagadda[3], A. A. Orr[3], M. Seoane-Blanco[4], C.P. Apostolidou[1,2], M. J. van Raaij[4], M. Kotzabasaki[1], A. Chatzoudis[1], J. M. Jakubowski[3], E. Mossou[5,6], V. T. Forsyth[5,6], E. P. Mitchell[6,7], M. W. Bowler[8,9], A. L. Llamas-Saiz[10] , P. Tamamis[3]

[1]Department of Materials Science and Technology, University of Crete, Heraklion, Greece.
[2] Institute of Electronic Structure and Laser (IESL) FORTH, Greece.
[3]Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, TX U.S.A.
[4]Departamento de Estructura de Macromoleculas, Centro Nacional de Biotecnologia (CSIC), Madrid, Spain.
[5]Institut Laue Langevin, Grenoble, France.
[6]Faculty of Natural Sciences / Institute for Science and Technology in Medicine, Keele University, United Kingdom.
[7] European Synchrotron Radiation Facility, Grenoble, France.
[8]European Molecular Biology Laboratory, Grenoble Outstation, Grenoble, France.
[9]Unit for Virus Host Cell Interactions, Univ. Grenoble Alpes-EMBL-CNRS, Grenoble, France.
[10]X-Ray Unit, Campus Vida, University of Santiago de Compostela, Santiago de Compostela, Spain
**mitraki@materials.uoc.gr*

Our work focuses on the design, engineering, production and characterization of novel bionanomaterials based on natural fibrous proteins and peptides mainly derived from Adenovirus Type 2 fiber and Alzheimer's Amyloid beta sequences. We aim to take advantage of their unique self-assembling properties and develop functional biomaterials for uses in the area of biomedicine, environmental protection etc. These biomaterials can be used as scaffolds for the insertion of additional functionalities, such as metal binding sites, tissue-targeting motifs, or enzymatic subunits. We have been using a combination of computational and experimental approaches towards rational self-assembling peptide designs. The designer peptides self-assemble into fibrils that are structurally characterized with Transmission Electron Microscopy, Scanning Electron Microscopy and X-ray fiber diffraction; these fibrils were previously targeted to bind to metal nanoparticles, silica, calcium, and more recently, cells [1]. We have recently reported that the YATGAIIGNII sequence from the HIV-1 gp120 V3 loop self-assembles into amyloid fibrils of which the first three and the last two residues are outside the GAIIG amyloid core [2]. We postulate that this sequence with suitable selected replacements at the flexible positions can serve as a designable scaffold for amyloid-based materials. Such short self-assembling peptides that are amenable to computational design offer open-ended possibilities towards multifunctional bionanomaterial scaffolds of the future.

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[2] C. Kokotidou et al., FEBS letters, in press, DOI: 10.1002/1873-3468.13096 (2018)

WS3 Invited Talk

Engineered cellular vesicles as targeted drug carriers: towards the development of a new generation of liposomes for efficient targeted drug delivery?

Sophia G. Antimisiaris[1,2]*, Antonia Marazioti[2] and Konstantina Papadia[1]
[1]*Department of Pharmacy, University of Patras, Patras 26504, Greece*
[2]*Institute of Chemial Engineering Science, FORTH/ICE-HT, Patras, Greece*
* *santimis@upatras.gr*

Several types of targeted liposomes were previously studied as drug delivery systems for Alzheimers Disease (AD). Most studies were carried out with liposomes decorated to target: (i) the blood-brain-barrier (BBB) [1], and/or (ii) the amyloid deposits in the brain [2,3]. The former liposomes were optimized to ensure formation of stable vesicles with nanoscale dimensions (hydrodynamic diameter <200 nm), high yield of targeting ligand immobilization on their surface and high production yield. In vitro and in vivo studies were carried out to evaluate their BBB targeting potential and affinity for Aβ peptides [4,5].

Recently, inspired by the high organotropism of extracellular vesicles (EVs), we have constructed various types of cellular vesicles (CVs) by applying liposome-technology engineering methodologies to lysed cell material. Such CVs were tested (in vitro) for their interaction (cytotoxicity and uptake) towards different cell types (B16, HEK 293 and hCMEC/D3). The results of these latter studies are very interesting [6], suggesting that exploitation of the targeting components of CVs (or EVs) may potentially lead to the development of superior drug-carriers for efficient targeted drug delivery.

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Acknowledgements: We acknowledge support of this work by the project “Advanced Research Activities in Biomedical and Agro alimentary Technologies” (MIS 5002469) funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund).

Cross linked enzyme aggregates as versatile tool for enzyme delivery: application to polymeric nanoparticles

Marianna Galliani[1,2]*, Melissa Santi[1,2], Ambra Del Grosso[2], Lucia Angella[2], Marco Cecchini[2] and Giovanni Signore[1,2]
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Polymeric nanoparticles (NPs) represent one of the most promising tools in nanomedicine and have been extensively studied for the delivery of water-insoluble drugs [1]. However, the efficient loading of therapeutic enzymes and proteins in polymer-based nanostructures remains an open challenge. Here, we report a synthesis method for a new enzyme delivery system based on cross linked enzyme aggregates (CLEAs) [2] encapsulation into poly(lactide-co-glycolide) (PLGA) NPs. We tested the encapsulation strategy on four enzymes currently investigated for enzyme replacement therapy in lysosomal storage diseases (LSDs): palmitoyl protein thioesterase 1 (PPT1; defective in NCL1 disease), galactosylceramidase (GALC; defective in globoid cell leukodystrophy, GLD), alpha glucosidase (aGLU; defective in Pompe disease) and beta glucosidase (bGLU; defective in Gaucher's disease). We demonstrated that our system allows encapsulating enzymes with excellent activity retention (usually around 60%), thus leading to functional nanostructures suitable for enzyme delivery. Then, we focussed on GALC delivery and synthesized three different targeted GALC CLEAs NPs, each one exposing a specific peptide with targeting potential for the Central Nervous System (CNS), where the therapy for GLD should be performed [3]. We demonstrated that GALC CLEAs NPs are taken up by cells and localized in lysosomes, where the enzyme is required to perform its catalytic activity. We also showed that enzymatic activity is fully recovered in a GLD in vitro model upon treatment with GALC CLEAs NPs. Lastly, we administered GALC CLEAs NPs to a mouse model for GLD (Twitcher mouse) and we evaluated the in vivo efficiency of CLEAs NPs as delivery systems.

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Thermo-responsive iron oxide nanocubes for an effective clinical translation of magnetic hyperthermia and heat-mediated chemotherapy

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The use of magnetic nanoparticles in oncothermia applications has been investigated for decades, but an effective combination of magnetic nanoparticles and chemotherapeutic agents in a working concentration for both magnetic hyperthermia (MH) and magnetic resonance imaging (MRI) calls for improved novel platforms[1]. In this study on the clinical translation of MH combined with a heat-mediated drug delivery, we have engineered magnetic thermo-responsive iron oxide nanocubes (TR-cubes). We have chosen FDA approved iron-oxide based-nanoparticles, reshaped as nanocubes, because of their outstanding heat performance, which makes them benchmark agents for MH. Accomplishing a surface-initiated polymerization of strongly interactive iron-oxide nanocubes remains the main challenge to overcome. Here, we demonstrate that it is possible to accelerate the growth of a polymer shell on each nanocube by simply irradiating a copper-mediated polymerization with a ultraviolet light (UV) light, thus preventing nanocube aggregation while still maintaining their outstanding MH heat-efficiency. These TR-cubes can carry chemotherapeutic doxorubicin (DOXO-loaded-TR-cubes) without compromising their thermo-responsiveness. In vivo efficacy studies showed complete tumor suppression and the highest survival rate for animals that had been treated with DOXO-loaded-TR-cubes, only when they were exposed to MH. The bio-distribution of intravenously injected TR-cubes showed signs of renal clearance within 1 week and complete clearance after 5 months. This biomedical platform works under clinical MH conditions and at a low iron dosage, which will enable the translation of dual MH/heat-mediated chemotherapy, thus overcoming the clinical limitation of MH, i.e. monitoring tumor progression post-MH-treatment by MRI.

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Ulvan, a Marine Sulfated Polysaccharide as a Versatile Biocompatible Material for the Production of Bioactive Nanoscaffolds

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Ulvan, a marine sulfated polysaccharide isolated from green algae, has been recently recognized as a natural biopolymer of biomedical interest. The physical properties and pharmacological activity of ulvan have been systematically investigated and a wide range of biological activities have been reported.

As an anionic polysaccharide, ulvan is considered a polyelectrolyte, which can potentially form an assembly with oppositely charged macromolecules. In this context, ulvan has been complexed with chitosan [1] and lysozyme [2] and tested for its potential as substrate material for cultivation of osteoblasts and antibacterial nanocomplex against *Staphylococcus aureus*, respectively. Moreover, novel hybrid structures based on chemically cross-linked ulvan and gelatin were prepared and characterized. The produced ulvan/gelatin scaffolds were characterized by a highly porous and interconnected structure, revealing a remarkable ability to uptake water.

In parallel, we have focused on the development of electrospun nanofibrous systems based on ulvan for the production of controlled-release composites. In order to enhance the poor electrospinnability of ulvan, due to its lack of molecular chain-entanglements, various blends with biodegradable polymers, such as PCL, PVA and PEO, were co-spun to afford non-woven fiber matrices with different structural and physicochemical characteristics [3,4]. Furthermore, neat ulvan fibers have been successfully fabricated after removal of the co-spun polymers from the composite fibers.

Our current results, in combination with the inherent cytocompatibility of ulvan, highlight the potential uses of the prepared ulvan-based biomaterials as novel formulations for peptide/protein and/or drug delivery systems, as well as prospective scaffolds in tissue engineering.

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Self-Propelled Synthetic Nanobots in Drug Delivery

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The first lines of defense of our body against disease-causing invaders (bacteria, fungi, viruses, etc.) are physical barriers including the skin, mucus layers, tears, blood-brain-barrier, ear wax as well as retention of foreign objects in digestive organelles (lysosomes) inside of mammalian cells. As successful as these defense barriers are in healthy humans, they are also a primary reason which prevents nanomedicine from reaching its targets in an efficient manner.

Although oral administration would be the most convenient and the cheapest way of drug delivery, its applicability is limited due to extremely tough physical barriers such as the mucus layer in the gastrointestinal tract. Mucus is a semipermeable and dynamic glycopeptide gel constantly secreted by mucosal membranes, which line various regions of the body. Therefore, mucopenetrating and mucoadhesive formulations are extensively investigated [1].

A novel mucopenetrating formulation to overcome these physical barriers could exploit the use of synthetic nanobots (SyNB). SyNB are advanced assemblies of particles with engineered structure and function, which exhibit (directional) locomotion outperforming Brownian motion by orders of magnitude. However, the thrust of biocompatible SyNB remains rather low, which still limits their applicability in biological context [2,3].

We develop SyNB, driven by self-diffusiophoresis triggered by disintegration of surface polymer multilayers. The mobility properties are assessed depending on the amount, type of deposited polymers, the SyNB size and shape, as well as environmental parameters. The SyNB with the highest velocity are biologically evaluated using human epithelial colon carcinoma cells in terms of cell viability and the SyNB uptake efficiency depending on the mucus thickness. We demonstrate that these novel SyNBs, exhibiting high initial velocities, are promising active mucopenetrating formulations with broad applicability in biomedicine.

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Studying cell penetrating peptides as possible drug delivery vectors using acoustic biosensors

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By controlling cell wall permeabilization, the ability of carrying any biologically active conjugate into the cell is very much improved. Cell penetrating peptides (CPPs) are one of the most known ways for cell membrane permeabilization and much attention has been given to them during the last 30 years, since the study of the first proteins carrying permeabilizing properties [1-2] and the observation that most CPPs retain their properties even when attached to other materials. In this work, we used three synthetic and potentially cell penetrating peptides of various lengths and compositions. The study has been carried out using both standard biochemical analytical techniques and acoustic biosensing; the latter is a technique which is widely used for analyzing intermolecular interactions because of the label-free and real-time monitoring it offers. Nevertheless, its use for studying membrane interactions with other biomolecules has only started during the last decade [3-8]. Despite the undoubted progress on the field, yet, there is no well-established model corresponding the acoustic signals obtained to the mechanism lying behind any peptide/membrane interaction. Our results reveal some crucial parameters for the ability of cell penetrating peptides to permeabilize model membranes, but also show that acoustic biosensors can be used in the future for the monitoring of real-time membrane interactions.

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Nanoparticle based non-invasive ocular delivery for the treatment of Retinoblastoma

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Retinoblastoma is an intraocular cancer that develops from retinal cell. Drug delivery to posterior segment of eye is highly limited due to the presence of blood-retinal barrier. Intravenous administration of drug requires higher amount of drug to achieve an effective concentration. Higher doses leads to toxicity in patients as most of the chemotherapeutic drug have side-effects. Nano-particulate delivery of chemotherapeutic agents will help in sustained and controlled release of drug. This will also reduce the frequency of administration of drug. The present talk is related to the work of Kang et al. [1] regarding the usage of nanoparticle carboplatin for drug delivery in murine retinoblastoma model. In the present study we have developed nanoparticles loaded with carboplatin. Nanoparticles have been characterized for their Size, Zeta potential, Entrapment efficiency. In-vitro release showed a sustained and controlled release of carboplatin in simulated environment. Nanoparticles in L929 cell line (mouse fibroblast) suggested biocompatibility of the system. Cell based study in Y79 cell line (Retinoblastoma) showed improved cytotoxicity and cellular uptake as compared to free drug. In-vivo study in Sprague Dawley rats showed higher bioavailability and lower toxicity when carboplatin was delivered using nanoparticles as compared to free carboplatin. Thus the study suggests the immense potential of nanotechnology for drug delivery in cancer treatment.

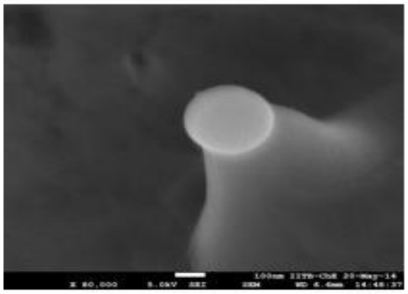

Figure 1: Cryo-FEG-SEM image of nanoparticle loaded with carboplatin.

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PARALLEL SESSIONS – WS4 Session V on Minos II

Invited Talk

2D Materials: Crystal Growth for Future Device Structures

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The isolation of graphene, now over decade ago, has given rise to the revitalization of an old full set of materials, two-dimensional materials (2DM), which have exceptional electrical, chemical and physical properties. Some of the materials under investigation in addition to graphene are hexagonal boron nitride (h-BN), semiconducting, metallic, and superconducting, transition metal dichalcogenides (TMD) with a general chemical formula, MX_2 where M is for example equal to Mo, W, Ta, Nb, Zr, Ti, and X = S, Se and Te, and others. While graphene is a material with many exceptional properties and h-BN is an excellent 2D insulator, TMD materials provide what neither graphene nor h-BN can, bandgap engineering that, in principle, can be used to create new devices that cannot be fabricated with h-BN and graphene alone. There is hope to that 2DM can be integrated to fabricate numerous device types for many applications ranging from inkjet-printed circuits, photonic applications, flexible electronics, and high performance electronics. However, in order to fully realize the benefits of these materials, the community will have to work together to define the device structures, device integration schemes, and materials growth processes and requirements.

A number of deposition techniques have been used to prepare large area graphene, such as growth on SiC through the evaporation of Si at high temperatures, precipitation of carbon from metals, and chemical vapor deposition on Cu. Direct growth of good quality graphene on dielectrics/semiconductors other than SiC with reasonable properties has only been reported recently on Ge. The preparation of large area h-BN is also in great demand and processes are being developed to achieve this on both metals and dielectrics. Transition metal dichalcogenides present altogether different opportunities and difficulties in the preparation of low defect density large area single crystals. Vapor transport, chemical vapor deposition (CVD), and molecular beam epitaxy (MBE) are being developed to produce these materials for initial studies of materials physics device fabrication. In addition, there is some effort in performing simulations to guide growth for both CVD and MBE growers. Therefore, there is an opportunity here to have the crystal growers and the modeling community to collaborate with each other to develop high quality materials and processes.

Many device structures are currently under evaluation to take advantage of the basic properties of graphene, bi-layer graphene, h-BN and TMDs. Some of the devices are based on tunneling phenomena while others are based on excitonic phenomena. In this presentation I will present the state of the art results of graphene, h-BN, and a few TMD materials and their prospects for future electronic device applications.

Invited Talk

Spin-valley polarization in WS_2 heterostructures: The effect of the dielectric environment

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WS_2 monolayer is a direct-gap semiconductor with unique physical and chemical properties. It has a direct transition at the K-point of the Brillouin zone and outstanding PL at room temperature (RT) in the visible. Due to its low-dimensional hexagonal structure there are two inequivalent K-points (K and K') and due to strong orbital hybridization and time reversal symmetry, it has unique optical selection rules [1-3] (Fig.1a). Therefore, WS_2's novel structure may lead to "valleytronics," a new concept in which both spin and charge are used to transport and store information.

Towards the development of 2D valleytronic devices, it is important to investigate the spin-valley polarization properties of WS_2 monolayers in a large range of temperatures. Some of the mechanisms affecting the T-dependence of the polarization are intervalley scattering, electron-hole radiative recombination and electron-phonon interactions and have a significant correlation with the underlying substrate [4,5]. In this work, we systematically investigate the spin-valley polarization properties of WS_2 heterostructures such as WS_2/Gr, WS_2/hBN and hBN/WS_2/hBN from 4K up to RT and compare them to the $WS_2/SiO_2/Si$ system. Spin-valley relaxation phenomena and the related scattering mechanisms of both neutral and charged excitons are examined in resonant and off-resonant excitation conditions. Significant differences in the low temperature spin-valley polarization degree (Fig.1b), as well as in the depolarization rate are observed. This study is expected to offer an insight into fundamental spin relaxation phenomena of 2D TMD monolayers.

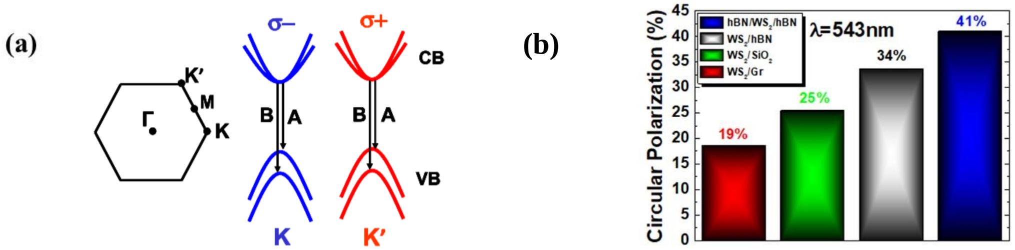

Fig.1: (a) Schematic drawing of the band structure and spin-valley-dependent optical selection rules of monolayer WS_2 at the band edges located at the K points, (b) maximum polarization at 4K for the 4 different WS_2 heterostructures studied. Excitation with 543nm laser line.

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High-Performance Supercapacitors Based on a Zwitterionic Network of Covalently Functionalized Graphene with Iron Tetraaminophthalocyanine

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Graphene derivatives and hybrids are promising candidates as electrode materials in supercapacitor cells [1,2]. Fluorographene [3,4] (FG) is a stoichiometric (C_1F_1) and well-defined graphene derivative, which has attracted significant attention due to its unique properties. Recent studies on the FG chemistry showed that it is susceptible to reductive defluorination [4] and nucleophilic attack [5], making it an alternative precursor for the preparation of graphene derivatives [6].

Here, we present an efficient way for the covalent functionalization of FG via Bingel-Hirsch reaction. Bromomalonate nucleophile attacked FG, producing diethyl-malonate units covalently attached to graphene, which could then be hydrolyzed to reactive carboxylic groups. Subsequently, the free carboxy groups on the graphene surface were successfully conjugated with a tetraamino-functionalized iron phthalocyanine (FePc-NH_2). Then, the prepared material was tested as an electrode for supercapacitor, delivering very high capacitance for graphene-based systems of 960 F g^{-1} at realistic rates (1 A g^{-1}), with zero losses upon charging-discharging. The material was also endowed with an exceptional energy density of 59 Wh kg^{-1} in an aqueous and neutral Na_2SO_4, (thus non-hazardous) electrolyte.

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Gas sensing elements based on graphene related and hybrid perovskite materials

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Achieving high quality transfer combined with low cost deposition techniques of innovative materials such as graphene-based and hybrid perovskite materials is a challenging task. In this work, we demonstrate our approach on the sequential laser transfer and laser reduction of graphene oxide based on the Laser Induced Forward Transfer technique for the fabrication of ultrasensitive resistive humidity sensors [1]. The latter exhibited sensitivities up to 0.2% for the limit of detection of 1700 ppm which is considered state of the art for this kind of sensors. Moreover, in this work we report for the first time the application of spin-coated hybrid perovskites as the sensing element for self-powered ozone sensors. The particular sensing element showed excellent detection limits down to 5 ppb upon exposure to ozone gas [2]. Future work involves the incorporation of these innovative materials in cellulose-based printed flexible electronics.

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Large-Area Nanoelectronic Devices Based on 2D Transition Metal Dichalcogenides Enabled via Adhesion Lithography

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Exploiting the benefits of device downscaling in the field of large-area electronics, represents a major hurdle for the development of next generation plastic nanoelectronics where device, and ultimately system performance, is largely governed by the device geometry rather than by the active material alone. Adhesion lithograph (a-Lith) [1] represents one innovative method to combine the ability of extreme device downscaling with large-area processing whilst being compatible with temperature sensitive flexible substrate materials. Unlike conventional electron-beam lithography methods, a-Lith, can be used to produce sub-20 nm gap between two symmetric or asymmetric metal electrode over large area substrates (>100 cm^2) simply with high throughput. Recent work has shown how this novel method can be adopted for the manufacturing of ultra-high aspect ratio co-planar electrode nanogap devices such as non-volatile semiconductor-free memory devices [2] and Schottky diodes for applications in printed radio-frequency (RF) electronics [3]. To fully exploit the opportunities that the a-Lith method has to offer, alternative material system that combined processing versatility with even higher performance characteristics, need to be identified and tested. One family of such electronic materials are 2-dimensional (2D) semiconductor transition metal dichalcogenides (TMDs) as they are characterized by a tunable electronic structure, direct bandgap, high mobility and extreme optical transparency due to their low dimensionality [4]. Here, we describe the development of ultra-high aspect ratio (>10^6) nanogap devices based on several 2D TMDs such as MoS_2, WSe_2, and their exploitation in RF diodes, photodetectors and high current-density nano-channel transistor applications. Due to the simplicity of the fabrication procedure, devices can be produced over large areas at low temperatures on arbitrary substrate materials with high yield. Furthermore, we show that by simply replacing the active material, functionalities such as light-emission and memristive effects, may also be obtained for practical applications. Our work bridges the gap between large-area manufacturing and nano-scale electronics and can be considered an important step towards next generation opto-/electronic systems.

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Highly efficient and stable perovskite solar cells using Graphene-related-materials as dopants and interlayers

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We present an overview of our recent results on interface/contacts engineering of perovskite solar cells (PSCs) using graphene related materials (GRM) (or other nanostructures) as interlayers and transport-layer dopants. This approach includes the incorporation of hybrid PSCs with metals and up-conversion nanoparticles [1], incorporation of 2D materials [2] and graphene or GRM [3-7]. We have shown that reduced graphene oxide (rGO) is highly capable in the field of organic SCs [3,4] and furthermore an excellent option as conductive electrode in PSCs [5]. More precisely, Kakavelakis et al. [5] studied the advantages of the addition of rGO into the PCBM electron transport layer (ETL) of planar inverted PSCs. It was shown that rGO enhanced the electron conductivity of the PCBM by fivefold, causing faster electron extraction and leading to higher Jsc and fill factor (FF) values. Moreover, rGO reduced the surface traps and passivated the perovskite surface, resulting in (1) V_{oc} enhancement and (2) reduction in the light-soaking effect, which both led to a PCE increase of 12.5% and a prolonged device stability with respect to the reference devices. Agresti et al. [6] demonstrated that the work-function tuning of GRM can provide optimal efficiency and improve the lifetime of the PSC. This was achieved by the incorporation of lithium-neutralized GO (GO-Li) as an interlayer between the perovskite semiconductor and the ETL in a mesocopic PSCs. The PCE of the GO-Li-based PSCs was enhanced by 12% compared to the reference device mainly due to (1) better energy band alignment between GO-Li and the mp-TiO_2 ETL, which led to more efficient electron transfer in terms of energy, (2) higher electron extraction rate, and (3) lower electron trapping because of traps passivation. All these improvements were reflected on the higher J_{sc} (increased by 10.5%) and FF (7.5%) values. Moreover, the GO-Li-based PSCs demonstrated longer operational stability and less hysteresis effects because of the mp-TiO_2 oxygen vacancies passivation induced by the GO-Li interlayer. In a latter study, we simultaneously attempted to dope the ETL by graphene flakes as well as insert spin coated GO-Li flakes interlayers [7]. All these improvements resulted in the realization of GRM-based PSC modules with a PCE of 12.6% over an active area of more than 50 cm^2 at 1 sun illumination. The achieved PCE was 9% higher than that of the graphene-free reference PSC module. Notably, prolonged aging tests have shown the long-term stability of the PSC modules.

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	WS4 Session VI – Chairs: L. Colombo (Sub: S. Psilodimitrakopoulos) *Room*: Minos I	*WS2 Session VII – Chairs: T.Watson (Sub: M. Stylianakis)* *Room*: Minos II
18:00-18:30	(WS4-Invited) Looking into the Future of Spintronics and Valleytronics using van der Waals Heterostructures **Stephan Roche* Catalan Institution for Research and Advanced Studies, Barcelona, Spain**	(WS2-Invited) Perovskite Solar Cells: Toward Industrial-Scale Manufacturing **Yulia Galagan*, TNO – Solliance, The Netherlands**
18:30-18:45	**Bias dependent low frequency noise model in single-layer, liquid-gated graphene FETs** Nikolaos Mavredakis[1]*, Ramon Garcia Cortadella[2], Andrea Bonaccini Calia[2], Jose A. Garrido[2] and David Jiménez[1] [1]Department d'Enginyeria Electrònica, Escola d'Enginyeria, Universitat Autònoma de Barcelona, 08193-Bellaterra, Barcelona, Spain [2] Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC, Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, Barcelona, Spain	**Environmental hazards of photovoltaic perovskites** László Forró* Laboratory of Physics of Complex Matter Ecole Polytechnique Fédérale de Lausanne CH-1015 Lausanne
18:45-19:00	**Brominated Graphene as a Versatile Precursor for Multifunctional Grafting** Noelia Rubio*, Heather Au and Milo S.P. Shaffer Nanostructured Hierarchical Assemblies & Composites (NanoHAC), Department of Chemistry, Imperial College London, London, SW7 2AZ	(WS2-Invited) Device Engineering Concepts for Solution Processed Photovoltaics **Stelios A. Choulis*, Cyprus University of Technology, Cyprus**
19:00-19:15	**MoS2-reduced graphene oxide composites by thermal processing: An in situ XPS study** Labrini Sygellou* Foundation for Research and Technology, Institute of Chemical Engineering Sciences (FORTH/ICE-HT), Patras, GR-26504, Greece	
19:15-19:30	**Sorption properties of high surface area amorphous graphene oxide** Vassilios Binas[1]* and Pantelis N. Trikalitis[2] [1] Institute of Electronic Structure and Laser (IESL), FORTH, P.O. Box 1527, Vasilika Vouton, GR-71110 Heraklion, Greece [2] Department of Chemistry, University of Crete, Voutes 71003, Heraklion	**END OF SESSION**
	END OF DAY 1 OF NANOBIO2018 – ENJOY YOUR EVENING!	
21:00	**Invited Speakers Dinner** **(sponsored by Applied Sciences, an Open Access Journal by MDPI)**	applied sciences an Open Access Journal by MDPI

PARALLEL SESSIONS – WS4 Session VI on Minos I

Invited Talk

Looking into the Future of Spintronics and Valleytronics using van der Waals Heterostructures

Stephan Roche
Catalan Institute of Nanoscience & Nanotechnology, Campus UAB, Bellaterra and ICREA, Institució Catalana de Recerca i Estudis Avancats, Spain
stephan.roche@icn2.cat

The physics of graphene can be strongly enriched and manipulated by harvesting the large amount of possibilities of proximity effects with magnetic insulators, strong SOC materials (TMDC, topological insulators, etc.). Simultaneously, the presence of extra degrees of freedom (sublattice pseudospin, valley isospin) points towards new directions for information processing [1,2], extending the playground to valleytronics, multifunctional electronic devices or novel quantum computing paradigms harnessing all these degrees of freedom in combination with electromagnetic fields or other external fields (strain, chemical functionalization) [3,4].

Here I will present some foundations of spin transport for Dirac fermions propagating in supported graphene devices or interfaced with strong SOC materials. The role of entanglement with "valley and sublattice pseudospins" in tailoring the spin dephasing and relaxation mechanisms will be explained as well as the impact of strong SOC proximity effects on spin lifetime anisotropy (Fig.1), weak antilocalization and Spin Hall effect [4-10].

[1] S. Roche et al. 2D Materials 2, 030202 (2015).
[2] D.V. Tuan et al. Nature Physics 10, 857 (2014).
[3] D.V. Tuan & S. Roche, Phys. Rev. Lett. 116, 106601 (2016).
[4] A.W. Cummings, J. H. García, J. Fabian and S. Roche, Phys. Rev. Lett. 119, 206601 (2016).
[5] J. García, A. Cummings, S. Roche, Nano Lett. 17, 5078 (2017).
[6] K. Song et al. Nano lett. 18 (3), 2033 (2018).
[7] J.H. García et al. Chem. Soc. Rev. 47, 3359-3379 (2018).
[8] D. Khokhriakov, A. Cummings, M. Vila, B. Karpiak, A. Dankert, S. Roche & S. Dash, Science Advances (in press)
[9] A. Cresti et al. Riv. Nuovo Cimento 39, 587 (2018).
[10] J. M. Marmolejo-Tejada et al., arXiv:1706.09361; J. Phys. Materials (in press).

Bias dependent low frequency noise model in single-layer, liquid-gated graphene FETs

Nikolaos Mavredakis[1]*, Ramon Garcia Cortadella[2], Andrea Bonaccini Calia[2], Jose A. Garrido[2] and David Jiménez[1]
[1]Department d'Enginyeria Electrònica, Escola d'Enginyeria, Universitat Autònoma de Barcelona, 08193-Bellaterra, Barcelona, Spain
[2]Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC, Barcelona Institute of Science and Technology, Campus UAB, Bellaterra, Barcelona, Spain
**nikolaos.mavredakis@uab.es*

In this work, a compact model for the bias dependence of Low Frequency Noise (LFN) in single-layer, electrolyte-gated graphene FETs (GFETs) is proposed considering both carrier number (ΔN) and mobility fluctuation ($\Delta\mu$) effects. The derivation of the model is based on dividing the device channel into elementary slices; local noise fluctuations are then propagated to the terminal currents and voltages [1]. The noise equations are extracted based on the chemical potential-based compact model proposed in [2]. Data from liquid-gated GFETs [3] validate the model as depicted in Fig. 1. ΔN mechanism is responsible for the M-shape of LFN with a minimum at Charge Neutrality Point (CNP) provided that the residual charge (ρ_0) is significant while $\Delta\mu$ also contributes to this minimum. Channel non-homogeneity at higher V_{DS} values is also taken into account and it slightly increases LFN at CNP.

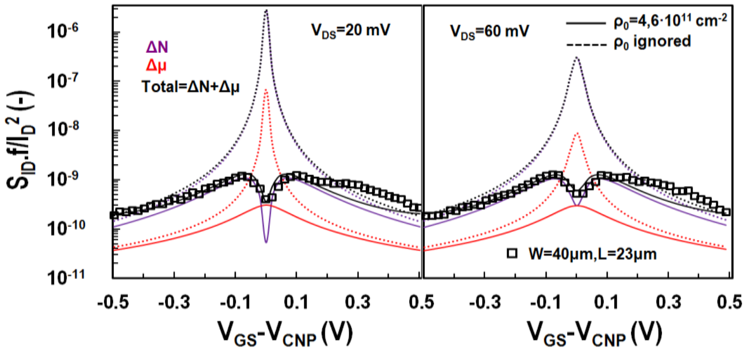

Figure 1: ΔN - $\Delta\mu$ effects and the total LFN contribution at V_{DS}=20 mV (left subplot) and V_{DS}=60 mV (right subplot) for either residual charge taken into account (ρ_0=4,6·10^{11}cm^{-2}) or ignored . LFN data for a transistor with W/L=40 μm/23 μm are also shown.

[1] C. Enz, et al. John Wiley and Sons, (2006)
[2] D. Jiménez et al. IEEE Transactions on Electron Devices, 58, 4049-4052 (2011)
[3] M. B. Blaschke, et al. 2D Materials 4[2], (2017)

Acknowledgements: "This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No GrapheneCore2 785219 and Marie Skłodowska-Curie Grant Agreement No 665919".

Brominated Graphene as a Versatile Precursor for Multifunctional Grafting

Noelia Rubio*, Heather Au and Milo S.P. Shaffer
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**n.rubio-carrero@imperial.ac.uk*

Graphene has attracted increased attention in recent years due to its exceptional electronic, optical, mechanical and thermal properties. The combination of graphene with existing polymer-based materials [1] has afforded promising applications. Strong efforts have been made to produce single layer graphene with minimal framework damage. A useful approach would be to exfoliate and functionalise the graphene layers directly from graphite avoiding the introduction of defects.

Graphite intercalation compounds (GICs) are well-known precursors that afford isolated graphene layers avoiding framework damage [2]. In this work we have used this method in order to introduce charges into few-layer graphene starting material followed by the addition of bromine, achieving direct covalent attachment of bromine to the graphene framework [3]. The brominated few-layer graphenes (FLG-Br) provide a convenient, stable, liquid-phase precursor, suitable for the synthesis of a variety of directly functionalised graphenes. As an example, the brominated species were used to initiate atom transfer radical polymerization (ATRP). In addition, brominated graphene is active for nucleophilic substitution reactions, by the addition of hydroxyl-substituted derivatives. The functionalisation process is highly versatile and would allow the introduction of a wide variety of polymers on the graphene layers.

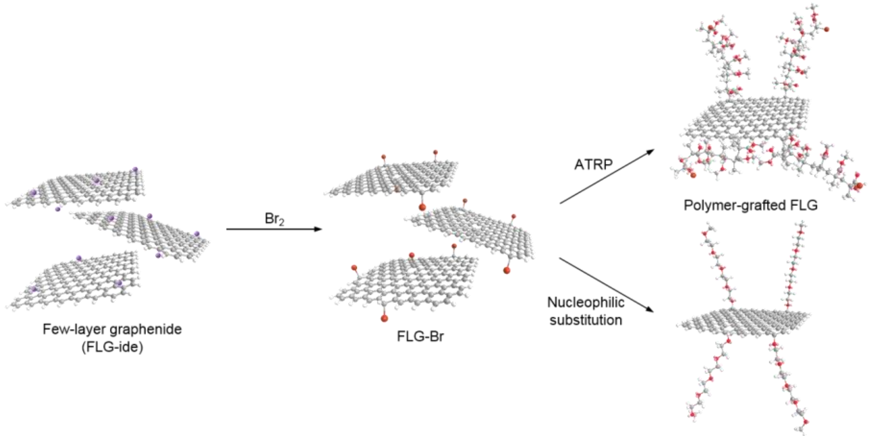

Figure: Schematic illustration of the bromine framework functionalization.

[1] X. Huang, X. Qi, F. Boeyab, H. Zhang, Chem. Soc. Rev., 2012, 41, 666.
[2] a) E. M. Milner, Skipper, N.T., Howard, C.A., M. Shaffer et al, J. Am. Chem. Soc., 2012, 134, 8302; b) N. Rubio, H, Au, H. Leese, S. Hu, A. Clancy, M, Shaffer, Macromolecules, 2017, 50, 7070.
[3] H. Au, N. Rubio, M. Shaffer, 2018, Chem. Sci., 2018, 9, 209-217.

MoS2-reduced graphene oxide composites by thermal processing: An in situ XPS study

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MoS_2 is an alternative material of Pt-derived electrocatalysts for Hydrogen Evolution Reaction (HER) because of constrained electrons within two-dimensional layers. However, MoS_2 presents poor intrinsic conductivity. In order to overcome this drawback, composites of MoS_2 with carbon materials are investigated [1,2]. Among them, the MoS_2-reduced graphene oxide (rGO) shows excellent electrocatalytic performance because rGO offers the conductive path for electron transfer between the catalyst and electrode and prevents the aggregation of MoS_2 enhancing the exposure of S-edges [3]. However, the elemental composition and bonding configuration of such films is not investigated yet. In this work, the chemical state and composition of MoS_2-rGO thin films for different GO mass fractions and GO reduction degree is presented. The $(NH_4)_2MoS_4$-GO composites in the form of thin films on ITO substrates were reduced upon step-wise heating in ultrahigh vacuum (UHV) and the surface was investigated in situ with x-ray photoelectron spectroscopy (XPS) in each reduction step [4]. It was found that upon heating, MoS_2, Mo oxides and rGO existed in all samples and the relative concentration depended on the initial GO percentage and heating temperature.

[1] Youfang Zhang et al. ACS Sustainable Chem. Eng,3, 3140–3148 (2015)
[2] Yu-Jia Tang et al.Adv. Energy Mater.,6, 1600116-1600123 (2016)
[3] Zhu, H.et al.ACS Appl. Mater. Interf.,6, 22126–22137 (2014)
[4] L.Sygellou et al, J. Phys. Chem. C, 120 (1), 281–290, (2016)

Acknowledgements: This research has been financed by Greek national funds through the Operational Program «Εθνική Υποδομή Νανοτεχνολογίας, Προηγμένων Υλικών και Μικρο/νανοηλεκτρονικής (INNOVATION EL) - Δυτική Ελλάδα».

Sorption properties of high surface area amorphous graphene oxide

Vassilios Binas[1]* and Pantelis N. Trikalitis[2]
[1]*Institute of Electronic Structure and Laser (IESL), FORTH, P.O. Box 1527, Vasilika Vouton, GR-71110 Heraklion, Greece*
[2]*Department of Chemistry, University of Crete, Voutes 71003, Heraklion*
**binasbill@iesl.forth.gr*

Hydrogen storage is one of the key issues for the realization of fuel - cell powered vehicles using hydrogen as the energy carrier. Porous carbon materials are a canditate for hydrogen storage and attracted extensive attention as a result if the advantages associated with its light weight, fast kinetics, complete reversibility, low cost, and high surface area. we present here a simple and quick method for a gram scale production of amorphous graphene oxide (solvothermal synthesis). Amorphous graphene oxide were succesfully synthesized using solvothermal method and characterized with powder XRD, FT-IR, RAMAN, BET, SEM, TEM and TGA. Also we study the gas sorption properties in N2, H2, CO2 and CH4.

PARALLEL SESSIONS – WS2 Session VII on Minos II

Invited Talk

Perovskite Solar Cells: Toward Industrial-Scale Manufacturing

Yulia Galagan
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Research progress in hybrid perovskite solar cells has increased enormously over the last years, making perovskites very promising candidates for future PV technologies. Perovskite solar cells use abundant and low-cost starting materials enabling their economic advantages for large-scale implementation. A transition from laboratory-scale fabrication to industry compatible manufacturing requires: scale up the dimension of the devices; manufacturing of large area modules, considering the development of interconnection as an important step toward upscaling; and development of alternative to spin coating processes, which are industrially compatible and facilitate high PCEs of the manufactured devices.

The latest developments in sheet-to-sheet and roll-to-roll slot die coating manufacturing will be discussed along with other related technologies required for industrial-scale manufacturing, e.g. laser ablation technologies, drying and post-treatments required for crystal formation, and the use of alternative industry compatible solvents for manufacturing perovskite solar cells. Using optimized S2S manufacturing technologies perovskite PV modules of 144 cm^2 with 13.8% stabilized efficiency on aperture area (14.5% on active area) were demonstrated. At the same time, by developing the R2R slot die deposition process the flexible modules of 160 cm^2 with 10.1 % stabilized efficiency on aperture area (11.0% on active area) were demonstrated. In addition, fully R2R coated cells exhibit PCE of up to 16%. These results can be considered as an important milestone toward industrial-scale manufacturing of perovskite photovoltaics.

Environmental hazards of photovoltaic perovskites

László Forró

Laboratory of Physics of Complex Matter
Ecole Polytechnique Fédérale de Lausanne
CH-1015 Lausanne
laszlo.forro@epfl.ch

The $CH_3NH_3PbI_3$ perovskite, is currently the most promising compound in photovoltaic (PV) technologies for making highly efficient solar cells because of their simple fabrication procedure, low price, and high efficiency. Several companies are already building perovskite-based PV devices for commercialization in the near future. Nevertheless, the perovskite contains Pb, and safety concerns during PV fabrication and transportation have not yet been addressed. But not only direct human exposure is an issue, but its release into the environment, soil and waterways, after failure of large area solar cells also represents major health risks.

Here an extensive toxicity study of the most promising photovoltaic perovskites $CH_3NH_3PbI_3$ and $CH_3NH_3SnI_3$ are presented. On cell cultures [1], the zoom-in *in vitro* (modification of the genes upon perovskite exposure, biochemical changes, various assays) and on living organisms (C-elegans and Drosophila) the zoom-out *in vivo* studies both show a high level of toxicity.

The results are conclusive, and encouraging the scientific community to conduct further tests on more complex organisms, but also to search for new materials which do not represent risk to the environment.

[1] I.R. Benmessaoud et al., Toxicol. Res. 5, 407–419 (2016)

Acknowledgments: The work is performed in collaboration with Ines Benmessaoud, Anne-Laure Mahul, Hilal Lashuel, Massimo Spina, Bohumil Maco and Endre Horvath and many others. The research of L.F. is supported by the ERC Advanced Grant Picoprop.

Invited Talk

Device Engineering Concepts for Solution Processed Photovoltaics

Stelios A. Choulis
Institution A, City, Country Molecular Electronics and Photonics Research Unit, Department of Mechanical Engineering and Materials Science and Engineering, Cyprus University of Technology, Limassol, 3603, Cyprus
stelios.choulis@cut.ac.cy

The advantages of Solution Processed Organic and Hybrid Perovskite Photovoltaics, such as their light weight, mechanical flexibility in addition to the small energy demand, and low-cost equipment requirements for roll-to-roll printing mass production, characterize them as interested candidate sources for future electrical power. The presentation aims in covering a range of scientific and engineering issues needed to bring organic and hybrid perovskite solar cells to commercial viability in terms of efficiency, lifetime and cost. A systematic understanding of the relationship between electrode materials [1], processing [2] and device performance [3,4] relevant to printed photovoltaics product development targets will be presented.

[1] Low-Temperature Combustion Synthesis of a Spinel $NiCo_2O_4$ Hole Transport Layer for Perovskite Photovoltaics, I.T Papadas, A. Ioakeimidis, G.S Armatas, S.A Choulis. Advanced Science 2018.
[2] Printed Copper Nanoparticle Metal Grids for Cost-Effective ITO-Free Solution Processed Solar Cells. E Georgiou, S.A. Choulis, F Hermerschmidt, S.M Pozov, I Burgués-Ceballos, et al, Solar RRL, 2018
[3] Improved Performance and Reliability of p-i-n Perovskite Solar Cells via Doped Metal Oxides. A Savva, I Burgués-Ceballos, S.A Choulis, Advanced Energy Materials 6 (18), 2016
[4] Influence of the Hole Transporting Layer on the Thermal Stability of Inverted Organic Photovoltaics Using Accelerated-Heat Lifetime Protocols, F. Hermerschmidt, A. Savva, E. Georgiou, S.M Tuladhar, et al., ACS applied materials & interfaces, 2017

Acknowledgements: Funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (H2020-ERC-2014-GoG project number 647311) is gratefully acknowledged.

END OF 1ST DAY OF NANOBIO2018

NanoBio

1st International Conference on Nanotechnologies and Bionanoscience (NanoBio 2018), 24-28 September 2018

TUESDAY, 25TH SEPTEMBER 2018 – 2ND DAY OF NANOBIO2018

<table>
<tr><th>TIME</th><th colspan="2">Tuesday 25th September</th></tr>
<tr><td>08:30-all day</td><td colspan="2">REGISTRATION
(at the Registration Desk in Atlantis Aquila Hotel)</td></tr>
<tr><td rowspan="2">9:30-10:15</td><td colspan="2"><i>Plenary Session I on WS3:</i> Tissue Engineering & Regenerative Medicine & <i>on WS4: Graphene & related 2D materials</i>
<i>Chair: E. Stratakis & E. Kymakis</i> <i>Room</i>: Minos</td></tr>
<tr><td colspan="2">(WS3-Plenary) Nanotechnology Approaches to Biological Cellular Therapies
Paul S. Weiss*
California NanoSystems Institute and Departments of Chemistry & Biochemistry and Materials Science & Engineering, UCLA, Los Angeles, USA</td></tr>
<tr><td>10:15-11:00</td><td colspan="2">(WS2-Plenary) The Roadmap to Applications of Graphene and Related Materials
Andrea Ferrari*
University of Cambridge, UK</td></tr>
<tr><td>11:00-11:30</td><td colspan="2">COFFEE BREAK (PASIPHAE ROOM)
All the Poster Presenters of POSTER SESSION I could place their Poster on the Poster Stands – Go to Registration Desk for adhesive material</td></tr>
<tr><td rowspan="2">11:30-12:00</td><td><i>WS3 & WS1 Sessions II – Chairs: P.S. Weiss (Sub: G. Malliaras)</i>
<i>Room</i>: Minos I</td><td><i>WS4 Session III – Chairs: A. Di Carlo (Sub: I. Konidakis)</i>
<i>Room</i>: Minos II</td></tr>
<tr><td>(WS3-Invited) Organic electronics to measure and control brain activity
Christophe Bernard*, Institut de Neuroscience des Systèmes, Inserm, France</td><td>(WS4-Invited) A universal platform for biomarker sensing based on the heterostructures of 2D carbon materials
Andrey Turchanin*, Friedrich Schiller University Jena, Germany</td></tr>
<tr><td>12:00-12:15</td><td>Microwell Arrays for Monitoring Phenotypic Heterogeneity in Vascular Cell Populations
Michele Zagnoni[1], Mairi E. Sandison[2]*
[1]Dept. of Electronic and Electrical Engineering, University of Strathclyde, Glasgow, UK; [2]Dept. Biomedical Engineering, University of Strathclyde, Glasgow, UK</td><td>Graphene boosts activity in neuronal cells by regulating extracellular ion availability
Denis Scaini* [1,2], Niccolò Paolo Pampaloni[1], Martin Lottner[3], Michele Giugliano[4], Alessia Matruglio[5], Francesco D’Amico[2], Maurizio Prato6,[7], Josè Antonio Garrido[3], Laura Ballerini[1]
[1] International School for Advanced Studies (SISSA), Trieste, Italy; [2] ELETTRA Synchrotron Light Source, Trieste, Italy; [3] Walter Schottky Institut and Physik-Department, Technische Universität München, Am Coulombwall, Garching, Germany; [4] Theoretical Neurobiology & Neuroengineering, University of Antwerp, Antwerp, Belgium; [5] CNR-IOM - Istituto Officina dei Materiali, Trieste – Italy; [6] Department of Chemical and Pharmaceutical Sciences, University of Trieste, Trieste, Italy. [7] Nanobiotechnology Laboratory, CIC biomaGUNE, -San Sebastiàn, Spain</td></tr>
<tr><td>12:15-12:30</td><td>Following the fate of Calcium Phosphate Nanoparticles for assessing their ability in cardiac targeting in vivo through a complete imaging platform
M. Rouchota[1], E. Fragogeorgi[2], S. Sarpaki[1], A. Adamiano[3], M. Iafisco[3], P. Bouziotis[2], D. Catalucci[4], G.Loudos[1,2]*
[1]Bioemission Technology Solutions, Research & Development, Athens, Greece; [2]National Center for Scientific Research (NCSR) “Demokritos”, Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety, Athens, Greece; [3]National Research Council (CNR), Institute of Science and Technology for Ceramics (ISTEC), Faenza, Italy; [4]National Research Council (CNR), Institute of Genetic and Biomedical Research, Milan, Italy</td><td>Graphene liquid cells for multi-technique analysis of biological cells in water environment
Alessia Matruglio[1]*, Paolo Zucchiatti[2] , Giovanni Birarda[2] , Paul Leidinger[3], Guo Hongxuan[4], Sebastian Guenther[3], Andrei Kolmakov[4] and Lisa Vaccari[2]
[1] CERIC-ERIC (Central European Research Infrastructure Consortium), Trieste, Italy; [2] Elettra Sincrotrone Trieste, Trieste, Italy; [3] Technische Universität München, Garching, Germany; [4] NIST (National Institute of Standards and Technology), Gaithersburg, United States</td></tr>
<tr><td>12:30-12:45</td><td>Design and fabrication of micro- and nanomaterials for endothelial cell cultures
P. Formentín[1]*, U. Catalán[2], S. Fernández-Castillejo[2], R. Solà[2] and L.F. Marsal[1]*
[1]Departament d’Enginyeria Electrònica, Elèctrica i Automàtica, Universitat Rovira i Virgili, Països Catalans 26, 43007, Tarragona, Spain; [2]Department of Medicine and Surgery, Universitat Rovira i Virgili, sant Llorenç 21, 432001, Reus, Tarragona, Spain</td><td>Electronic Fingerprints of DNA/RNA Nucleobases on Graphene
Jiří Červenka*
Department of Thin Films and Nanostructures, Institute of Physics of the Czech Academy of Sciences, Praha 6, Czech Republic</td></tr>
<tr><td>12:45-13:00</td><td>Effect of topography on neuronal cell response: The underlying cellular mechanisms
Anthi Ranella*, IESL-FORTH, Greece</td><td>Optical and Non-Volatile Switching in Memristor Devices Based On Hybrid Organic-Inorganic Materials
Ayoub H Jaafar[1,2]*, Rob Gray[1], Emanuele Verrelli[1] , Stephen Kelly[1] and Neil Kemp[1]
[1]School of Mathematics and Physical Sciences, University of Hull, Hull, UK; [2]Physics Department, College of Science, University of Baghdad, Baghdad, Iraq</td></tr>
<tr><td>13:00-13:30</td><td>(WS1-Invited) Neurons on Nanotopographies
Insung S. Choi*
Center for Cell-Encapsulation Research, Department of Chemistry, KAIST, Daejeon, Korea</td><td>(WS4-Invited) Water-based and biocompatible inkjet printable 2D-inks: From formulation engineering to all-printed devices
Cinzia Casiraghi*, University of Manchester, UK</td></tr>
</table>

Plenary Session I on WS3: Tissue Engineering & Regenerative Medicine & on WS4: Graphene & related 2D Materials

Plenary Talk

Nanotechnology Approaches to Biological Cellular Therapies

Paul S. Weiss
California NanoSystems Institute and Departments of Chemistry & Biochemistry and Materials Science & Engineering, UCLA, Los Angeles, CA 90095
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We introduce biomolecular payloads into cells for gene editing at high throughput for off-the-shelf solutions targeting hemoglobinopathies, immune diseases, and cancers. We circumvent the need for viral transfection and electroporation, both of which have significant disadvantages in safety, throughput, cell viability, and cost. Mechanical deformation can make cell membranes transiently porous and enable gene-editing payloads to enter cells. These methods use specific chemical functionalization and control of surface contact and adhesion in microfluidic channels. Likewise, penetration of reproducibly nanomanufactured, loaded sharp features can introduce these packages into individual or many cells. We discuss our progress with these approaches and the methods that we use to quantify success.

Plenary Talk

The Roadmap to Applications of Graphene and Related Materials

Andrea Ferrari*

University of Cambridge, UK

Disruptive technologies are usually characterised by universal, versatile applications, which change many aspects of our life simultaneously, penetrating every corner of our existence. In order to become disruptive, a new technology needs to offer not incremental, but dramatic, orders of magnitude improvements. Moreover, the more universal the technology, the better chances it has for broad base success. The Graphene Flagship has brought together universities, research centres and companies from most European Countries. I will overview the progress done thus far and the future roadmap.

PARALLEL SESSIONS – WS3 & WS1 Session II on Minos I

WS3 Invited Talk

Organic electronics to measure and control brain activity

Christophe Bernard
Institut de Neuroscience des Systèmes, Inserm U1106, Marseille France
christophe.bernard@univ-amu.fr

Brain Machine Interfaces (BMIs) have been used and are being designed to control several pathologies, such as Parkinson's disease, depression and addiction. Most BMIs are invasive (large size), trigger an inflammatory reaction that is detrimental to their function and are poorly biocompatible. Organic materials offer interesting alternatives and solutions to the aforementioned problems. In collaboration with the group of George Malliaras (Cambridge), we have developed several BMIs to measure and control brain activity. We demonstrate organic recording electrodes with unsurpassed quality. The electrodes can also be used to stimulate neurons in the most efficient manner. Finally, we have developed micropumps to control brain activity. We show some applications in epilepsy, the second most common neurological disorder after migraine. We hope to transfer this technology to patients.

Microwell Arrays for Monitoring Phenotypic Heterogeneity in Vascular Cell Populations

Michele Zagnoni[1], Mairi E. Sandison[2]*
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[2]Dept. Biomedical Engineering, University of Strathclyde, Glasgow, UK
** mairi.sandison@strath.ac.uk*

Significant remodeling of the vascular wall underlies cardiovascular disease resulting in the formation of atherosclerotic plaques populated with macrophage and smooth muscle cells (SMCs). These SMCs are thought to arise from the vessel wall, as mature SMCs de-differentiate from a contractile to a migratory, proliferate phenotype. However, the remodeling process is not fully understood and uncertainties remain over plaque cell origins and the plasticity of cells within the vascular wall. Both drug development and regenerative medicine have been restricted by these uncertainties.

Recently, through a combination of time-lapse, high-speed fluorescence and 3D reconstruction microscopy, we demonstrated unambiguously [1] that freshly isolated mature, contractile SMCs can rapidly transform into not only a migratory but a phagocytic phenotype, a characteristic behaviour of macrophage. Results also showed strong heterogeneity in the proliferative capacity of SMCs [2] and the presence of other highly proliferative cell types in vascular wall that readily interact with SMCs.

To better understand vascular call fate, including characterizing the phenotype of cell sub-populations, we employed SU-8 microfabrication to create a series of addressable microwell arrays that enable screening at the single cell level of large numbers of freshly isolated vascular cells. By incorporating microwells of different areas (from 60x60 to 180x180 μm) and seeding with a cell suspension of appropriate density (either a pure SMC population or a mixed vascular population), cells sedimented stochastically across the microwell arrays such that many wells contained single cells. These cells were characterized by imaging *in situ* prior to tracking them for >1 week as they were induced to de-differentiate in culture. To validate this approach, variation in the proliferation of individual cells was tracked and the expression of SMC markers (e.g. SMA) following phenotypic modulation quantified.

This microwell array approach, which is amenable to drug screening applications, will enable detailed characterization of phenotypic changes in vascular cell sub-populations, providing new insights to inform tissue engineering applications.

[1] M.E. Sandison, et al. J Physiol 594(21), 6189-6209 (2016)
[2] M.E. Sandison, J.G. McCarron. FASEB J 29, 418.8 (2015)

Following the fate of Calcium Phosphate Nanoparticles for assessing their ability in cardiac targeting in vivo through a complete imaging platform

M. Rouchota[1], E. Fragogeorgi[2], S. Sarpaki[1]*, A. Adamiano[3], M. Iafisco[3], P. Bouziotis[2], D. Catalucci[4], G.Loudos[1,2]
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The purpose of this study is to present the workflow and first results of monitoring the fate of Calcium Phosphate Nanoparticles (CaP-NPs), towards the assessment of their ability in cardiac targeting, within the scope of the European funded project CUPIDO.

For CaP-NPs' radiolabeling, the metastable isotope of technetium (^{99m}Tc) was used via the preparation of ^{99m}Tc-MDP conjugate. Aliquots of ^{99m}Tc-MDP were added to CaP-NPs suspension and the radiochemical yield of Tc-MDP CaP-NPs was assessed by ITLC-SG. In vitro stability was evaluated for up to 24h post-preparation, over a range of temperatures and different incubation conditions. *Ex vivo* (biodistribution) and *in vivo* (imaging) profiles in normal mice were studied by intravenously injecting CaP-NPs. Control experiments were also performed for the intratracheal administration route. The radiochemical yield for ^{99m}Tc-MDP -Cap-NPs was 81.5 ± 8.5 % providing a single radioactive species. *In vitro* stability up to 24 h post-labelling was high (>98 %) at all different sets of temperature, in aqueous conditions and in biological media. Radioactivity was mainly found in liver, spleen and lungs up to 2 h post injection (p.i.) and in liver and spleen at 24 h p.i. based on biodistribution results, which were confirmed by imaging results. Intratracheal imaging results showed a more targeted biodistribution, and is currently being further evaluated.

The encouraging results allow the use of CaP-NPs as a suitable approach for other routes of administration, such as gavage or inhalation.

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Design and fabrication of micro- and nanomaterials for endothelial cell cultures

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Micro- and nanofabricated structural substrates have demonstrated advantages over planar surfaces for biological studies. Cell behavior is influenced by topography and surface chemistry of the material used to culture cells. Macro- and nano topographical features, such as pores, grooves or pillars, have shown to affect cell response [1-3].

We report cell adhesion and cell morphology of Human Aortic Endothelial Cells cultured on macroporous silicon and nanoporous anodic alumina substrates. We have also studied the influence of the topography on the cell behavior using silicon dioxide pillars and silicon microgrooves as 3-D structural surfaces. All of them were chemically modified with proteins (collagen and fibronectin) in order to promote enhanced cell attachment. Microscopy analysis revealed differences on the number of the attached cells depending on the protein and the porous material used but, not differences on cell morphology have been observed with macroporous silicon or nanoporous alumina. For SiO_2 pillars, the structure induces an alteration in the cell spreading area and cell morphology including nuclei and body shape distortion and cytoskeletal reorganization. This effect was also observed when the substrate is a microgroove, which was fabricated to mimic the elongated endothelium in natural vessels.

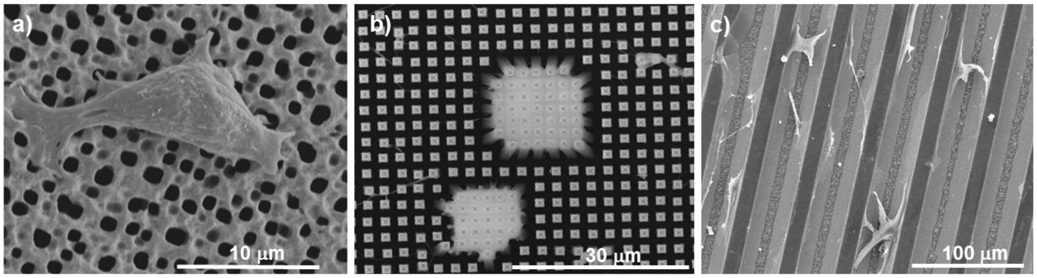

Figure 1. SEM micrographs of HAECs cultured on a) macroporous silicon, b) SiO_2 micropillars and c) silicon microgrooves.

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Acknowledgments: TEC2015-71324-R and AGL2016-76943-C2-2-R. AGAUR 2017-SGR-1527 and 2014-ICREA Academia Award.

Effect of topography on neuronal cell response: The underlying cellular mechanisms

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Understanding the mechanisms by which the topographical cues of extracellular matrix (ECM) affect cellular responses such as proliferation, adhesion, growth, orientation, and differentiation is fundamentally important for tissue engineering / regenerative medicine applications. However the complexity of the hierarchical micro/nano topography of ECM render extremely difficult the investigation of cell-substratum response; revealing, thus, the need of the development in vitro experimental models with defined surface topography. Towards this scope research efforts have been focused on lasers as tools for 2D and 3D structuring materials as they do not require harsh processing conditions (chemicals or high temperature). Ultrafast pulsed laser irradiation is considered as a simple and effective microfabrication method to produce structures with controlled geometry and pattern regularity. Specifically, using laser precision 3D micro/nano fabrication techniques, silicon substrates comprising arrays of parallel oriented elliptical microcones (MCs) were fabricated to investigate whether a discontinuous geometry comprising anisotropic features at the subcellular level could influence the morphology, outgrowth and differentiation of nerve, neuroglial and neuronal stem cells (NSCs). It was found that the distinct geometrical characteristics of a discontinuous topographical pattern alone could influence a variety of neuronal and neuroglial cell functions, however in a different manner. In the PC12 cell study the surfaces roughness did effectively influence the PC12 cells' differentiation fate. In primary cell cultures it was shown that the distinct anisotropic morphology of the microconical surfaces did affect the outgrowth orientation of both neurons and Schwann cells in a surface dependent manner. The laser patterned Si substrates presented here could be used as model scaffolds for the systematic exploration of the role of 3D microtopography on cell differentiation and neural network outgrowth, with the ultimate goal of providing mechanistic insight to guide the development of clinically relevant strategies for nerve repair.

WS1 Invited Talk

Neurons on Nanotopographies

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Recent experimental data, found rather in a scattered fashion, unceasingly echoes that we should delve into the deterministic roles of nanostructure-derived physical cues in neuronal development. Since the reports, in 2010, that neuritogenesis and neurite outgrowth are accelerated on the nanometric substrates, such as anodized aluminum oxide (AAO) and electrospun fibers, compared with a flat slide, the validity of the 2D, flat surface as a neuron-culture platform has been controversial. Not to mention the faithful recapitulation of the in vivo situations in an in vitro setting for legitimate neuron studies, advances in the field would make it possible to control and manipulate the developmental and morphological processes of neuronal and glial cells at one’s will for certain purposes and applications. Fundamental studies also have been executed to identify the genes and proteins in charge of these unforeseen phenomena and elucidate the underlying mechanisms, along with studies on their in vivo relevance. Ultimately, the characterization of the unknown network of pathways will unveil many aspects of the behavior and intracellular processes of neurons, and play an important role in the manipulation of neuronal development for applications in neural circuits, neuroregenerative medicine and prostheses, and much more.

PARALLEL SESSIONS – WS4 Session III on Minos II

Invited Talk

A universal platform for biomarker sensing based on the heterostructures of 2D carbon materials

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Biochemically functionalized single-layer graphene field effect transistors (BioGrFETs) present a highly attractive platform for ultrasensitive detection of biomarkers in nanobiotechnology and nanomedicine. However, the electronic structure of graphene in the FETs is typically degraded after the functionalization, which significantly restricts such kind of applications. Here, we present a universal route to non-destructive chemical and biochemical functionalization of graphene FETs with amino-terminated molecular nanosheets - carbon nanomembranes (CNM). CNMs have a thickness ~1 nm; they are synthesized via electron beam induced crosslinking of aromatic self-assembled monolayers. [1-3] We demonstrate experimental characterization and modelling of the transport properties of CNM/graphene heterostructure devices and employ them for highly sensitive detection of the pH-values at physiological conditions. Moreover, we show that the biochemical functionalization of CNMs enables the engineering of customer-designed, highly sensitive BioGrFET$_S$ for specific detection of biomarkers in clinical diagnostics. [4-5]

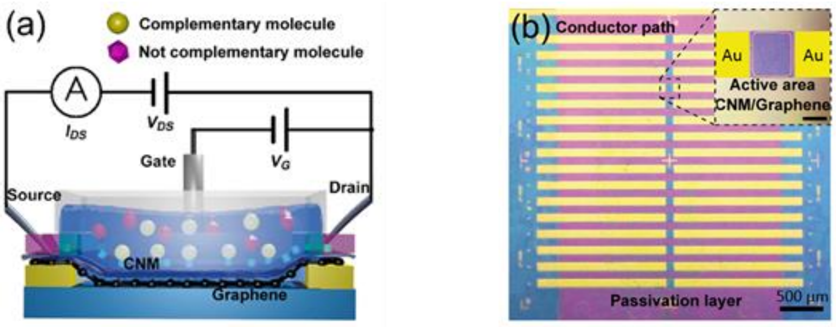

Figure 1: (a) Schematic representation of a CNM-functionalized BioGrFET device. (b) Optical image of a sensor array. Size of the scale bar in the insert is 50 µm.

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Graphene boosts activity in neuronal cells by regulating extracellular ion availability

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Graphene, with its peculiar bi-dimensional crystal arrangement of pure carbon atoms, is catching the eye of the research community with its extraordinary physicochemical properties. In particular, single layer graphene (SLG) potential applications in biology and (nano)medicine have being deeply investigated during last years. Although preliminary reports have shown that graphene based materials can be safely interfaced with cells, only recently we achieved an exhaustive functional study of neuronal networks developed interfaced with SLG [1]. In this scenario, we shown that uncoated SLG is not only fully biocompatible but, surprisingly, induces in cultured neurons an increased network synaptic activity, presumably by altering the availability of extracellular K^+ ions to cells. Interestingly, the homeostatic changes observed in SLG-interfaced cells, as well as the increased network activity, were observed only when graphene is supported by an insulating substrate and not when neurons were interfaced neither on SLG deposited on a conductive substrate (e.g. indium tin oxide – ITO), nor onto many-layers graphene (MLG), suggesting that substrate electronic and charge properties play a key role in this adaptive interaction. We made a tentative interpretation of such phenomena hypothesizing that a surface-modulated cation-π interaction is taking place at the interface between graphene and cells. Understanding this interaction could represent an important advancement in our fundamental knowledge about graphene properties when in contact with electrolytic solutions but, even more important, an important basement for future applications of graphene as bio-interfacing material.

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Graphene liquid cells for multi-technique analysis of biological cells in water environment

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The investigation of processes in aqueous environment has the advantage to observe realistic conditions of a vast class of biological, physical and chemical phenomena, taking place exclusively in the liquid phase [1]. Unfortunately, water often poses severe limitations to numerous experimental techniques. For instance, infrared light is strongly absorbed by water [2], and volatile liquids are incompatible with vacuum-based techniques, such as soft X-rays or electronic microscopies, SEM and TEM [3]. Extensive efforts have been made by the scientific community to fabricate membrane sealed liquid cells suitable for multi-technique analyses. However, the membrane materials compatible with one of the aforementioned technique are not such for the others. Graphene membranes represents a straightforward solution because of their elasticity, mechanical strength, electron and optical transparency as well as their ability to sustain high differential pressure and impermeability to liquids [4]. A single-layer graphene can neatly encapsulate biological cells, preventing their dehydration and yet limiting the parasitic light absorption by excessive water layers, as recently demonstrated by the authors [5]. However, up to now only proof-of-principle experiments have been reported, but reproducible and easy fabrication protocols of Graphene Liquid Cells (GLCs) still remain a bottleneck. Here we propose a new, lithography based strategy for the fabrication of reproducible GLCs for the analysis of hydrated biological specimen, suitable for different environmental and low-vacuum techniques. The proposed approach could open unique opportunities for performing correlative analyses of hydrated biological cells and shed new light on biosciences.

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Electronic Fingerprints of DNA/RNA Nucleobases on Graphene

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Fast, cheap and reliable identification of the exact order of nucleobases within a DNA/RNA molecule is an important goal of next-generation genome sequencing. Graphene has recently attracted enormous attention for next-generation DNA/RNA sequencing and sensing thanks to its unique electronic and structural properties. Here we present a systematic study of the electronic structure of a graphene-nucleobase system for various molecular orientations and concentrations using density functional theory [1]. We identify that the in-plain dipole moments of the nucleobases play the dominant role in the modification of the electronic structure of graphene, demonstrating both p- and n-type of doping depending on the direction of the dipole moments. We demonstrate that intermolecular interactions have a strong influence on the adsorption geometry, resulting in a tilt of the molecules on graphene. The predicted tilt of nucleobases causes significant changes to the electronic structure and molecular fingerprints of nucleobases in graphene, supporting our recent experimental observations [2]. Our findings have important implications for identification and understanding of molecular fingerprints of DNA/RNA nucleobases in graphene-based sensing and sequencing methods.

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Optical and Non-Volatile Switching in Memristor Devices Based On Hybrid Organic-Inorganic Materials

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Memristors are one of the most promising emerging memory technologies. Their non-volatile switching properties with low power consumption and good scalability are highly desirable for the next generation of memory devices with potential applications in computer memory, logic operations and neuromorphic computing. Modulation of their electronic properties by optical stimuli provides a new level of functional control, enabling the development of new types of optoelectronic devices and circuits, such as photonic integrated circuits with memory elements controllable by light. Memristors too have important applications in neuromorphic computing, and in this context the dynamic and spatial patterning by light opens the route to new optically configurable and tunable synaptic circuits. Here, we demonstrate a novel optically controllable hybrid organic-inorganic memristor device consisting of vertically aligned ZnO nanorods embedded within an optically active polymer, poly(disperse red 1 acrylate) (PDR1A) [1]. Illumination by polarization- and wavelength-specific light induces *trans-cis* photoisomerization of the azobenzene molecules causing an expansion or contraction of the material, which modifies the resistance of the on/off states, their ratio and retention times. We demonstrate optical control of short-term and long-term memory and tunable learning through spike timing dependent (synaptic) plasticity. We believe this has important applications in the dynamic patterning of memristor networks, whereby both spatial and temporal patterning via light allows the development of new optically reconfigurable neural networks, adaptive electronic circuits and hierarchical control of artificial intelligent systems.

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Invited Talk

Water-based and biocompatible inkjet printable 2D-inks: From formulation engineering to all-printed devices

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The isolation of various two-dimensional (2D) materials allows to combine them into heterostructures. Such a concept can be used to make functional devices such as tunnel diodes [1], tunneling transistors [2,3], photodetectors [4] and light emitters [5]. Solution processing of graphene [6] allows simple and low-cost techniques such as inkjet printing [7, 8] to be used for fabrication of heterostructure of arbitrary complexity. However, the success of this technology is determined by the nature and quality of the inks used. An ideal ink should be based on non-toxic solvents, have high concentration, and should be inkjet printable (e.g. provide stable drop formation, minimize coffee stain effect, etc) with minimum pre- or post-processing. In the case of all printed heterostructure-based devices, the formulation should also be carefully engineered to minimize re-mixing of different 2D crystals at the interface, which causes device poor performance and lack of reproducibility.

In this work we show a general formulation engineering approach to achieve highly concentrated, and inkjet printable water-based 2D crystal formulations, which also provide optimal film formation for multi-stack fabrication [9]. Examples of all-inkjet printed heterostructures, such as large area arrays of photosensors on plastic [9], programmable logic memory devices [9], strain sensors on paper [10] and capacitors [11] will be discussed.

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	WS3 Session IV – Chairs: A. Ranella (Sub: A. Markaki) *Room*: Minos I	*WS5 & WS2 Sessions V – Chairs: K. Brintakis* *Room*: Minos II
15:00-15:30	(WS3-Invited) 3D DNA imaging in live cells at ultra-high-throughput **Lucien Weiss*, Israel Institute of Technology, Israel**	(WS5-Invited) New materials and devices for interfacing with the brain **George Malliaras*, University of Cambridge, UK**
15:30-15:45	**Diagnostics on the chip: micro-patterned functional arrays for advancement of medicine** Sylwia Sekula-Neuner[1]*, Falko Brinkmann[1], Ravi Kumar[1], Emmanuel Oppong[2], Alice Bonicelli[2], Andrew C. B. Cato[2], Klaus Pantel[3], Michael Hirtz[1],Harald Fuchs[1, 4] [1] Karlsruhe Institute of Technology, Institute of Nanotechnology, Germany; [2] Karlsruhe Institute of Technology, Institute of Toxicology and Genetics, Germany; [3] Universitätsklinikum Hamburg-Eppendorf, Department of Tumor Biology, Germany; [4] Institute of Physics, University of Münster, Germany	**Biosensors for Non-Invasive Medical Diagnostics** A. Romeo[1]*, P.E.D. Soto Rodriguez[1], A. Moya[2,3], G. Gabriel[2,3], R. Villa[2,3], R. Artuch[4,5], S. Sánchez[1,6] [1] Institute for Bioengineering of Catalonia (IBEC), The Barcelona Institute of Science and Technology (BIST), Barcelona, Spain; [2] Instituto de Microelectrónica de Barcelona, IMB-CNM (CSIC), Esfera UAB, Bellaterra, Barcelona, Spain; [3] Research Networking Center in Bioengineering, Biomaterials and Nanomedicine (CIBER-BBN), Barcelona, Spain; [4] CIBER-ER (Biomedical Network Research Center for Rare Diseases), Instituto de Salud Carlos III, Madrid, Spain; [5] Laboratory of hereditary metabolic diseases, Hospital Sant Joan de Déu, Barcelona, Spain; [6] Institució Catalana de Recerca i Estudis Avancats (ICREA), Barcelona, Spain
15:45-16:00	**Matrix vesicles-loaded microreactors co-assembled with bone-like osteoblast cells with ability to enhance biomineralization** Fabian Itel[1]*, Jesper Skovhus Thomsen[2] and Brigitte Städler[1] [1] Interdisciplinary Nanoscience Center, University of Aarhus, Aarhus, Denmark; [2] Department of Biomedicine, University of Aarhus, Aarhus, Denmark	**Molecularly imprinted photonic sensor for detection of cancer biomarkers** Manuela F. Frasco*, Carla F. Pereira, Sara Resende and M. Goreti F. Sales BioMark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Porto, Portugal
16:00-16:15	**Modulation of the rheological properties of agarose hydrogels by addition of cellulose nanowhiskers** Thierry Aubry* IRDL – UMR CNRS 6027, Université de Bretagne Occidentale, Brest, France	**Towards an unprecedented molecularly imprinted photonic biosensor for venous thromboembolism** Carla F. Pereira*, Manuela F. Frasco and M. Goreti F. Sales BioMark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Porto, Portugal
16:15-16:30	**Directional Electromechanical Response in Self-Assembled Cellulose Nanofibers** Yonatan Calahorra[1]*, Anuja Datta[1], James Famelton[1], Doron Kam[2], Oded Shoseyov[2], and Sohini KarNarayan[1] [1] Department of Materials Science & Metallurgy, University of Cambridge, Cambridge, UK. [2] The Robert H. Smith Institute of Plant Science and Genetics, the Hebrew University of Jerusalem, Rehovot, Israel	(WS5-Invited) Self-assembly of nanoparticle superlattices and their post-assembly transformations **Rafal Klajn*, Weizmann Institute of Science, Israel**
16:30-16:45	**Electro-mechanically interfacing with biology using nanostructured piezoelectric poly-L-lactic acid** Michael Smith1*, Dr. Yonatan Calahorra1, Dr. Daniel Bax2 and Dr. Sohini Kar-Narayan1 1Device Materials Group, Department of Materials Science, University of Cambridge, UK; 2Cambridge Centre for Medical Materials, Department of Materials Science, University of Cambridge, UK	
16:45-17:00	**END OF SESSION**	**Hot-electron driven photosynthesis of catalytic nanostructures** Sven H. C. Askes*, Evgenia Kontoleta and Erik C. Garnett AMOLF, Amsterdam, The Netherlands
17:00-17:15		(WS2-Invited) The versatility of polyelemental perovskite compositions **Michael Saliba*, Adolphe Merkle Institute, Fribourg & Swiss Federal Institute of Technology, Switzerland**
17:15-17:30		

PARALLEL SESSIONS – WS3 Session IV on Minos I

WS3 Invited Talk

3D DNA imaging in live cells at ultra-high-throughput

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Imaging fluorescently-labeled DNA in live cells with nanoscale precision shows significant promise as a diagnostic tool; however, the intrinsically stochastic nature of biological systems limits our ability to interpret meaningful signals from the noise. Balancing the constraints of high-resolution microscopy while attaining the necessary number of samples for statistical significance means expensive and slow measurements. Imaging-flow cytometry replaces the normally-static sample plane of a microscope with a microfluidic device, enabling rapid image acquisition of many different objects. Thus far, these measurements have been limited to 1 and 2 dimensions. Here we discuss the implementation of advanced, 3D microscopy into an imaging flow cytometer and the unique calibration protocol we developed, in which we rely on statistical distributions rather than the unattainable static ground-truth. We demonstrate our system on live yeast cells, attaining 3D spatial information with orders of magnitude higher throughput than previous methods.

Diagnostics on the chip: micro-patterned functional arrays for advancement of medicine

Sylwia Sekula-Neuner[1]*, Falko Brinkmann[1], Ravi Kumar[1], Emmanuel Oppong[2], Alice Bonicelli[2], Andrew C. B. Cato[2], Klaus Pantel [3], Michael Hirtz[1], Harald Fuchs[1, 4]
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Background: Next generation nanomedicine would benefit greatly from new developments in bio-functional microarray fabrication. Great progress was made with DNA and protein microarrays fabrication over the last years. However new technologies allowing for fabrication of multiplexed arrays with high resolution that can be easily incorporated in the microfluidic systems are still in the development phase. **Methods**: We are presenting two printing techniques for the flexible fabrication of micropatterns: dip-pen nanolithography (DPN) and polymer pen lithography (PPL). DPN makes use of atomic force microscope (AFM) tips, which are coated with different inks and transfer the material onto the substrate via capillary forces. To enhance throughput and to pattern large areas PPL technique can be used. It is a complementary approach combining features of DPN and microcontact printing (µCP). It makes use of 2-dimensionally aligned elastomeric PDMS pens, shaped as pyramids, which are molded from a silicon master. Appropriate leveling of pens relative to a sample surface allows for generation of homogenous or gradient nano- and micropatterns under well-controlled lateral movements with a piezoelectric system. **Results**: Bottom – up fabrication via DPN or PPL allows for easy and fast generation of features with biological inks in a wide range of relevant pattern sizes, possibility of adjustment, and preserved stability of patterned biomolecules. The retained bioactivity of the patterns is demonstrated by showing: -allergen arrays integrated into microfluidics chip for antibody profiling and mast cell activation studies and cell sorting applications -microarray for capturing rare cells on the example of circulating tumor cells (CTC) and single cell extraction for downstream analysis. **Conclusions**: The profiling of allergic responses is a powerful tool in biomedical research and in judging therapeutic outcome in patients suffering from allergy. Specific and sensitive recognition of the various doses of allergen by dedicated IgE molecules, as well as the quick response of living mast cells to allergen arrays show the potential of micropatterns in diagnostic research. Click-chemistry bound allergens produced by PPL technique can be easily integrated in microfluidic chips and utilized as a platform for mast cell activation studies and cell sorting. Additionally, such setup allows for easy handling of other analytes like serum or drug solutions and incorporation into an automated read out system. Similar automation can be applied for capturing CTC. Cells can be applied by and automated feeder syringe into a microfluidic chip where capturing strategy based on dot microarrays offers intrinsic specificity enhancement by co-localization detection, limiting unspecific binding of other cells to the microarrays. Proof-of-principle studies on blood samples from cancer patients showed performance comparable or even complementary to the current clinical gold standard (CellSearch®). Both examples: the allergen chip and CTC chip show great potential of PPL generated arrays in the advancements of novel personalized diagnostics solutions.

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Matrix vesicles-loaded microreactors co-assembled with bone-like osteoblast cells with ability to enhance biomineralization

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Therapeutic cell mimicry aims to provide a source of cell-like assemblies, which exhibits the core structural or functional properties of their natural counterparts with broad envisioned applications in biomedicine [1]. Enzyme-equipped microreactors, which provide a way to stimulate cells into a certain direction, can increase the successful formation and integration of artificial cell tissues into patients. Bone tissue engineering (BTE), for example, aims at promoting and inciting the natural healing process of bone within critically-sized bone defects, where the natural self-healing process of bone has been lost. Our aim was to design microreactors that co-assemble with biological bone-forming osteoblast like SaOS-2 cells to kick-start biomineralization. This is one of the first attempts to show successful stimulation of cells with artificial microreactors. Specifically, we generated alginate-based microparticles with cell-attachment ability that are able to co-assemble with SaOS-2 cells to form spheroids. The empty microparticles provided increased cell viability and enhanced biomineralization. We equipped the alginate-based microparticles with SaOS-2 derived matrix vesicles (MVs) and illustrated actively stimulated biomineralization by colorimetric calcium quantification by micro-computed tomography (µCT). Our findings show the great promise in the combination of cell mimicry and BTE holds – bone cells cannot only be stimulated to enhance tissue integration but the number of required cells might be decreased and replaced with artificial entities.

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Modulation of the rheological properties of agarose hydrogels by addition of cellulose nanowhiskers

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Agarose-based biomaterials have particularly attractive properties for biomedical applications, and more particularly for tissue engineering applications and regenerative medicine [1]. Besides, the combination of cellulose nanocrystals (CNC) with various biopolymer matrices seems to be a promising route to enhance the mechanical performance of tissue repair materials [2].

The present work aims at studying the influence of addition of tunicate cellulose nanocrystals on the rheological properties of an agarose hydrogel matrix. The CNC aspect ratio and surface charge were experimentally determined, and the linear viscoelastic properties of 0.2wt% agarose matrix nanocomposite hydrogels were characterized for CNC volume fractions up to 0.2%, which is below the CNC viscosity percolation threshold [3].

Results show that elastic properties of the nanocomposite hydrogels are mainly governed by the agarose network, but can be significantly improved by adding CNC, at least up to a volume fraction of 0.13%, for which a one decade increase in storage modulus is obtained [4]. Moreover, the reinforcement effect of the agarose matrix by addition of CNC can be enhanced by increasing the CNC surface charge, at least up to a limit value, which depends on the CNC volume fraction [5]. To sum up, the results of the present work strongly suggest the existence of an optimum volume fraction/ surface charge couple for maximum reinforcement effect.

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Directional Electromechanical Response in Self-Assembled Cellulose Nanofibers

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Cellulose is the major constituent of wood and a structured biodegradable biopolymer. Piezoelectricity in wood has been known since the 1950's, attributed to internal crystalline arrangement of cellulose molecules [1]. Cellulose exhibits shear piezoelectricity with potential applications in energy harvesters, biomedical sensors, electro-active displays and actuators [2]. In this talk I will present the results of piezoelectric characterization of cellulose nanofibers, formed through self-assembly within nanoporous templates. This was achieved using the non-destructive piezoresponse force microscopy (ND-PFM) method, developed specifically for nanoscale piezoelectric materials [3]. Previous studies have shown that template formed polymers have superior electro-active properties, for example self-poling in PVD-TrFE nanowires [4]. We show the formation and characterization of cellulose nanofibers through template assisted for the first time. Electron microscopy reveals a three-step hierarchical self-assembly process: where basic crystalline cellulose units – cellulose nanocrystals (CNCs), join to form cellulose nanorods (about 15 nm in diameter and 100 nm in length), and these join to form larger cellulose nanofibers, confined by the template nanopore walls. The self-assembled cellulose nanofibers were characterized using ND-PFM, and exhibited an anisotropic shear piezoelectric response. We attribute these results to the chiral internal ordering of cellulose nanorods within the nanofibers; COMSOL simulations support this interpretation. Overall this study demonstrates the complicated interactions governing piezoelectricity in nanomaterials, and shed light on the possible ways to take advantage of inherent piezoelectric anisotropy.

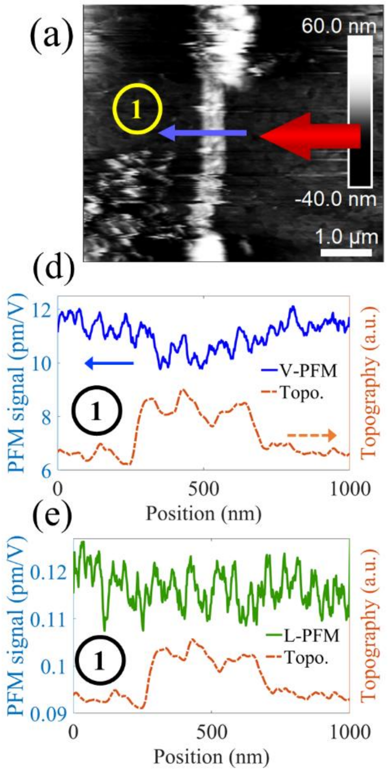

Figure 1. (a) AFM topography of a cellulose nanofiber; (b) the vertical ND-PFM signal from the nanofiber; (c) the lateral NDPFM signal from the nanofiber.

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Electro-mechanically interfacing with biology using nanostructured piezoelectric poly-L-lactic acid

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In vivo cells are exposed to a wealth of stimuli that influence their function and behaviour. In fields such as tissue engineering and regenerative medicine, where the focus is on artificially growing biological tissue, it is important to consider this array of stimuli to ensure correct cell signaling and tissue development. For decades, however, research has targeted only the chemical aspects of these stimuli.

Mechanical and electrical signals are also fundamental in the development of our biology. Piezoelectric materials offer a promising solution to the electrical stimulation issue, and have drawn much attention recently as 'active' cell culture scaffolds. However, little thought has been given to the mechanical properties of these materials and how they align with the requirements of cellular systems. Furthermore, the composition of many piezoelectric materials raises questions about biocompatibility.

In this work, we demonstrate a novel template wetting process to nanostructure the well-known bio-polymer poly-L-lactic acid so that it may provide both electrical stimulation (through the piezoelectric effect) and appropriate mechanical signaling (through high aspect ratio nanostructures) while retaining its biocompatible properties. Furthermore, this method also enables printed electrodes be embedded within the structure to allow targeted, local physical and electrical stimulation [1].

We present extensive material characterisation and simulation to highlight the ability of this method to tune the electro-mechanical properties of the polymer. Scanning probe microscopy reveals the effects of this at the nanoscale, demonstrating shear piezoelectricity in nanostructures of poly-l-lactic acid for the first time [2].

The implications for tissue engineering are shown with human dermal fibroblast (HDF) cell attachment, proliferation and phenotype. We conclude that through careful control of the electro-mechanical properties, nanostructured poly-L-lactic acid can be used to create tissue culture platforms that provide significant mechanical, electrical and chemical stimuli.

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PARALLEL SESSIONS – WS5 & WS2 Session V on Minos II

WS5 Invited Talk

New materials and devices for interfacing with the brain

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One of the most important scientific and technological frontiers of our time is the interfacing of electronics with the human brain. This endeavour promises to help understand how the brain works and deliver new tools for diagnosis and treatment of pathologies including epilepsy and Parkinson's disease. Current solutions, however, are limited by the materials that are brought in contact with the tissue and transduce signals across the biotic/abiotic interface. Recent advances in organic electronics have made available materials with a unique combination of attractive properties, including mechanical flexibility, mixed ionic/electronic conduction, enhanced biocompatibility, and capability for drug delivery. I will present examples of novel devices for recording and stimulation of neurons and show that organic electronic materials offer tremendous opportunities to study the brain and treat its pathologies.

Biosensors for Non-Invasive Medical Diagnostics

A. Romeo[1*], P.E.D. Soto Rodriguez[1], A. Moya[2,3], G. Gabriel[2,3], R. Villa[2,3], R. Artuch[4,5], S. Sánchez[1,6]
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In the last few decades, innovative healthcare solutions contributed to improve quality of life by decreasing the cost of health assessment and making it easier and more accessible. In particular, medical diagnostics has taken advantage of the development of biochemical sensors, [1,2] that analyze body fluids (e.g., blood, sweat, saliva, tear fluid, urine, etc.) and target bio-analytes like metal ions, proteins, amino acids, glucose, lactate, etc. Here we present the development of biosensors for non-invasive, painless and on-demand self-assessment of health conditions. Electrochemical and optical sensing are chosen because they are well suited for simple, rapid, and cost-effective personalized medicine devices. [3] The sensing platforms like those presented here are highly versatile, as they can adapt to specific needs in terms of target biomarkers and health issues to monitor. This opens to on-demand biosensing, where various recognition systems, including antibodies, enzymes, and inorganic nanomaterials, can be used to modify the sensors and achieve high selectivity. We describe portable diagnostic tools for the analysis of glucose in tear fluid [4] and amino acids in blood and urine, respectively, aimed at monitoring various disorders like diabetes and phenylketonuria (an inborn metabolic disorder). Personalized and non-invasive technologies such those described here will allow to easily and frequently monitor the health status of an individual as often as needed. This will enhance the efficacy of therapeutic treatments by making early-stage detection and frequent monitoring simple and convenient.

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Molecularly imprinted photonic sensor for detection of cancer Biomarkers

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BioMark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Porto, Portugal
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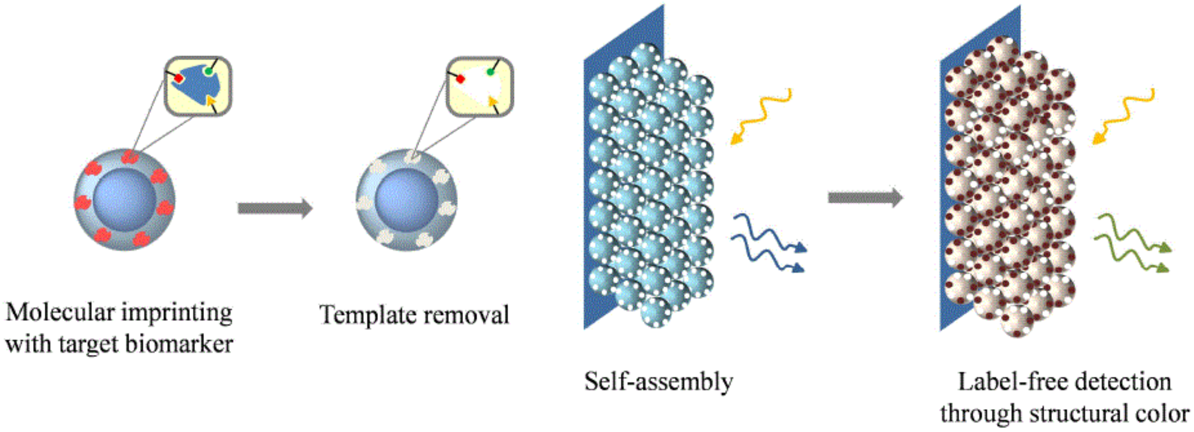
The rapidly evolving biosensor technology continues answering the strong demand for point-of-care devices. New design approaches relying on optical/optoelectronic functionalities, on biocompatible, and bioinspired soft materials are very promising to achieve improved sensitivity and accuracy in real-time analysis. Herein, a novel sensing strategy based on a biomimetic photonic layout applied to circulating cancer related biomarkers is presented. Selective recognition is achieved by producing plastic recognition elements using the molecular imprinting technique. These synthetic complementary recognition nanocavities show advantages over their biological counterparts, like improved stability, cost-effective production and reusability. Aiming for label-free detection of protein cancer biomarkers (e.g., carcinoembryonic antigen), a highly ordered colloidal crystal structure is then obtained by self-assembly of the responsive imprinted nanoparticles (Scheme 1). The change in photonic properties upon recognition of the target biomarker results in a sensitive optical response. The versatility of such biomimetic photonic technology is foreseen to find broad applications in the assessment of disease biomarkers.



***Scheme 1** – Schematic illustration of the biomimetic photonic sensor fabrication.*

Acknowledgements: The authors gratefully acknowledge the financial support from STRIP2SENSE (NORTE-01-0145-FEDER-024358) and IBEROS (INTERREG POCTEP/0245_IBEROS_1_E) projects.

Towards an unprecedented molecularly imprinted photonic biosensor for venous thromboembolism

Carla F. Pereira[1*], Manuela F. Frasco[2] and M. Goreti F. Sales[3]

BioMark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Porto, Portugal

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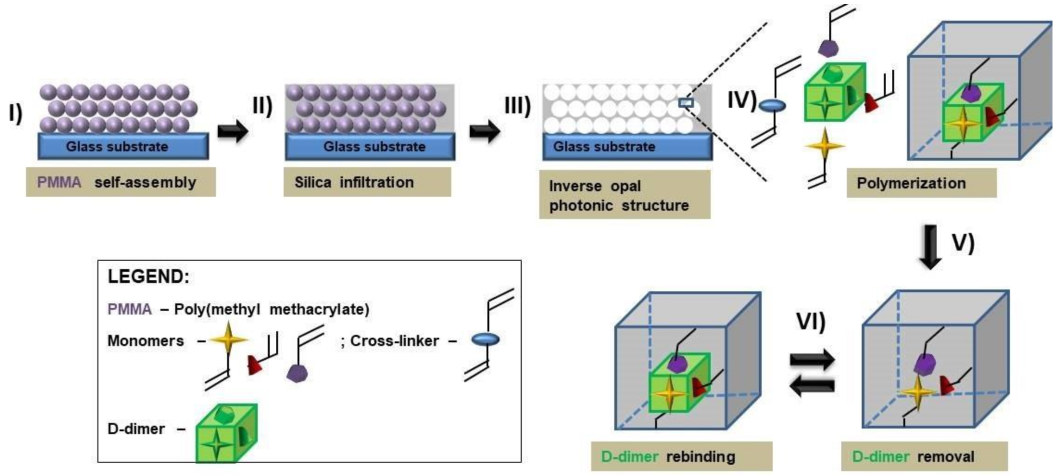
Molecularly imprinted photonic biosensors (MIPB) constitute a special branch of molecular imprinting that has received a huge attention in recent years [1,2]. In the most elementary sense, MIPB result from a synergy between photonic crystals and molecular imprinting technique. It involves 3D highly ordered structures exhibiting nanocavities complementary to the analyte(s) in study, with the recognition giving rise to a readable optical signal.

Venous thromboembolism (VTE) has been established as a serious concern in oncology [3], which motivated the design of a MIPB to detect D-dimer, a biomarker of VTE, as a new and efficient detection method. Herein, an unprecedented MIPB with an inverse opal structure, exhibiting structural colors owing to D-dimer detection, is presented (**Scheme 1**).



Scheme 1 *– Overall preparation and recognition process of the proposed MIPB.*

Acknowledgements: The authors gratefully acknowledge the financial support from STRIP2SENSE (NORTE-01-0145-FEDER-024358) and IBEROS (INTERREG POCTEP/0245_IBEROS_1_E) projects.

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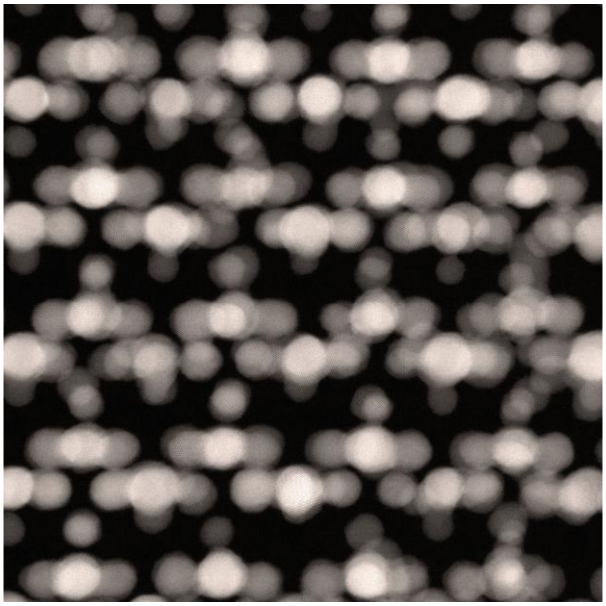
WS5 Invited Talk

Self-assembly of nanoparticle superlattices and their post-assembly transformations

Rafal Klajn
Weizmann Institute of Science

Self-assembly of nanoparticles has been used to fabricate structurally diverse colloidal crystals, including binary, ternary, and quasicrystalline superlattices, many of which were found to exhibit unanticipated optical, electronic, and catalytic properties. In this talk, I will describe how these nanoparticle superlattices can be further (post-assembly) subjected to chemical reactions and transformed into novel classes of materials. I will focus on non–close-packed nanoparticle arrays, which we created through the selective removal of one of two components comprising binary nanoparticle superlattices. I will also discuss the importance of the liquid on the structure of binary superlattices assembled at the liquid-air interface, and how modifying the liquid led to the fabrication of superlattices featuring previously unknown types of packing of the constituent nanoparticles.



Hot-electron driven photosynthesis of catalytic nanostructures

Sven H. C. Askes[1*], Evgenia Kontoleta[1] and Erik C. Garnett[1]

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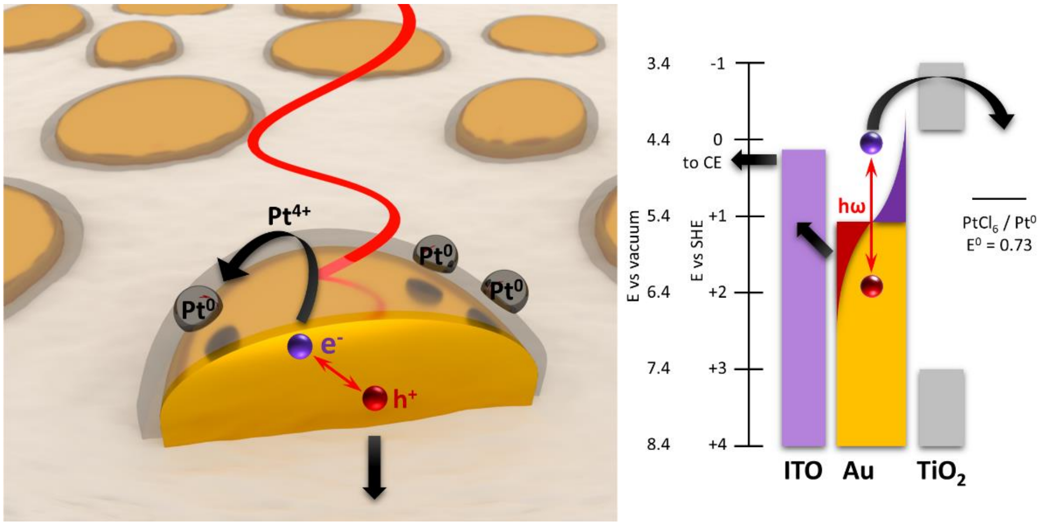
It is well known that plasmonic gold nanostructures feature extraordinary capability of absorbing visible light and concentrating the excitation energy in subwavelength volumes. Recently, they have also been proposed as promising candidates for the production of chemical fuels from sunlight. Upon excitation of these nanostructures, the energy is transferred to single electrons that for a brief period of time become highly energetic. Recent scientific advances demonstrate that these highly energetic, “hot” electrons can be extracted and used to drive chemical reactions, such as the conversion of protons to molecular hydrogen. However, to greatly improve the production rate, expensive and rare cocatalysts such as platinum are required.

In order to make effective use of as little catalyst material as possible, it is therefore important to localize the cocatalyst at the places where it is best coupled to the photogenerated hot electrons. To this end, we use the hot electrons themselves to deposit the cocatalyst and to construct photocatalytically active nanostructures. Briefly, a photocathode consisting of ITO-gold nanoislands-TiO_2 was illuminated with red light in presence of $PtCl_6$, which resulted in the local deposition of platinum nanoparticles on the gold nanoislands. We furthermore compare the photocatalytic performance of these photocathodes with those that were fabricated by random deposition techniques such as electrodeposition and e-beam evaporation. Overall, these results demonstrate that plasmonic hot electron chemistry can be used for fabricating photocatalytic nanostructures with sub-wavelength control over localization.



WS2 Invited Talk

The versatility of polyelemental perovskite compositions

Dr. Michael Saliba
Fribourg, Switzerland

Perovskites have emerged as low-cost, high efficiency photovoltaics with certified efficiencies of 22.1% approaching already established technologies. The perovskites used for solar cells have an ABX_3 structure where the cation A is methylammonium (MA), formamidinium (FA), or cesium (Cs); the metal B is Pb or Sn; and the halide X is Cl, Br or I. Unfortunately, single-cation perovskites often suffer from phase, temperature or humidity instabilities. This is particularly noteworthy for $CsPbX_3$ and $FAPbX_3$ which are stable at room temperature as a photoinactive “yellow phase” instead of the more desired photoactive “black phase” that is only stable at higher temperatures. Moreover, apart from phase stability, operating perovskite solar cells (PSCs) at elevated temperatures (of 85 °C) is required for passing industrial norms.

Recently, double-cation perovskites (using MA, FA or Cs, FA) were shown to have a stable “black phase” at room temperature.(1,2) These perovskites also exhibit unexpected, novel properties. For example, Cs/FA mixtures supress halide segregation enabling band gaps for perovskite/silicon or perovskite/perovskite tandems.(3) In general, adding more components increases entropy that can stabilize unstable materials (such as the “yellow phase” of $FAPbI_3$ that can be avoided using the also unstable $CsPbI_3$). Here, we take the mixing approach further to investigate triple cation (with Cs, MA, FA) perovskites resulting in significantly improved reproducibality and stability.(4) We then use multiple cation engineering as a strategy to integrate the seemingly too small rubidium (Rb) (that never shows a black phase as a single-cation perovskite) to study novel multication perovskites.(5) One composition containing Rb, Cs, MA and FA resulted in a stabilized efficiency of 21.6% and an electroluminescence of 3.8%. The V_{oc} of 1.24 V at a band gap of 1.63 eV leads to a very small loss-in-potential of 0.39 V, one of the lowest measured on any PV material indicating the almost recombination-free nature of the novel compound. Polymer-coated cells maintained 95% of their initial performance at 85°C for 500 hours under full illumination and maximum power point tracking. This is a crucial step towards industrialisation of perovskite solar cells.

Lastly, to explore the theme of multicomponent perovskites further, molecular cations were revaluated using a globularity factor. With this, we calculated that ethylammonium (EA) has been misclassified as too large. Using the multication strategy, we studied an EA-containing compound that yielded an open-circuit voltage of 1.59 V, one of the highest to date. Moreover, using EA, we demonstrate a continuous fine-tuning for perovskites in the "green gap" which is highly relevant for lasers and display technology.The last part elaborates on a roadmap on how to extend the multicatio to multicomponent engineering providing a series of new compounds that are highly relevant candidates for the coming years.

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END OF 2nd DAY OF NANOBIO2018

WEDNESDAY, 26TH SEPTEMBER 2018 – 3RD DAY OF NANOBIO2018

	Wednesday 26th September	
9:00-all day	**REGISTRATION** (at the Registration Desk in Atlantis Aquila Hotel)	
TIME	*WS3 Session I – Chairs: C. Bernard (Sub: W. Parak)* *Room*: Minos I	*WS4 & WS5 Session II – Chairs: F. Bonaccorso* *Room*: Minos II
09:30-10:00	(WS3-Invited) Soft Electronic Devices in Neuro-technology **Yael Hanein*** **Tel Aviv University, Israel**	(WS4-Invited) Functional Supercapacitors: From Materials Development and Processing to Smart Integrated Systems **Ali Shaygan Nia* and Xinliang Feng** **Department of Chemistry and Food Chemistry & Center for Advancing Electronics Dresden (cfaed), Technische Universität Dresden, 01062 Dresden, Germany**

10:00-10:30	(WS3-Invited) Multidynamic micro-collagen-based neuroimplants for spinal cord injury **Achille Gravanis*** **Dept. Of Pharmacology, Medical School University of Crete, IMBB-FORTH**	(WS4-Invited) Plasmon-enhanced graphene photodetectors and modulators **Eleftherios Lidorikis*, University of Ioannina, Greece**
10:30-10:45	(WS3-Invited) Active dendrites and their role in neuronal and circuit computations **Panayiota Poirazi*** **Institute of Molecular Biology and Biotechnology (IMBB), Foundation for Research and Technology-Hellas (FORTH), Heraklion, Crete, GREECE**	**All-optical quality assessment of 2D TMDs, using polarization-resolved SHG** Sotiris Psilodimitrakopoulos[1]*, Leonidas Mouchliadis[1], Ioannis Paradisanos[1,2], Andreas Lemonis[1], George Kioseoglou[1,3] and Emmanuel Stratakis[1,3] [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Heraklion Crete, Greece [2]Department of Physics, University of Crete, Heraklion, Greece [3]Department of Materials Science and Technology, University of Crete, Heraklion Crete, Greece
10:45-11:00		**Automated Electrochemical Sensing Systems for Real Time Monitoring and Detection of Chemical Species** V.I. Ogurtsov*, M. Todorovic Tyndall National Institute, University College Cork, Lee Maltings Complex, Dyke Parade, Cork, Ireland
11:00-11:15	**Carbon Dots as a Trackable Drug Delivery System** Qin Li * Queensland Micro- and Nanotechnology Centre, & School of Engineering & Built Environment, Griffith University, Nathan, QLD 4111, Australia	**END OF SESSION**

PARALLEL SESSIONS – WS3 Session I on Minos I

Invited Talk

Soft Electronic Devices in Neuro-technology

Yael Hanein

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Stimulating and recording the electrical activity of neurons and muscles is a major scientific and technological challenge. Although this field dates back centuries, it still remains at the forefront of contemporary investigations, in particular owing to the exploding interest in brain machine interfaces and electronics skin technology. Our investigations in recent years focus on developing and characterizing highly efficient nanomaterial based platforms for superior electronic interfacing with the human body. In particular, we focus on artificial vision and skin electronics for recording emotions. Artificial vision in particular is a very active field with many researchers and companies are trying to restore vision to blind patients through specially designed electronic devices. We recently implemented and validated ex-vivo, two novel systems: The first consists of photosensitive pixels made of a three-dimensional matrix of carbon nanotubes (CNTs) decorated very densely with quantum dots (QDs) or nano rods (NRs) (referred to also as quantum rods (QRs)). Light is absorbed and converted into a transient electrical dipole by the QRs/CNTs system. The use of a three-dimensional matrix as well as an optimized selection of QRs, their surface coating, and conjugation procedure contributes to the superior properties of our films. The second system consists of organic pigments. These materials offer superior photo response and most importantly can be readily implemented on flexible materials. Compared with other photo-sensitive artificial retinal platforms the two systems we have developed so far are marked by several clear advantages. Foremost is low stimulation threshold. Second is their biocompatibility, chemical stability and mechanical flexibility rendering the devices improved stability in the tissue. Implementing some insights gained in our artificial retina project into the realm of skin electronics, we developed a new skin electromyography system to open entirely new and exciting opportunities in recording facial emotions, in neuro-modulation application and in bio-feedback based on EMG.

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WS3….
Invited Talk

Multidynamic micro-collagen-based neuroimplants for spinal cord injury.

Achille Gravanis*

Dept. Of Pharmacology, Medical School University of Crete, IMBB-FORTH

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Combinatorial treatments based on Neural Stem Cells (NSCs) have recently demonstrated significant effects in Spinal Cord Injury (SCI) in rodent and primate models. While these studies focused mostly on NSC effects on axonal elongation and neural relay formation, they provide evidence that the insoluble microenvironment at the injury site, defined mostly by the biomaterial host of NSCs, is a key mediator of graft effects. We evaluated SCI grafts where mouse embryonic NSCs are seeded inside porous collagen based scaffolds (PCS). We demonstrate that PCS can regulate in vitro NSC proliferation and differentiation, induce axon elongation and enable the formation of functional 3D neuronal circuits as assessed by electrophysiology and synapse marker assays. Furthermore, we show that PCS can safely deliver NSCs at SCI sites, enable axonal elongation through the graft boundary and NSC differentiation towards both glial and neuronal fates in vivo in a mouse dorsal column crush SCI model. Finally, NSC-seeded PCS grafts resulted in a partial, statistically significant locomotion recovery in the mouse dorsal column crush SCI model. Our findings suggest that PCS can provide tunable microenvironments that upon optimization can accelerate the development of effective clinical treatments for SCI. Our future steps focus on chemically attaching on our PCS/NSC neuroimplants our proprietary neuroprotective and neurogenic synthetic microneutrophins to increase the efficacy of our neurograft both in vitro during its construction and in vivo after its transplantation.

Invited Talk

Active dendrites and their role in neuronal and circuit computations

Panayiota Poirazi

Institute of Molecular Biology and Biotechnology (IMBB), Foundation for Research and Technology-Hellas (FORTH), Heraklion, Crete, GREECE
** poirazi@imbb.forth.gr*

The goal of this presentation is to provide a set of predictions generated by biophysical and/or abstract mathematical models regarding the role of dendrites in information processing, learning and memory across different brain regions. Towards this goal I will present modelling studies from our lab –along with supporting experimental evidence- that investigate how dendrites may be used to facilitate the learning and coding of both spatial and temporal information at the single cell, the microcircuit and the neuronal network level. I will present the main findings of a number of projects in lab dealing with how dendrites of PV interneurons integrate incoming signals [1], the mechanisms underlying key hippocampal functions such as pattern separation, completion and place cell dynamics as well as the role of dendrites in supporting different stable states in the PFC. This presentation aims to highlight how dendrites are likely to serve as key players in different memory functions.

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Carbon Dots as a Trackable Drug Delivery System

Qin Li*

Queensland Micro- and Nanotechnology Centre, & School of Engineering & Built Environment, Griffith University, Nathan, QLD 4111, Australia

E-mail: qin.li@griffith.edu.au

Carbon dots (CDs) refer to carbonaceous nanoparticles typically of a size smaller than 10 nm, which are strongly fluorescent, biocompatible, and of low to none cytoxicity. Their potential application in nanomedicine has received intense interest in recent years. Unique to carbon dots is its rich surface functionalities due to carbon chemistry and the surface functionality's influence on photoluminescence. In this talk we will show how to tailor-design the carbon dots to make them a trackable drug delivery system for biomedical applications, such as cancer theranostics and localized therapy.

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PARALLEL SESSIONS – WS4 & WS5 Session II on Minos II

WS4 Invited Talk

Functional Supercapacitors: From Materials Development and Processing to Smart Integrated Systems

Ali Shaygan Nia*, Xinliang Feng

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As growing requirements for intelligent electronic devices, extensive attentions have been attracted to functional (particularly, smart and stimuli-responsive) energy storage devices, which are rapidly responsive to the variations of devices themselves or the external environment, *e.g.*, configuration, voltage, deformation, light, and temperature, etc. Meanwhile, the portable, implantable, and wearable electronics are advancing toward miniaturization as well as ultralight, and safe, long-term, and high-speed operation, thus stimulating the urgent pursuit for miniaturized energy storage devices such as micro-supercapacitors and micro-batteries. In this regard, rational material and device designs as well as optimal energy storage performance (high energy density and power density) are provital for the development of functional energy storage devices. Specially, designing functional electrolyte and functional electrode are two promising strategies for realizing smart functions in energy storage devices.

In this lecture, we will present our recent efforts in developing energy storage devices with smart functions including electrochromism, thermo-response, and photo-response. Moreover, the novel fabrication methods based on 2D materials, e.g. inkjet printing, layer-by-layer assembly, in-situ growth, spray coating, etc. will be demonstrated. The fabrication of functional energy storage devices opens up windows for realizing the intelligent electronic devices. The future prospects of such new-generation smart energy storage devices and microfabrication technologies will be also provided.

WS4 Invited Talk

Plasmon-enhanced graphene photodetectors and modulators

Elefterios Lidorikis

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Graphene's optical response is characterized by constant absorption in the visible and electrically-tunable absorption and plasmonic excitations in the IR spectrum. The light-graphene interactions become much stronger when graphene is integrated into a resonant photonic cavity. In this case, small changes in the graphene doping can alter the coupling condition and shift the optical response, enabling sensitive photodetection, light modulation and sensing applications. Here we'll review our recent progress in the use of plasmonic and photonic effects to increase the graphene-light interaction and in the design of novel optoelectronic devices based on graphene.

All-optical quality assessment of 2D TMDs, using polarization-resolved SHG

Sotiris Psilodimitrakopoulos[1*], Leonidas Mouchliadis[1], Ioannis Paradisanos[1,2], Andreas Lemonis[1], George Kioseoglou[1,3] and Emmanuel Stratakis[1,3]

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While large-area crystal growth techniques, such as chemical vapor deposition (CVD), are successfully used for the production of two-dimensional (2D) transition-metal dichalcogenides (TMDs), the presence of grain boundaries, vacancies and arbitrarily oriented grains arising in such growths, substantially affect their crystal quality. Here, we demonstrate a fast, high-resolution non-linear optical method for the quality control of such atomically thin crystals. Non-invasive polarization-resolved second harmonic generation (PSHG) imaging revealed with unprecedented resolution detailed information on the crystal orientation, thickness inhomogeneities and grain boundaries[1]. In particular, we carried out PSHG in CVD-grown WS_2 monolayers and we obtained the orientation of the main crystallographic axis (armchair orientation) for each individual 120x120 nm^2 pixel of the 2D crystal area. This enabled us to distinguish between different crystallographic domains, locate boundaries, and evaluate the crystal quality (Fig. 1). Hence, we were able to calculate the mean orientation of the armchair angle distributions in specific regions of interest (ROI) and define the corresponding standard deviation as a figure-of-merit for the 2D crystal quality.

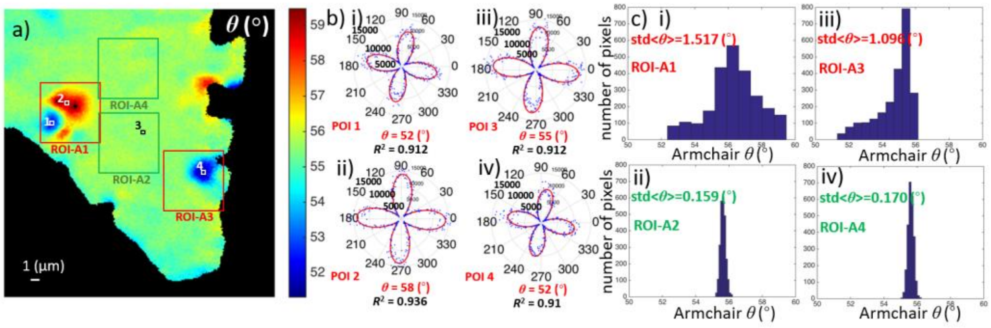

Figure 1: a) Armchair mapping reveals grains of different crystal orientations. b) Experimental PSHG modulation for pixels of interest 1-4. c) Image histograms showing the distribution of armchair orientations inside ROIs-A1-4. Small std<ϑ> values are indicative of good crystal quality.

[1] S. Psilodimitrakopoulos, L. Mouchliadis, I. Paradisanos, A. Lemonis, G. Kioseoglou and E. Stratakis, "Ultrahigh-resolution nonlinear optical imaging of the armchair orientation in 2D transition metal dichalcogenides," *Light: Science & Applications* **7**, 18005 (2018).

Acknowledgements: NFFA-Europe, EU's H2020; ARCHERS, Stavros Niarchos Foundation.

Automated Electrochemical Sensing Systems for Real Time Monitoring and Detection of Chemical Species

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Nowadays, necessity of real time monitoring and detection of different chemical/bio targets in different areas has significantly increased. The most of traditional analytical methods are slow, complicated and require expensive, bulky and power hungry equipment expected to be operated in specialized labs by skilled personnel. In contrast, electrochemical sensing systems can be implemented with a simple sample preparation protocol and portable, non-expensive instrumentation where modern nanotechnologies applied to sensor fabrication together with up-to-date electronic components, circuitry and tailored signal processing can significantly improve the system performance. Electrochemical equipment available on market cannot meet end-user requirements on portability, real time operation in field conditions, ease of use and intelligence. This necessitates custom development of the corresponding instrumentation with in-built automated instrumentation control and signal processing. Two examples of such development are reported in the presented study.

Smart autonomous chemical sensing system for monitoring of seawater pollution and its quality [1] operates on-board of a robotic fish. It provides real time voltammetric measurements of seawater contaminants (heavy metal (Cu^{2+}) and phenol derivatives) and seawater quality parameters: dissolved oxygen, oxidation-reduction potential and seawater conductivity. Multiparametric sensing device is implemented on a single silicon chip where platinum working electrodes are realized as microdics arrays for enhancing sensor sensitivity and detection limit.

Comprehensive multichannel scalable instrumentation for toxicity assessment [2] is a main part of the smart non-animal high throughput platform for screening the impact of nanomaterials on human and environment. Here each channel includes a wafer-based sensor located inside of a flow chamber of the microfluidic system. The sensors are based on biological objects (DNA, cells of different organs i.e. lung, intestine, liver, kidney). Instrumentation provides full automated multichannel fluidic flow control synchronized with electrochemical examination of the cell-based sensors.

[1] https://www.roboshoal.com/ 25.05.2018.
[2] https://hisents.eu/ 25.05.2018.

Acknowledgement: Financial support of this work by European Commission (projects FP7-ICT-231646 “SHOAL” and H2020-NMP-29-2015 “HISENTS”) is gratefully acknowledged.

	WS1 Session III – Chairs: N.Feliu ((Sub: P.Kavatzikidou) *Room*: Minos I	*Special Session IV– Chairs: M. Stylianakis & A. Kostopoulou* *Room*: Minos II
12:00-12:15	(WS1-Invited) Nanomaterials with Synergistic actions **Antonios G. Kanaras* et. al. , University of Southampton, UK**	Special Session-Invited Nano-bio Journals and Connecting with the Community
		Leanne M Mullen*, **Elsevier Ltd, The Boulevard, Langford Lane, Kidlington** **Oxford OX5 1GB, UK**
12:15-12:30		Special Session-Invited Impact beyond boundaries: introducing JPhys Materials **Daniel Jopling[1]*, Stephan Roche[2] and Piera Demma Cara[1]** **[1]IOP Publishing, Bristol, UK** **[2] Catalan Institute of Nanoscience and Nanotechnology - Theoretical and Computational Nanosciences, Barcelona, Spain**
12:30-12:45	**Passion fruit-like nano-architecturers: towards the clinical translation of metal nanomaterials** D. Cassano*[1,2], S. Pocoví-Martínez[3], A. K. Mapanao[1,2], S. Luin[1,4] and V. Voliani[2] [1]NEST – Scuola Normale Superiore, P.zza S. Silvestro 12- 56126, Pisa (PI), Italy; [2]CNI@NEST – Istituto Italiano di Tecnologia, P.zza S. Silvestro 12 – 56126, Pisa (PI), Italy; [3]Istituto di fisiologia clinica – CNR, Via G. Moruzzi 1 - 56124, Pisa (PI), Italy; [4]NEST - Istituto Nanoscienze – CNR, P.zza San Silvestro 12 - 56126, Pisa (PI), Italy	Special Session-Invited **MDPI Publishing House**
12:45-13:00	**Endogenously activated ultrasmall-in-nano theranostics for the treatment of head and neck squamous cell carcinoma** Melissa Santi[1]*, Ana Katrina Mapanao[1,2], Domenico Cassano[1,2] and Valerio Voliani[1] [1]Center for Nanotechnology Innovation@NEST, Istituto Italiano di Tecnologia, Pisa, Italy; [2]NEST-Scuola Normale Superiore,Pisa, Italy	**ACS Publishing House**
13:00-13:15	**Carbogenic nanoparticles for biomedical and forensic applications** Antonios Kelarakis*, University of Central Lancashire, Preston, PR12HE, U.K.	**NFFA Project**
13:15-13:45	(WS1-Invited) 3D Printing and Cellular Strategies to promote Vascularization in Tissue Engineering **Athina Markaki*, Department of Engineering, University of Cambridge, UK**	

PARALLEL SESSIONS - WS1 Session III in Minos I

Invited Talk

Nanomaterials with Synergistic actions

Antonios G. Kanaras[1,2]* and Maria-Eleni Kyriazi[1]
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[2]Institute for Life Sciences, University of Southampton, UK
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Nanoparticulate systems are of great interest for applications in biomedicine due to the ability to design their properties. The ligand coating of the nanoparticles is critical for nanoparticle stability and function while the morphology and chemical composition of the nanoparticle core is important in defining optoelectronic and magnetic and other properties of the particles. In recent years, advances in nanoparticle chemical synthesis and surface functionalization rendered available a library of functional nanomaterials. The next step of evolution is to synthesize nanomaterials that perform multitasking roles triggered by external stimuli. Such designs will be of high importance in biomedicine, especially for targeted and efficient drug delivery.

In this presentation I will discuss recent progress in our group concerning the design of nanoparticle assemblies and their incorporation in biological systems to facilitate sensing, drug delivery and accurate manipulation. My talk will focus on a new class of nanoparticle dimers that can accommodate multiplexed synergistic actions of sensing and drug delivery in cells.[1-3] These multitasking particle assemblies are able to selectively release anticancer drugs in response to specific messenger RNA signatures and selectively kill model cancerous cells as opposed to healthy cells.

[1] M.E. Kyriazi, D. Giust, A. H. El-Sagheer, P. M. Lackie, O. L. Muskens, T. Brown, A. G. Kanaras, *ACS Nano*, 12 (4), 3333 (2018).
[2] M. E. Kyriazi, A. Heuer-Jungemman, A. G. Kanaras, *Ther. Deliv.* 8, 171 (2017).
[3] A. Heuer-Jungemman, A. H. El-Sagheer, P. M. Lackie, T. Brown, A. G. Kanaras, *Nanoscale* 8, 16857 (2016).
[4] A. Heuer-Jungemann, P. Harimech, T. Brown, A. G. Kanaras, *Nanoscale* 5, 9503 (2013).
[5] A. Heuer-Jungemann, R. Kirkwood, A. H. El-Sagheer, T. Brown, A. G. Kanaras, *Nanoscale* 5, 7209 (2013).

Passion fruit-like nano-architecturers: towards the clinical translation of metal nanomaterials

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Noble metal nanoparticles (NPs) hold the promise of shifting the current medical paradigms for the detection and therapy of neoplasms thanks to their well known physiochemical properties. Nonetheless, no noble metal NPs for cancer theranostics are currently available in the market. Clinical translation is mainly hampered by the issue of persistence in organism, which increases the likelihood of toxicity and the interference with common medical diagnoses. Size reduction of NPs to ultrasmall regime (1-6 nm) promotes excretion by the renal pathway, yet most of their appealing properties are lost or severely altered.[1] We propose a smart approach to circumvent this issue by synthesizing biodegradable silica nano-architectures (NAs) of 100 nm containing polymeric arrays of strictly packed 3 nm noble metal NPs, in a passion fruit-like fashion.[2,3] NAs mimic the optical behaviour of 30 nm NPs while affording biodegradation into kidney clearable or health beneficial building blocks in less than 48h. Their therapeutic and diagnostic capability have been demonstrated *in vitro*, towards pancreatic cancer cells and *ex vivo,* through combined US/photoacoustic imaging, respectively.[4,5] Recently, *in vivo* excretion assessment have been performed and their promising results will be presented.

[1] D. Cassano, S. Pocoví-Martínez, and V. Voliani, *Bioconj. Chem. 29* (1), 4-16 (2018)

[2] D. Cassano, D. Rota Martir, G. Signore, V. Piazza, V. Voliani, *Chem. Commun.*, *51*, 9939–9941 (2015).

[3] D. Cassano, J. David, S. Luin and V. Voliani, *Scientific Reports* **7**, Art. num: 43795 (2017)

[4] D. Cassano, M. Santi, V. Cappello, S. Luin, G. Signore and V. Voliani, *Part. Part. Syst. Charact*., 33: 818–824 (2016).

[5] C. Avigo, D. Cassano, C. Kusmic, V. Voliani, L. Menichetti, *J. Phys. Chem. C*, 121 (12), pp 6955–6961 (2016)

Endogenously activated ultrasmall-in-nano theranostics for the treatment of head and neck squamous cell carcinoma

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Engineered noble metal nanoparticles (NPs) have gained increasing interest due to the intrinsic multifunctional features for treatment and diagnosis of neoplasms. To date, none of them passed to the clinical trials and reached the market because of the persistence issue. Indeed, NPs showing the most interesting theranostic features have size exceeding 20 nm, and suffer from long standing persistence in excretory system organs. In order to bring again NPs to the forefront of cancer theranostics, we have recently employed the ultrasmall-in-nano approach in order to develop biodegradable nanoplatforms comprising ultrasmall NPs (size <8nm): the Passion fruit-like nano-architectures (NAs).[1] NAs are composed by a 100 nm silica capsule that surrounds gold seeds (3nm) plunged in a polymeric matrix and combine the properties of noble metals with their excretion by renal pathway. NAs have demonstrated progressive degradation in cellular environment to renal-clearable building-blocks and high cytotoxicity to human pancreatic adenocarcinoma cells if coupled to a cisplatin prodrug.[2] Here we demonstrate the versatility of NAs comprising cisplatin prodrug by their employment to other aggressive neoplasms such as the head and neck squamous cell carcinomas (HNSCCs). In particular, we shall discuss the efficacy of NAs on two HNSCC cell lines (SCC-25 and SCC-154). Moreover, due to NAs straightforward modifiable and functionalizable surface, they were decorated with a targeting agent. We employed a peptide (Tf2) able to recognize Transferrin (Tf) directly in the medium, improving the nano-architectures internalization through the Transferrin receptor (TfR) that is overexpressed in solid tumors and, thus, enhancing their efficacy.[3] Our findings expand the potential applications of NAs and represent a significant step forward toward the translation of metal nanotheranostics to clinics.

Acknowledgements: This work is supported by the MFAG number 19852 from Associazione Italiana per la Ricerca sul Cancro (AIRC)

[1] D. Cassano, et al. *Bioconjugate Chemistry* 29, 4-16 (2018)

[2] D.Cassano, M.Santi et al. *Particles and Particles System Characterization* 33, 818-824 (2016)

[3] M.Santi, G. Maccari et al. *Bioconjugate Chemistry* 28, 471-480 (2016)]

Carbogenic nanoparticles for biomedical and forensic applications

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The emergence of C-dots as a new class of fluorescent nanoparticles offers exciting opportunities for the development of advanced materials with a wide range of potential applications. C-dots exhibit enhanced photostability, resistance to photobleaching and high quantum yields coupled with their nontoxic character and remarkable structural and colloidal stability even in the presence of harsh environments [1]. By comparison, their synthesis is cost and time efficient, it relies on abundant and recyclable resources and eliminates the use of toxic solvents. In this talk we will focus on the biomedical applications of C-dots with respect to their antimicrobial, biosensing, bioimaging and targeted drug delivery capabilities. Emphasis will also be given to interesting forensic applications regarding intelligent fingerprinting and the detection of counterfeit objects, biological fluids, explosives and illicit drugs [2].

[1] A. Kelarakis, Current Opinion in Colloid and Interface Science 20, 354-361 (2015)

[2] D. Fernandes et al. Chemical Communications 51, 4902-4905 (2015)

Invited Talk

3D Printing and Cellular Strategies to promote Vascularization in Tissue Engineering

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The networks of blood vessels that comprise the circulatory system provide living tissue with the required nutrients and oxygen, whilst removing waste products. Lack of vascularization within a large and densely populated tissue engineered construct leads to necrotic core formation, preventing fabrication of functional tissues and organs. Strategies for vascularization involve engineering vascularized tissue before transplantation into the patient or by promoting vascularization in situ after transplantation. My talk will focus on our work in this area. More specifically, I will present: (i) A space-filling algorithm for generation of physiologically relevant three-dimensional models of vascular structures. The vascular models are generated in a Computer Aided Design (CAD) environment, and can be exported to any 3D printer format. (ii) A method for production of three-dimensional and hierarchical vascular networks in hydrogels, using sacrificial 3D printing and cellular co-cultures.

PARALLEL SESSIONS - Special Session IV on Publishing Houses and European Projects in Minos II

SPECIAL SESSION – Publishing Houses

Nano-bio Journals and Connecting with the Community

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In addition to our publication programme, I also manage the International Conference on Multifunctional, Hybrid and Nanomaterials which will be held 11-15 March 2019 in Sitges, Spain [1]. This is a highly interdisciplinary conference which includes: biohybrids, biomaterials and biological materials, functional hybrid nanomaterials, nanocomposites and their applications and functional porous materials. This conference typically attracts more than 1000 delegates and represents a key event for the community. I hope that you will consider attending!

[1] https://www.elsevier.com/events/conferences/international-conference-on-multifunctional-hybrid-and-nanomaterials

Impact beyond boundaries: introducing *JPhys Materials*

Daniel Jopling[1*], Stephan Roche[2] and Piera Demma Cara[1]

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JPhys Materials is a new open access journal from IOP Publishing reporting high-quality, significant, and original research at the forefront of materials science. The journal will showcase the most exciting research advances and discoveries that constitute today's science and will shape tomorrow's technologies. With a particular focus on interdisciplinary research—marrying chemical, physical and engineering aspects of materials study—JPhys Materials is designed to support the flow and exchange of knowledge across existing and emerging communities, maximising the reach and impact of published research.

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Special Session – European Project

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	WS1 Session V – Chairs: Y. Hanein (Sub: L.Papadimitriou) *Room*: Minos I	*WS2 Session VI – Chairs: P.Patsalas* *Room*: Minos II
15:30-16:00	(WS1-Invited) Nanoparticles For Future Cell Tracking Applications: Some Basic Considerations **Neus Feliu*, University of Hamburg, Germany & Karolinska Institutet, Sweden**	(WS2-Invited) Halide Perovskite and 2D nanomaterials for performing solar cells **Aldo Di Carlo*, CHOSE – Centre for Hybrid and Organic Solar Energy, University of Rome Tor Vergata, Italy and National University of Science and Technology "MISiS", Moscow, Russia**
16:00-16:15	**Au-SiO2-WO3 Core-shell Nanoparticles for SERS Cancer Imaging** P. Martinez Pancorbo*, K. Thummavichai, L. Clark, H. Chang, N. Stone, Y. Zhu University of Exeter, Exeter, United Kingdom	**Improved Charge Carrier Dynamics of CH3NH3PbI3 Perovskite Films Probed by Femtosecond Transient Absorption Spectroscopy** Ioannis Konidakis[1]*, Efthymis Serpetzoglou[1,2], Temur Maksudov[3,4], George Kakavelakis[3,4], Emmanuel Kymakis[4] and Emmanuel Stratakis[1,3] [1]Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH), Heraklion, Crete, Greece [2]Physics Department and [3]Department of Materials Science and Technology, University of Crete, Crete, Greece. [4]Center of Materials Technology and Photonics, Electrical Engineering Dept, Technological Educational Institute (TEI) of Crete, Heraklion, Crete, Greece.
16:15-16:30	**Pattern-Generating Fluorescent Molecular Probes for Chemical Biology** Leila Motiei*, and David Margulies Department of Organic Chemistry, Weizmann Institute of Science, 7610001, Rehovot, Israel	**Hot Electron Injection into Semiconducting Polymers Limits the Efficiency in Perovskite Solar Cells** Jesús Jiménez-López[1,2]*, Bianka M.D. Puscher[3], Werther Cambarau[1], Emilio Palomares[1,4] and Dirk M. Guldi[3] [1]Institute of Chemical Research of Catalonia (ICIQ), BIST, Tarragona, Spain; [2]DEEEA, Universitat Rovira i Virgili, Tarragona, Spain; [3]Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany; [4]ICREA, Barcelona, Spain
16:30-16:45	**Structural tuning of carbon nanodots and their potential in clinical diagnostics** C. Toncelli*, E. Armagan, S. Thiyagarajan, L. Boesel and R.M. Rossi Empa, Swiss Federal Laboratories for Materials Science and Technology, Laboratory for Biomimetic Membranes and Textiles, Lerchenfeldstr. 5, 9014 St. Gallen, Switzerland, www.empa.ch	**Graphene-based photoelectrode for efficient carrier collection and stable hot-electron lifetime in perovskite solar cells** Antonio Agresti[1]*, Sara Pescetelli[1], Daniele Catone[2], Patrick O'Keeffe[2], Anna Vinattieri[3], Emmanuel Kymakis[4], Francesco Bonaccorso[5] and Aldo Di Carlo[1] [1] CHOSE - Centre for Hybrid and Organic Solar Energy, Department of Electronic Engineering, University of Rome Tor Vergata, Rome, Italy; [2] CNR-ISM, Division of Ultrafast Processes in Materials (FLASHit), Italy; [3] Department of Physics and Astronomy, University of Florence and LENS,Sesto Fiorentino (FI), Italy; [4] Center of Materials Technology and Photonics & Electrical Engineering Department, School of Applied Technology, Technological Educational Institute (T.E.I) of Crete, Greece; [5] Istituto Italiano di Tecnologia, Graphene Labs, Genova, Italy
16:45-17:00	**Anisotropic noble metal nanoparticles as highly efficient agent for photodynamic therapy** Jan Krajczewski*[1], Helen Townley[2] [1]Laboratory of Moleculer Interactions, Faculty of Chemistry, University of Warsaw, Warsaw, Poland; [2]Nuffield Department of Women's and Reproductive Health, University of Oxford, John Radcliffe Hospital, Oxford, UK Department of Engineering Sciences, University of Oxford, Oxford, United Kingdom	**All-inorganic perovskite nanocrystals: from material design to potential applications** Athanasia Kostopoulou*, Konstantinos Brintakis and Emmanuel Stratakis Institute of Electronic Structure and Laser, Foundation for Research and Technology, Crete, Greece
17:00-17:15	**Supramolecular polyamine phosphate nanocarriers for siRNA and CRISPR/Cas9 delivery** P. Andreozzi[1], M.G. Ortore[2] and S. Moya[1]* [1]Soft Matter Nanotechnology Group, CIC biomaGUNE, San Sebastián, 20014, Spain; [2]Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italy.	(WS2-Invited) Defect Physics and (In)Stability in Metal-halide Perovskite Semiconductors **Annamaria Petrozza*** **Center for Nano Science and Technology @Polimi, Istituto Italiano di Tecnologia, Milan, Italy**
17:15-17:30	(WS1-Invited) How degradation of nanoparticles effects their colloidal properties and interaction with cells **Wolfgang Parak*, Universität Hamburg, Germany & CIC Biomagune, Spain**	
17:15-17:45		

PARALLEL SESSIONS – WS1 Session V on Minos I

Invited Talk

Nanoparticles For Future Cell Tracking Applications: Some Basic Considerations

Neus Feliu

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Nanomaterials offer promising opportunities for a wide range of applications including medicine. Their novel properties make them excellent imaging and diagnostic agents. However, nanoparticles could be potentially harmful for humans and environment. To understand the possible effects of nanoparticles exposed to biological systems, a detail association of such effects to the physicochemical properties of the nanoparticles is needed. Therefore, we will provide an overview of the common denominators to evaluate the nanosafety research, and discuss the potential use of an advanced system based on nanoparticle-based imaging labels to monitor stem cells non-invasively in vivo. A deeper understanding in these areas will help to improve the development of nanomaterials for future medical applications.

N. Feliu, D. Docter, M. Heine, P. del Pino, S. Ashraf, J. Kolosnjaj-Tabi, P. Macchiarini, P. Nielsen, D. Alloyeau, F. Gazeau, R. H. Stauber, W. J. Parak, “In vivo degeneration and the fate of inorganic nanoparticles”, *Chemical Society Reviews* 45, 2440-2457 (2016).

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Au-SiO2-WO3 Core-shell Nanoparticles for SERS Cancer Imaging

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Surface-enhanced Raman spectroscopy (SERS) is a powerful technique which can achieve 109 times enhancement of single-molecule vibrational bands signals close to the surface via plasmon resonances on metal substrates such as Au, Ag and Cu. In composite nanoparticles containing different layers, SERS signals could arise from multiple phases for specific molecule detection and disease diagnosis. Currently, the only clinically approved material to form the core of diagnostic agents with hyperthermia capabilities is iron oxide, but it suffers serious aggregation problems [1]. This report describes the design and key synthetic steps for the creation of a new class of composite nanoparticles, named Au-SiO2-WO3 that displays attractive biomedical imaging properties for cancer detection (see Figure 1). We prepared these nanoparticles by modifying the Stöber process to create the intermediate SiO2 shell over the WO3 core, and by using the Turkevich method to form the external Au nanoshell that was thiolized with benzene rings to produce strong Raman signals.

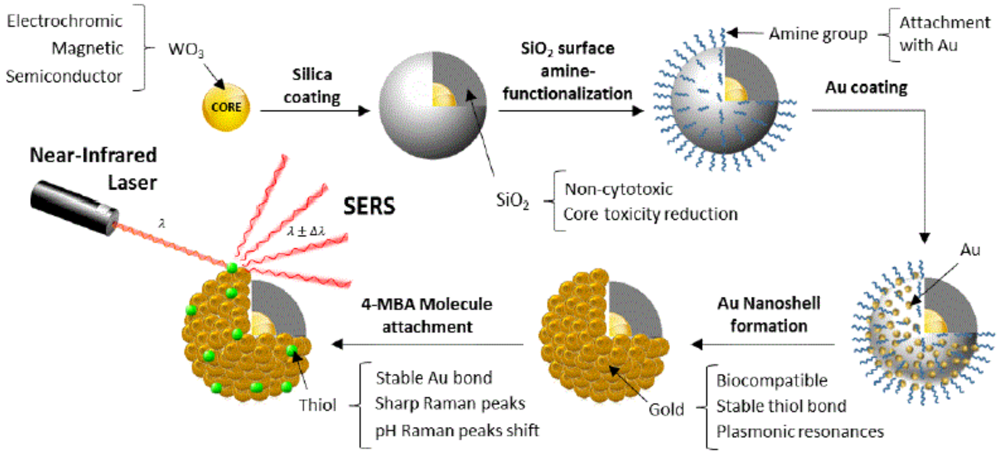

Fig. 1 | Illustration of the synthesis route for the Au-SiO2-WO3 composite nanoparticles and their SERS application

The resulting nanoparticles were thoroughly characterised by transmission electron microscopy, powder X-ray diffraction, Raman spectroscopy and ultraviolet-visible spectrophotometry. Light absorption and plasmonic generation tests have been carried out to understand the benefits of these novel composite nanoparticles. Preliminary results have confirmed their advantageous SERS properties for single molecule detection. Anti-bodies can be used to functionalise the surface of these composite nanoparticles to bind with specific surface proteins on cells, such as cancer cells. The long-term objective is to measure SERS nanoparticles in vivo using SESORS which requires Near-Infrared light to reach and return from the nanoparticle buried in tissues.

[1] C. Guibert et al. *J. Phys. Chem. C* 119, pp 28148–28154 (2015)

Pattern-Generating Fluorescent Molecular Probes for Chemical Biology

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Fluorescent molecular probes have become a powerful tool in protein research. However, these probes are less suitable for analyzing specific populations of proteins in their native environment. In this talk I will give an overview of a new class of fluorescent molecular probes[1-5] recently developed in our group, and show how they can be used to detect individual proteins, protein combinations, as well as binding interactions and dynamic changes that occur on their surfaces. In the second part of this talk, I will present a new class of fluorescent molecular sensors that combines the properties of small molecule-based probes and cross-reactive sensor arrays (the so-called chemical nose/tongue') and explain how these pattern-generating probes could expand the fluorescent toolbox currently used to detect and image proteins.[6] Specifically, I will show how such systems can be used to identify combinations of specific protein families within complex mixtures and to discriminate among protein isoforms in living cells, where macroscopic arrays cannot access.[6]

[1] B. Rout, L. Motiei, D. Margulies, *Synlett* 25, 1050-1054 (2014).

[2] L. Motiei, Z. Pode, A. Koganitsky, D. Margulies, *Angew. Chem. Int. Ed.* 53, 9289-9293 (2014).

[3] Y. Nissinkorn, N. Lahav-Mankovski, A. Rabinkov, S. Albeck, L. Motiei , D. Margulies, *Chem. Eur. J.*, 21, 15981-15987 (2015).

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[5] J. Hatai, L. Motiei, D. Margulies, *J. Am. Chem. Soc.* 139, 2136-2139 (2017).

[6] Z. Pode, R. Peri-Naor, J. M. Georgeson, T. Ilani, V. Kiss, T. Unger, B. Markus, H. M. Barr, L. Motiei, D. Margulies, *Nature Nanotechnol.* 12, 1161–1168 (2017).

Structural tuning of carbon nanodots and their potential in clinical diagnostics

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Carbon dots represent a unique platform amid the portfolio of optical probes. Indeed, incomplete carbonization processes of carbogenic precursors lead to a covalent network of polyaromatic domains within an amorphous carbon frame, all of it surrounded by a plethora of surface hydrophilic groups. The conjugated domains within these highly cross-linked networks, while still confined within 2-10 nm of size, generate remarkably stable photoluminescence [1]. In addition, where examined, excellent bio-inertness and diffusion through cell membrane has been observed [2].

Hereby, contrary to the majority of studies employing citric acid as the main carbogenic precursor [1], we want to demonstrate how urea could represent an interesting building block for the development of multi-emission optical probes (Figure 1) and how we can tune the different response of each emission center to different environmental parameters by altering the co-precursor structure. Some examples will be presented in the field of oxygen, ammonia and carbon dioxide monitoring for breath analysis as well as multi-parameter wound healing assessment.

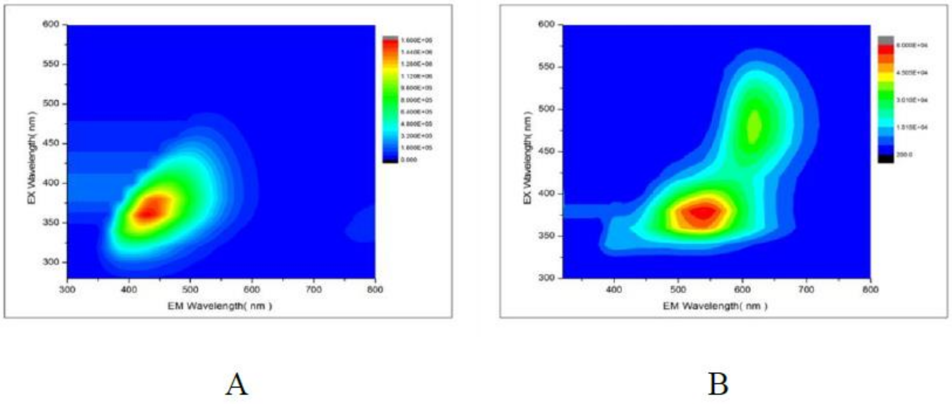

Figure 1. (A) Fluorescence of urea-based carbon nanodots and (B) fluorescence of urea-based carbon nanodots in the presence of an aromatic di-amine as co-precursor

[1] H. Li, Z. Kang, Y. Liu, S.-T. Lee, J. Mater. Chem. 22 24230 (2012).
[2] A.S. Karakoti, R. Shukla, R. Shanker, S. Singh, Adv. Colloid Interface Sci. 215 28–45 (2015).

Anisotropic noble metal nanoparticles as highly efficient agent for photodynamic therapy.

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[2]*Nuffield Department of Women's and Reproductive Health, University of Oxford, John Radcliffe Hospital, Oxford, UK Department of Engineering Sciences, University of Oxford, Oxford, United Kingdom*

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In the 21st century the main cause of human death is heart disease and cancer; accounting for almost 70% of total deaths. Every year almost 14 million new cancer cases are registered, with over 8 million deaths annually. In many cases five year survival rates is lower than 10%. One of the most promising methods to cure cancers is photodynamic therapy (PDT). In this technique, special organic compounds called photosensitizers are introduced into the diseased tissue. As a result of the interaction with visible light, the photosensitizer is excited. Energy of excitation can be transferred onto other molecules in the vicinity, e.g. oxygen molecules which leads to the formation of oxygen in the excited singlet state. This kind of oxygen is highly cytotoxic and causes cell death in its surroundings. However, organic photosensitizers like porphyrin and its derivatives have very complicated structures meaning that their synthesis is difficult and expensive, and further more they are easily degradable by enzymes. Therefore, researchers try to replace typical organic photosensitizers by noble metal nanoparticles. Noble metal nanoparticles exhibit very interesting optical properties. Primarily, gold and silver nanoparticles exhibit significantly higher absorption coefficients than organic photosensitizers. An important point for consideration is that the human body exhibits a 'biological window' for electromagnetic radiation in the range from 650 to 1100 nm. In the case of noble metals it is possible to obtain nanoparticles which interact with light in this region.

In this work we present possibility of application of anisotropic gold and silver nanoparticles as new agent for photodynamic therapy. Optical and structural characteristics of nanoparticles were carried out. Measurements of singlet oxygen emission in laboratory conditions will be taken. Described noble metal nanoparticles have been successfully used against cancer cells line like: RH30, RD, Mo59K and U87. Results showed that noble metal nanoparticles could be used as highly efficient photosensitizer suitable for photodynamic therapy.

Supramolecular polyamine phosphate nanocarriers for siRNA and CRISPR/Cas9 delivery.

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[2]*Dipartimento di Scienze della Vita e dell’Ambiente, Università Politecnica delle Marche, Ancona, Italy.*

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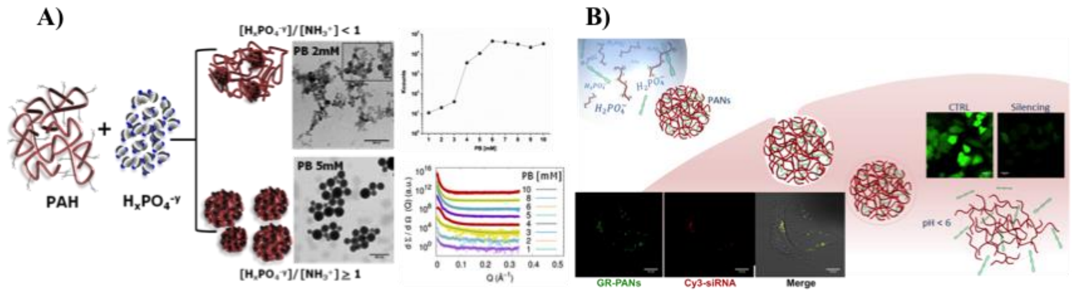
Gene therapy is a promising strategy for the treatment of numerous diseases. An ideal nanocarrier (NC) for gene delivery should be i) stable at physiological pH, ii) enter the cell by endocytosis, iii) disassembly inside endosomes, and finally iv) release the genetic materials only inside the cytosol. Here, we show a novel application of polyamine phosphate nanoparticles (PANs) based on their capacity to load the negatively charged nucleic acids. PANs are formed by a simple and straightforward one step procedure, involving the mixing of polyamines solutions and nucleic acid such as siRNA or CRISP/Cas9. Their assembly is driven by electrostatic and hydrogen bonding interactions between the positively charged amines groups of the polyamines and the negatively charged phosphate ions. We have studied PANs formation and stability by DLS, TEM, and SAXS. DLS and TEM show the minimal amount of phosphate ions needed for formation of spherical nanoparticles. SAXS studies show how the nucleation of the PAH chains with the phosphate groups result in a progressive decrease in conformational freedom and in an increase in bending rigidity for the polyamines as evidenced by the increase in the Kuhn length as the phosphate ions concentration increases, Figure A. The efficacy of this approach is shown for the silencing of the Green Fluorescence Protein (GFP) protein in the GFP-A549 cell line. Co-localization experiments with labeled endosomes and either labeled PANs or siRNAs prove the translocation of PANs and siRNAs into the cytosol. As a proof of concept, it is shown that PANs with encapsulated green fluorescence protein (GFP) siRNAs are able to silence GFP in A549 cells expressing this protein, Figure B. Silencing efficacy was evaluated by flow cytometry, CLSM and western blot assay. These results open the way for the use of poly(allylamine) phosphate nanocarriers for the intracellular delivery of genetic materials.



Invited Talk

How degradation of nanoparticles effects their colloidal properties and interaction with cells

Wolfgang Parak

Fachbereich Physik und Chemie, CHyN, Universität Hamburg, Germany

CIC Biomagune, San Sebastian, Spain

Composite nanoparticles comprising an inorganic core and an organic shell, which provides water-solubility can be enzymatically degraded. This is relevant for particles that are endocytosed by cells. As enzymes can be specifically present in certain intracellular compartments degradation can depend on the intracellular location of particles. Degradation can be tuned by different surface chemistries, to make particles labile in one environment or stabile in other environments.

M. Chanana, P. Rivera Gil, M. A. Correa-Duarte, L. M. Liz-Marzán. W. J. Parak, "Physicochemical Properties of Protein-Coated Gold Nanoparticles in Biological Fluids and Cells before and after Proteolytic Digestion", *Angewandte Chemie International Edition* **52**, 4179–4183 (2013).

W. G. Kreyling, A. M. Abdelmonem, Z. Ali, F. Alves, M. Geiser, N. Haberl, R. Hartmann, S. Hirn, K. Kantner, D. Jimenez de Aberasturi, G. Khadem-Saba, J.-M. Montenegro, J. Rejman, T. Rojo, I. Ruiz de Larramendi, R. Ufartes, A. Wenk, W. J. Parak, "In vivo integrity of polymer-coated gold nanoparticles", *Nature Nanotechnology* **10**, 619–623 (2015).

N. Feliu, D. Docter, M. Heine, P. del Pino, S. Ashraf, J. Kolosnjaj-Tabi, P. Macchiarini, P. Nielsen, D. Alloyeau, F. Gazeau, R. H. Stauber, W. J. Parak, “In vivo degeneration and the fate of inorganic nanoparticles”, *Chemical Society Reviews* **45**, 2440-2457 (2016).

PARALLEL SESSIONS – WS2 Session VI on Minos II

Invited Talk

Halide Perovskite and 2D nanomaterials for performing solar cells

Aldo Di Carlo
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In the energy field, the use of hybrid organic-inorganic perovskite materials such as CH3NH3PbI3 (MAPI) has opened up new directions to fabricate cost effective and high efficient photovoltaic (PV) devices. Many factors can influence the efficiency and stability characteristics of Pervovskite Solar Cells (PSCs). In this perspective, bidimensional (2D) nanomaterials, such as graphene and related materials can play a primary role owing to their 2D nature and the large variety of 2D crystals, whose complementary opto/electronic properties, can be on-demand tuned by chemical functionalization and edge modification. Here, we demonstrate the use of graphene and 2D materials as an effective way to control the morphology [1] and to stabilize the device's interfaces. Several strategies have been used to master interface properties both at the anode and cathode parts of the cell. By dispersing graphene flakes into the mesoporous TiO2 layer [2] and by inserting graphene oxide (GO) as interlayer between perovskite and Spiro-OMeTAD layers, we demonstrate a PCE exceeding 18% with a two-step MAPI deposition, carried out in air.[3] Further optimization of the 2D interface layers could promote the efficiency above 20% with a strong improvement of the stability. The proposed approach has been exploited for the fabrication of state-of-the-art large area perovskite modules with a PCE of 13.7% on a monolithic (active area exceeding 100 cm2). The use of 2D materials permitted to increase the PCE by more than 10% with respect to "conventional" modules.[4] Additional results will be shown for other 2D materials such as MoS2 and for module with active regions > 100 cm2 where a proper laser patterning was used to reduce interconnection dead area of a module below 400 ⍰m making an aperture ratio of 95%.

[1] F. Biccari et al. Adv. Energy Mat. 2017, 7, 1701349
[2] B. Taheri et al, 2D Materials, in press, 2018. DOI: 10.1088/2053-1583/aad983
[2] A. Agresti et al. ChemSusChem 2016, 9, 2609
[3] A. Agresti et al. ACS Energy Lett. 2017, 2, 279−287
[4] A. Palma et al. IEEE J. Photovoltaics 2017, 7, 1674

Improved Charge Carrier Dynamics of $CH_3NH_3PbI_3$ Perovskite Films Probed by Femtosecond Transient Absorption Spectroscopy

Ioannis Konidakis[1*], Efthymis Serpetzoglou[1,2], Temur Maksudov[3,4], George Kakavelakis[3,4], Emmanuel Kymakis[4] and Emmanuel Stratakis[1,3]

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[2]Physics Department and [3]Department of Materials Science and Technology, University of Crete, 71003 Heraklion, Crete, Greece.

[4]Center of Materials Technology and Photonics, Electrical Engineering Department, Technological Educational Institute (TEI) of Crete, 71004 Heraklion, Crete, Greece.

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During the last decade organic and inorganic lead halide perovskites have attracted significant attention due to the enormous potential for being the key component of next generation commercially available photovoltaic devices. However, for the realization of this important milestone more scientific knowledge is still required in order to maximize further the power conversion efficiency (PCE) while improving stability of the devices. To this aim, we herein employ time-resolved transient absorption spectroscopy (TAS) under inert atmosphere conditions in order to probe the charge carrier dynamics of various $CH_3NH_3PbI_3$ perovskite films. Firstly, we present results on $CH_3NH_3PbI_3$ films deposited on two different hole transport layer (HTL) polymers, namely the super hydrophilic polymer poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate), known as PEDOT:PSS, and the more hydrophobic poly(triarylamine) semiconductor polymer, known as PTAA. It was found that upon utilizing the latter polymer, the PCE of the perovskite solar cells (PSCs) increases from 12.6 to 15.6% [1]. TAS studies of the so-formed $CH_3NH_3PbI_3$/HTL configurations revealed faster relaxation times and decay dynamics when the PTAA polymer is employed, a finding that potentially accounts for the enhanced PCE of the $CH_3NH_3PbI_3$/PTAA devices. In the second part of the study, we explore the dynamics of $CH_3NH_3PbI_3$ films synthesized by means of laser-assisted (LA) crystallization. It is revealed than when the LA procedure is followed instead of the conventional thermal annealing, significantly enhanced charge carrier dynamics are achieved [2]. All TAS findings are correlated with the structure and crystalline quality of the perovskite films as depicted by scanning electron microscopy, X-ray diffraction, micro-photoluminescence and transmittance spectroscopy.

[1] E. Serpetzoglou et al. *ACS Appl. Mater. Intefaces* 9, 43910-43919 (2017).

[2] I. Konidakis et al. *ACS Appl. Energy Mater.*, Just-accepted, 10.1021/acsaem.8b01152.

Hot Electron Injection into Semiconducting Polymers Limits the Efficiency in Perovskite Solar Cells

Jesús Jiménez-López[1,2*], Bianka M.D. Puscher[3], Werther Cambarau[1], Emilio Palomares[1,4] and Dirk M. Guldi[3]

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[2]DEEEA, Universitat Rovira i Virgili, Tarragona, Spain

[3]Department of Chemistry and Pharmacy, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

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Since their emergence as light sensitizers [1], great research efforts have been made on hybrid organic-inorganic perovskite solar cells (PSC), reaching efficiencies above 22%. Despite all of these efforts, there is no agreement yet on the physical insights of perovskite solar cells, e.g., charge generation, the role of ions in the perovskite structure, or charge recombination.

In this particular work, we focused on a series of semiconducting polymers that have been used in Organic Solar Cells (OSC) and we tried to find why they are not as efficient working as Hole Transporting Materials (HTM) as it is spiro-OMeTAD [2] small molecule.

With this purpose, we have used femtosecond Transient Absorption Spectroscopy (fsTAS) to study interfacial charge processes happening between methylammonium lead iodide perovskite and titanium dioxide, used as electron transport material (ETM), as well as several semiconducting polymers employed as HTMs.

We have identified and analyzed charge processes happening in the perovskite. In addition, we have found charge injection dynamics in both perovskite/ETM and perovskite/HTM interfaces. Finally, we have found a possible carrier loss pathway that could explain the differences in power conversion efficiencies observed for certain semiconducting polymers.

[1] A. Kojima,et al. *J. Am. Chem. Soc.* **131,** 6050–6051 (2009).

[2] J. Jiménez-López, et al. *Sci. Rep.* **7,** 6101 (2017).

Graphene-based photoelectrode for efficient carrier collection and stable hot-electron lifetime in perovskite solar cells

Antonio Agresti[1*], Sara Pescetelli[1], Daniele Catone[2], Patrick O'Keeffe[2], Anna Vinattieri[3], Emmanuel Kymakis[4], Francesco Bonaccorso[5] and Aldo Di Carlo[1]

[1] CHOSE - Centre for Hybrid and Organic Solar Energy, Department of Electronic Engineering, University of Rome Tor Vergata, Rome, Italy

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Sesto Fiorentino (FI), Italy

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The fast and remarkable advancement in perovskite solar cells (PSCs) efficiency was not accomplished by a significant improvement in device's stability and production process scaling-up, remaining the crucial points for a feasible exploitation of perovskite as PV technology. In this work, we demonstrated the role of graphene and related 2D materials (GRMs) in controlling the perovskite film morphology by enlarging the device lifetime. In particular, the addition of graphene nanoflakes (G-nfs) into the mesoporous TiO_2 ($mTiO_2$) electron transporting layer (ETL) resulted in very good crystalline quality of the perovskite small crystals wrapped into $mTiO_2$, with a trap density about one order of magnitude lower than that found with pristine ETL. [1] Moreover, by mean of femtosecond transient absorption spectroscopy (TAS), we related carrier temperature time decrease to the degradation of small perovskite crystals wrapped into the mesoporous TiO_2 layer. In fact, while both as-prepared graphene-free and graphene-containing PSCs exhibit similar values of hot-carrier temperatures as a function of the pump-probe time delay, the aged graphene-free PSC presents lower carrier temperatures with respect to the aged graphene-containing PSC. This difference arises from a faster thermalization of the carriers occurring in the aged graphene-free PSC as a result of the degradation of its small perovskite crystals. Notably, the morphology and stability improvements achieved by the use of GRMs into the mesoscopic PSC structure already concretized in a successful perovskite technology scaling-up [2] by paving the way for its concrete commercialization in not so far future.

[1] A. Agresti, et al., *ACS Energy Letters* 2, 279-287 (2017).

[2] F. Biccari, et al., *Advanced Energy Materials* 22, 1701349 (2017).

All-inorganic perovskite nanocrystals: from material design to potential applications

Athanasia Kostopoulou[1*], Konstantinos Brintakis[1] and Emmanuel Stratakis[1]

[1]Institute of Electronic Structure and Laser, Foundation for Research and Technology –
** akosto@iesl.forth.gr*

The past decade, metal halide perovskites have attracted great scientific and technological interest due to their promising application in diverse fields. Despite the great success of organic metal halide perovskite material, several problems remain to be resolved such as their moisture, oxygen, light and heat intrinsic sensitivity. The replacement of the organic group with inorganic ions found that are more stable and some of these problems seems to be solved. [1] Nanostructured all-inorganic metal halide perovskites are acknowledged as viable materials for applications ranging from photovoltaics and energy storage to light-emitting diodes and photodetectors. [2, 3] In this work, we focus on the synthesis of such nanocrystals with various morphologies with low-cost and simple processes at low temperatures. [4] Morphological and structural features as well as their physicochemical properties of these materials will be presented. Furthermore, the potential utilization of these nanostructures in energy storage and gas sensing will be discussed.

[1] Q. Zhang, et al. *ACS Central Science* 4, 668-679 (2018)

[2] A. Kostopoulou, et al. *Journal of Materials Chemistry A* 6, 9765-9798 (2018)

[3] L. Polavarapu, et al. *Advanced Energy Materials* 7, 1700267 (2017)

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Acknowledgements: This work was supported by General Secretariat for Research and Technology (GSRT) and Hellenic Foundation for Research and Innovation (HFRI).

Invited Talk

Defect Physics and (In)Stability in Metal-halide Perovskite Semiconductors

Annamaria Petrozza*
Center for Nano Science and Technology @Polimi, Istituto Italiano di Tecnologia, via Giovanni Pascoli 70/3, 20133, Milan, Italy.
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Semiconducting metal-halide perovskites present various types of chemical interactions which give them a characteristic fluctuating structure sensitive to the operating conditions of the device, to which they adjust. This makes the control of structure-properties relationship, especially at interfaces where the device realizes its function, the crucial step in order to control devices operation. In particular, given their simple processability at relatively low temperature, one can expect an intrinsic level of structural/chemical disorder of the semiconductor which results in the formation of defects. Here, first I will present our results on the role of structural and point defects in determining the nature and dynamic of photo-carriers in metal-halide perovskites. Then, I will discuss our understanding of key parameters which must be taken into consideration in order to evaluate the suscettibility of the perovkite crystals (2D and 3D) to the formation of defects, allowing one to proceed through a predictive synthetic procedure. Finally, I will show the correlation between the presence/formation of defects and the observed semiconductor instabilities. Instabilities are manifested as light-induced ion migration and segregation, eventually leading to material degradation under prolonged exposure to light. Understanding, controlling and eventually blocking such material instabilities are fundamental steps towards large scale exploitation of perovskite in optoelectronic devices. By combining photoluminescence measurements under controlled conditions with ab initio simulations we identify photo-instabilities related to competing light-induced formation and annihilation of trap states, disclosing their characteristic length and time scales and the factors responsible for both processes. We show that short range/short time defect annihilation can prevail over defect formation, happening on longer scales, when effectively blocking undercoordinated surface sites, which act as a defect reservoir. By an effective surface passivation strategy we are thus able to stabilize the perovskite layer towards such photo-induced instabilities, leading to improved optoelectronic material quality and enhanced photo-stability in a working solar cell. The proposed strategy represents a simple solution towards longer stability perovskite thin films that could be easily implemented in large scale manufacturing.

END OF 3rd DAY OF NANOBIO2018

THURSDAY, 27TH SEPTEMBER 2018 – 4th DAY OF NANOBIO2018

TIME	Thursday 27th September
09:00-	**REGISTRATION DESK - OPEN**

All day	
9:00- 9:45	*Plenary Session I on WS3:* Tissue Engineering & Regenerative Medicine & *WS1:* Nanobiomaterials and Nanomedicine *Chair: E. Stratakis & E. Kymakis - Room: Minos*
	(WS3-PLENARY) Biomaterials for Tissue Engineering and Regenerative Medicine **Antonios G. Mikos, Rice University, Houston, Texas, USA**
9:45- 10:30	(WS1-PLENARY) Aptamer-field-effect transistor biosensors **Nako Nakatsuka,[1,2] Kyung-Ae Yang,[5] John M. Abendroth,[1,2] Kevin M. Cheung,[1,2] Xiaobin Xu,[1,2] Chuanzhen Zhao,[1,2] Yang, Yang,[1,3] Paul S. Weiss,[1,2,3] Milan Stojanovic,[5,6] and Anne M. Andrews[1,2,4]*** [1]California NanoSystems Institute; [2]Department of Chemistry and Biochemistry; [3]Department of Materials Science and Engineering; [4]Semel Institute for Neuroscience & Human Behavior and Hatos Center for Neuropharmacology, University of California, Los Angeles, Los Angeles, CA, USA; [5]Division of Experimental Therapeutics, Department of Medicine; [6]Department of Biomedical Engineering, Columbia University, New York, NY, USA
10:30- 11:00	**COFFEE BREAK (PASIPHAE ROOM)** **NOTE: All the Poster Presenters of POSTER SESSION I should remove their Poster!**

	WS4 Session II – Chairs: E. Kymakis (Sub: A. Petrozza) *Room:* Minos I	*WS2 & WS5 Sessions III – Chairs: I. McCulloch (Sub: G. Tsibidis)* *Room:* Minos II	*Chairs: A.Pagkozidis & PRAXIS Network Room: Apollon*
11:00- 11:30	(WS4-Invited) Large scale production of 2D-materials for energy applications **Francesco Bonaccorso** **Istituto Italiano di Tecnologia, Graphene Labs, Via Morego 30, 16163 Genova, Italy** **BeDimensional Srl, Via Albisola 121, 16163 Genova, Italy**	(WS2-Invited) The Role of Metal Oxides in the Stability of Halide Perovskite Solar Cells **Monica Lira-Cantu*, Catalan Institute of Nanoscience and Nanotechnology (ICN2), CSIC and The Barcelona Institute of Science and Technology (BIST), Barcelona, Spain**	MATCHMAKING EVENT

11:30- 11:45	(WS4-Invited) Supramolecular engineering of 2-D materials: chemical tailoring of multifunctional foams and coatings **Paolo Samorì*, ISIS, Université de Strasbourg & CNRS, Strasbourg, France**	**Energy level alignment and surface properties of Pb-free halide double perovskites** George Volonakis* and Feliciano Giustino Department of Materials, University of Oxford, Oxford, UK	
11:45- 12:00		**Perovskite solar cells impedance spectroscopy explained via 1D time dependent drift-diffusion modelling** Ilario Gelmetti[1,2]*, D. Moia[3], P. Calado[3], E. Palomares[1,4], J. Nelson[3] and P. Barnes[3] [1] Institute of Chemical Research of Catalonia (ICIQ), Spain; [2] DEEEA, Universitat Rovira i Virgili, Avda. Països Catalans 26, 43007 Tarragona, Spain; [3] Department of Physics, Imperial College London, London SW7 2AZ, UK. [4] ICREA, Passeig Lluís Companys, 23, Barcelona, Spain	
12:00- 12:15	(WS4-Invited) Graphitic carbon nitrides and functionalized graphene materials for energy and other applications **Paul F. McMillan* et.al., UCL, UK**	**Silicon going indoor** Djordje Jovanović[1]*, Tijana Tomašević-Ilić[1], Nikola Tasić[2], Aleksandar Matković[1,3], Marko Spasenović[1], Radoš Gajić[1], and Emmanuel Kymakis[4] [1]Graphene Laboratory, Center for Solid State Physics and New Materials, Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia [2]Department of Materials Science, Institute for Multidisciplinary Research, University of Belgrade, Kneza Višeslava 1,11000 Belgrade, Serbia [3]Institut für Physik, Montanuniversität Leoben, Franz-Josef-Straße 18, 8700 Leoben, Austria [4]Electrical Engineering Department, Technological Educational Institute (TEI) of Crete, Heraklion, 71004 Crete, Greece	
12:15- 12:30		**Synthesis and protection of copper nanoparticles for power electronic devices** T. Michaud[1]*, S. De Sousa Nobre[2], T. Baffie[2] and J.-P. Simonato[2] [1] University Grenoble Alpes, CEA/LITEN, MINATEC Campus, France; [2]CEA/LITEN, Grenoble, France	

12:30- 13:00	(WS4-Invited) A versatile graphene-based platform for robust nano-bio-hybrid **M. Garcia-Hernandez* et. al., Institute of Materials Science of Madrid (ICMM-CSIC), Spain**	(WS5-Invited) Simulations of single-electron states in metal nanoparticles and transition-metal-dichalcogenides. **Ioannis N. Remediakis*, Daphne Davelou and George Kopidakis** **Dept of Materials Science and Technology, University of Crete & Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas**	

Plenary Session I on WS3: Tissue Engineering & Regenerative Medicine & WS1: Nanobiomaterials and Nanomedicine

PLENARY TALK

Biomaterials for Tissue Engineering and Regenerative Medicine

Antonios G. Mikos

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Advances in biology, materials science, chemical engineering, and other fields have allowed for the development of tissue engineering, an interdisciplinary convergence science. For the past two and a half decades, our laboratory has focused on the development and characterization of biomaterials-based strategies for the regeneration of human tissues with the goal of improving healthcare outcomes. In a collaborative effort with physicians, surgeons, and other scientists, we have produced new material compositions and three-dimensional scaffolds, and investigated combinations of biomaterials with cell populations and bioactive agents for their ability to induce tissue formation and regeneration. We have examined the effects of material characteristics, such as mechanical properties, topographical features, and functional groups, on cell behavior and tissue guidance, and leveraged biomaterials as drug delivery vehicles to release growth factors and other signals with spatial and temporal specificity. This presentation will review recent examples of biomaterials-based approaches for regenerative medicine applications and highlight future areas of growth, such as the use of tissue engineering for validation of cancer therapeutic discovery.

WS1 Plenary Talk

Aptamer-field-effect transistor biosensors

Nako Nakatsuka,[1,2] Kyung-Ae Yang,[5] John M. Abendroth,[1,2] Kevin M. Cheung,[1,2]
Xiaobin Xu,[1,2] Chuanzhen Zhao,[1,2] Yang, Yang,[1,3] Paul S. Weiss,[1,2,3] Milan Stojanovic,[5,6] and
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Protein-receptor-field-effect transistor sensors for *in vivo* applications suffer from the inability to circumvent limitations due to ionic screening under physiological conditions due to the large size of the protein/antibody-based molecular recognition element, in combination with a small (<1 nm) Debye length. The Debye length is the distance beyond semiconducting channel surfaces wherein changes in local electric fields affect the distributions of channel free charge carriers to the greatest extent. We overcome this limitation through the use of short, rationally designed oligonucleotide sequences, termed aptamers, for molecular recognition. Stem-loop aptamers undergo conformational changes upon target capture that involve rearrangement of highly negatively charged nucleic acid backbones in close proximity to semiconducting channels, resulting in measurable changes in channel conductances, even when detecting singly charged (serotonin and dopamine), neutral (glucose), or zwitterionic (sphingosine-1-phosphate) small-molecule targets. Circular dichroism spectroscopy indicates that some, though not all of the aptamers investigated adopt new secondary structural motifs that are stabilized by target binding. Fluorescence resonance energy transfer studies indicate that aptamers undergo significant target-induced adaptive changes involving repositioning of stems and/or loops. These and other findings provide mechanistic understanding of interactions between aptamers, targets, and charge carriers in semiconductors that lead to tunable signals and sensitivities that are amenable for *in vivo* small-molecule sensing.

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PARALLEL SESSIONS – WS4 Session II on Minos I

Invited Talk

Large scale production of 2D-materials for energy applications

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2D materials are emerging as promising materials[1-5] to improve the performance of existing devices or enable new ones.[1-5] A key requirement for the implementation of 2D materials in applications as flexible (opto)electronics and energy is the development of industrial-scale, reliable, inexpensive production processes,[2] while providing a balance between ease of fabrication and final product quality. The production of 2D materials by solution processing[2,6] represents a simple and cost-effective pathway towards the development of 2D materials-based (opto)electronic and energy devices, presenting huge integration flexibility compared to other production methods. Here, I will first present our strategy to produce 2D materials on large scale by wet-jet milling[7] of their bulk counterpart and then an overview of their applications for flexible and printed (opto)electronic and energy devices. [3,8,9,10,11,12,13,14]

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13. A. Capasso, *et al.* Few-layer MoS_2 flakes as active buffer layer for stable perovskite solar cells. ***Adv. Ener. Mater***. 6, 1600920, (2016).
14. L. Najafi, *et al.* MoS_2 Quantum Dot/Graphene Hybrids for Advanced Interface Engineering of CH3NH3PbI3 Perovskite Solar Cell with Efficiency over 20 %. *ACS Nano* 2018 in press

We acknowledge financial support from the European Union's Horizon 2020 Graphene Flagship.

Invited Talk

Supramolecular engineering of 2-D materials: chemical tailoring of multifunctional foams and coatings

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The interfacing of molecular science with 2-dimensional materials, by mastering the supramolecular approach, is a powerful route to tune of the dynamic physical and chemical properties of 2D materials, by imparting them novel functions, with the ultimate goal of generating multifunctional hybrid systems for applications in (opto)electronics, sensing and energy.

In my lecture, I will review our recent findings on the covalent and non-covalent functionalization of layered materials to create artificial responsive hetero-structures as well as functional foams and coatings which can operate as selective chemical sensors for ions and polar molecules. Finally, I will describe how the same approaches can be exploited to fabricate highly sensitive pressure sensors which can monitor heartbeats, thus holding great potential for their integration in medical diagnostic devices or sport apparatus.

Our approaches provide a glimpse on the chemist's toolbox to generate multifunctional 2D materials based nanocomposites with ad-hoc properties to address societal needs in electronics, sensing and energy applications.

Invited Talk

Graphitic carbon nitrides and functionalized graphene materials for energy and other applications

Paul F. McMillan[1*], Noelia Rubio Carrero[2], Theo Suter[3], Thomas S. Miller[3], Kit McColl[1], Daniel J.L. Brett[3], Furio Corà[1], Paul Shearing[3], Andrea Sella[1], Martin C. Wilding[4], Chris A. Howard[5], Cecilia Mattevi[6], Milo S.P. Shaffer[2]

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Layered "graphitic" carbon nitride solids (gCN) are an emerging class of materials for energy, environmental and catalytic science applications [1]. Their unique combination of chemical, structural and physical properties led to our investigation of their use as photocatalysts and Li^+-ion battery electrodes, and as catalyst supports for PEM fuel cell devices. However, although they exhibit promising characteristics including enhanced catalyst lifetimes their poor electrical conductivity leads to lowered overall performance [2]. New directions include development of functionalized graphenes that combine the desirable lifetime behavior with useful electrical conductivity. Crystalline gCN compounds have the remarkable property of spontaneous exfoliation and dissolution in a range of polar solvents, leading to nanomaterials with tunable luminescence properties across the visible range [3]. The crystalline solids also show unusual and interesting properties of ion exchange and H_2O transport, within and between the layers. We will present some of these new results, not all of which we fully understand yet, but that will certainly lead to high performance materials for energy and sustainabilty outcomes.

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Invited Talk

A versatile graphene-based platform for robust nano-bio-hybrid

Rebeca Bueno[1], Marzia Marciello[1], Miguel Moreno[2], Carlos Sánchez-Sánchez[1], José I. Martinez[1], Lidia Martinez[1], Elisabet Prats-Alfonso[3,4], Anton Guimerà-Brunet[3,4], Jose A. Garrido[5], Rosa Villa[3,4], Federico Mompean[1], Yves Huttel[1], María del Puerto Morales[1], Carlos Briones[2], María F. López[1], Gary J. Ellis6, Luis Vázquez[1], José A. Martín-Gago[1] and M. Garcia-Hernandez[*1]

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Technologically useful and robust graphene-based interfaces for devices require the introduction of highly selective, stable and covalently bonded functionalities on the graphene surface, whilst essentially retaining the electronic properties of the pristine layer. This work demonstrates that highly-controlled, ultra-high vacuum covalent chemical functionalization of graphene sheets with a variety of molecules, among them para-aminophenol and p-aminothiophenol [1]. These systems are subsequently used for the development of hybrid nanostructures by attaching metal nanoparticles and nuclei acid aptamers. The impact of this controlled surface functionalization methodology on the electrical properties of graphene was evaluated by studying graphene solution-gated field-effect transistors (gSGFET), which were measured prior to and after functionalization with p-aminothiophenol.

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PLENARY SESSIONS - WS2 & WS5 Session II on Minos I

Invited Talk

The Role of Metal Oxides in the Stability of Halide Perovskite Solar Cells

Prof. Dr. Monica Lira-Cantu
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Halide perovskite solar cells (PSCs) have emerged as a competitive photovoltaic technology with power conversion efficiencies (PCEs) surpassing the 23 % mark. One of the main bottlenecks of the technology is their long-term stability. Understanding the different degradation mechanisms of the constituent materials, as well as interface instabilities, is of crucial importance for commercialization. Semiconductor oxides (SO) constitute a fundamental part of highly efficient photovoltaic technologies such as PSCs. Electron transport semiconductor oxides, like TiO_2, are characterized by an oxygen vacancy (O_{vac})-mediated conductivity caused by a deviation in stoichiometry, the presence of impurities, or both. In oxygen-containing atmospheres, and especially under UV light, holes generated at the nonstoichiometric oxide surface react with the oxygen adsorbed at an O_{vac} increasing charge recombination and degradation of the solar cell. Different methods have been employed to passivate or eliminate these O_{vac}. For example, the application of organic interfacial modifiers with anchoring groups specifically selected to bond with oxides, or the application of less reactive SnO_2 which results in less hygroscopicity, fewer O_{vac} at its surface, and less UV-damage. Another possibility is the application of a coating of secondary oxides, like Al_2O_3, applied to supress surface defects, avoid interfacial recombination, and enhance device stability. A less-explored option is the application of complex oxides with singular properties, such as ferroelectric, multiferroic, magnetic, etc. In this talk, we report our most recent studies on the application of classic oxides (binary, doped, nanostructured) and complex oxide compounds (ternary, ferroelectric) as transport layers in Halide Perovskite Solar Cells. We will focus the discussion on the effect on the long-term stability of solar cell devices.

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Energy level alignment and surface properties of Pb-free halide double perovskites

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Over the last two years, halide double perovskites that are based on combinations of monovalent and trivalent cations, have been extensively investigated as potential lead-free alternatives to lead halide perovskites [1-3]. Since their theoretical prediction [1,2], four compounds have been successfully synthesized: $Cs_2BiAgCl_6$, $Cs_2BiAgBr_6$, $Cs_2SbAgCl_6$, and $Cs_2InAgCl_6$. Among these some exhibit band gaps in the visible and all have low carrier effective masses. Therefore, these compounds are candidates for various opto-electronic applications like solar cells and photo-catalysts. Here, we will briefly discuss the computational design principles that lead to the synthesis of these compounds [3]. We will mainly focus on recent findings based on first-principles calculations, that investigate the structural and electronic properties of the bulk compounds and their surfaces [4]. In particular we will show that the double perovskites $Cs_2BiAgCl_6$ and $Cs_2BiAgBr_6$ are particularly interesting compounds for photo-catalytic water splitting. On the other hand, $Cs_2InAgCl_6$ and $Cs_2SbAgCl_6$ have energy levels appropriate for water splitting only for specific surface terminations. Finally, we show that mixing halogens can be used as a way to tune the electron affinity of these materials.

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Perovskite solar cells impedance spectroscopy explained via 1D time-dependent drift-diffusion modelling

Ilario Gelmetti[1,2], D. Moia[3], P. Calado[3], E. Palomares[1,4], J. Nelson[3] and P. Barnes[3]
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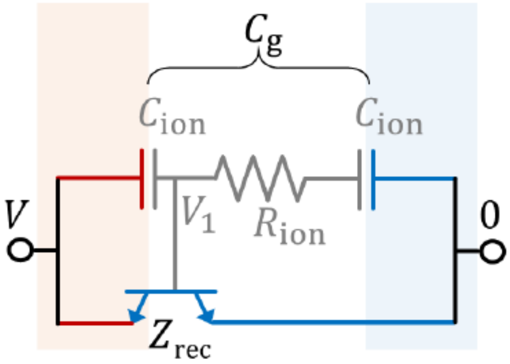
Impedance spectroscopy (IS) is a versatile technique for extracting the main parameters from electronic devices. Its use for studying a solar cell requires a good equivalent electrical circuit, which in turn needs a close-to-full understanding of the charge dynamics in such a device. Hybrid perovskite semiconductors demonstrated amazing photovoltaic behaviour, still, because of their novelty, have some uncovered aspect. Most importantly, ionic migration seems to have a predominant role in the physics of this kind of materials [1]. The interplay between free charges and mobile ions can originate unintuitive results in complex measurements like IS. We employed time-dependent 1D drift-diffusion modelling for exploring the causes of reported giant capacitance [2] and inductive loops [3]. DrIFtFUSION [1] code had been open sourced [4]. The simulated Nyquist and apparent capacitance plots [5] are remarkably close to the experimental data. As expected, when an a.c. voltage was applied, an out of phase ionic current was generated. This in turn drives an amplification of the recombination current. This boosts the measured out of phase current, which can be mistaken for a huge capacitive current, without actually being stored in the device. For including this concept in the equivalent electrical circuit, we introduced at perovskite-contacts interface a bipolar transistor gated by the ionic concentration [5].



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Silicon going indoor

Djordje Jovanović[1], Tijana Tomašević-Ilić[1], Nikola Tasić[2], Aleksandar Matković[1,3], Marko Spasenović[1], Radoš Gajić[1], and Emmanuel Kymakis[4]

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We develop and test low-light efficient graphene/n-Si Schottky junction solar cells (SCs) based on liquid phase exfoliated (LPE) graphene produced by *Langmuir-Schaefer* (LS) assembly. SCs performances are tested under different light intensities of the solar simulator. Our SCs have better performances in indoor then outdoor light conditions. For illumination of only 0.002 Sun, the SCs have up to 10% efficiency and just 0.2% for illumination of 1 Sun, which is about 50 times efficiency increase. This result is, according to our knowledge, highest efficiency solar cells made by LPE 2D materials and is better than commercial Si solar cells in indoor conditions. SC performance in low light regime mainly depends on high shunt (parallel) resistance of solar cells. Better performances in low-light regime proposed their usage in indoor conditions. Furthermore, the low cost of the graphene films we used will have an impact on faster adoption of these specific devices.

Synthesis and protection of copper nanoparticles for power electronic devices.

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Power electronic devices are intended to operate in rough conditions, at temperatures above 200°C. To assemble them, metallic nanoparticles (NPs) are employed instead of traditional soldering alloys such as SAC (Sn, Ag and Cu; T_{melt} = 217°C) thanks to the LTJT for "Low Temperature Joining Technique" [1]. With silver nanoparticles it is possible to sinter at temperatures between 200 and 300°C to obtain a final joint with a melting temperature equal to that of the metal (962°C for Silver).

Silver being an expansive metal, copper nanoparticles are good candidates to replace silver. However pure copper oxidizes quickly and sinters less effectively than silver, that's why copper is usually covered by different kinds of shells. Polymer coated NPs can be employed for printed electronic but organic and polymeric shells don't protect the copper NPs enough for power electronic assembly temperatures. Nevertheless a silver shell can be obtain by a simple electroless reaction [2] and the thickness can be adjusted by post-treatment.

In this work we will discuss the synthesis in polyol medium of copper nanoparticles and copper@silver core-shell nanoparticles, control of nanoparticles diameter and respective characterization (TEM-EDS, XRD…). We will focus our study on the oxidation phenomena for copper and Cu@Ag core-shell nanoparticles by thermogravimetric analysis (TGA). From TG curves it is possible to identify two different oxidation regimes.

In order to obtain a dense and conductive joint, high concentered screen printing pastes are needed that's why Cu@Ag NPs can be produced by scale up.

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Invited Talk

Simulations of single-electron states in metal nanoparticles and transition-metal-dichalcogenides.

Ioannis N. Remediakis[1,2*], Daphne Davelou[1,2] and George Kopidakis[1,2]

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Electronic structure calculations, typically at the level of Density-Functional Theory (DFT), play a key role in the design of new materials, including nanocomposites, heterostructures and nanoparticles. Such complicated structures often demand for multi-scale simulation schemes where DFT couples to classical atomistic or continuous models in order to link the electronic structure to properties of materials. In this talk, I will present results for two classes of hard nanomaterials that dominate current research in materials theory: metal nanoparticles and two-dimensional materials.

Atomistic models of nanoparticles are generated by combining the Wulff construction and surface energies obtained from DFT calculations [1]; these models allow for detailed calculations for any structure-property relationship such as the number of active sites for catalysis or the quantum-confinement levels [2]. This method predicts convex polyhedral shapes for nanoparticles; a recent extension allows for concave polyhedral shapes, too [3].

We studied the well-known problem of metallic edges on two-dimensional semiconductors and found that MoS2 and related materials possess metallic edges. Electrons are localized within 0.5 nm of the zigzag edge, and the energy of these states lies in the middle of the gap of the single-layer [4].

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MATCHMAKING EVENT

The matchmaking event will help you to get your innovations endeavors to grow.

Participants will have the opportunity to present their own project concepts and to meet representatives from companies/SMEs, universities, investors and research organizations in order to exchange ideas during pre-arranged meetings with the aim of paving the way for future venture, co-development and co-operations activities and European projects including call topics for 2018-2020.

Brokerage activity support will be offered by representatives of National Contact Points for NMBP and members of the Enterprise Europe Network

https://nanobioconf.com/matchmaking-event/

KET4
CLEAN PRODUCTION

12:30-13:00	(WS4-Invited) A versatile graphene-based platform for robust nano-bio-hybrid **M. Garcia-Hernandez* et. al., Institute of Materials Science of Madrid (ICMM-CSIC), Spain**	(WS5-Invited) Simulations of single-electron states in metal nanoparticles and transition-metal-dichalcogenides. **Ioannis N. Remediakis*, Daphne Davelou and George Kopidakis** **Dept of Materials Science and Technology, University of Crete & Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas**	
13:00-14:30	**LUNCH BREAK (PASIPHAE ROOM)**		
	WS1 & WS3 Sessions IV – Chairs: A. Andrews (Sub: L.Weiss) *Room*: Minos I	*WS5 Session V – Chairs: G. Malliaras (Sub: R. Klajn)* *Room*: Minos II	Room: Apollon
14:30-14:45	**Nanoreactors with Intracellular Activity** Bo Thingholm* and Brigitte Städler Interdisciplinary Nanoscience Center, University of Aarhus, Aarhus, Denmark	(WS5-Invited) Lab-on-a-Chip & 3D-printing technologies for molecular diagnostics **Electra Gizeli*et.al., University of Crete & IMBB-FORTH, Greece**	Graphene Flagship WP11 meeting
14:45-15:00	**Cellular responses under static and dynamic conditions of polymeric micropatterned substrates fabricated via ultrafast laser direct writing** Eleftheria Babaliari[1,2]*, Paraskevi Kavatzikidou[1], Anna Mitraki[1,2], Anthi Ranella[1] and Emmanuel Stratakis[1,2] [1]Foundation for Research and Technology – Hellas (F.O.R.T.H.), Institute of Electronic Structure and Laser (I.E.S.L.), Heraklion, Crete, Greece [2]Department of Materials Science and Technology, University of Crete, Heraklion, Crete, Greece		
15:15-15:30	**Nanocellulose-based cell culture platforms** Ruut Kummala[1]*, Chunlin Xu[2] and Martti Toivakka[1] [1]Laboratory of Paper Coating and Converting and Center for Functional Materials, Åbo Akademi Univeristy, Turku, Finland; [2]Laboratory of Wood and Paper Chemistry, Åbo Akademi University, Turku, Finland	(WS5-Inivted) Engineering Conjugated Polymers for Biosensing/Interfacing **Sahika Inal*, KAUST, Saudi Arabia**	
15:30-15:45	**Stimuli-Responsive Surfaces for Biological Applications** A. R. Kyvik,[1]* J. Veciana, K. Sugihara,[2] D. Pulido[3] M. Royo,[3] J. Guasch[1] and I. Ratera.[1] [1]Institut de Ciència dels Materials de Barcelona (ICMAB-CSIC)/CIBER-BBN, Spain; [2]Department of Physical Chemistry, University of Geneva, Switzerland; [3]Combinatorial Chemistry Unit, Barcelona Science Park, Baldiri Reixac 10, 08028, Barcelona, Spain		
15:45-16:00	**Optoelectronic control of single cells using organic photocapacitors** Marie Jakešová[1]*, Malin Silverå Ejneby[2], Tony Schmidt[3], Johan Brask[2], Vedran Derek[1], Magnus Berggren[1], Rainer Schindl[3], Fredrik Elinder[2], Daniel Simon[1] and Eric Daniel Głowacki[1] [1] Laboratory of Organic Electronics, ITN Campus Norrköping, Linköping University, 60221, Norrköping, Sweden; [2]Department of Clinical and Experimental Medicine, Linköping University, SE-58185, Linköping, Sweden; [3]Institute for Biophysics, Medical University of Graz, Harrachgasse 21/IV, 8010, Graz Austria	**Photonic crystal-based sensor for label-free detection of fibrinopeptide B** Sara Resende*, Manuela F. Frasco and M. Goreti F. Sales BioMark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Porto, Portugal	
16:00-16:15	**Amyloid Designable Peptide Materials and Their Use as Scaffolds** Chrysoula Kokotidou[1,2] *, Sai Vamshi R. Jonnalagadda[3], Asuka A. Orr[3], Mateo Seoane-Blanco[4], Chrysanthi Pinelopi Apostolidou[1,2], Mark J. van Raaij[4], Antonio L. Llamas-Saiz[5], Phanourios Tamamis[3], Anna Mitraki[1,2] [1]Dept of Materials Science and Technology, University of Crete, Heraklion, Greece; [2] Institute of Electronic Structure and Laser (IESL), FORTH, Heraklion, Greece; [3] Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, TX, USA; [4] Dept de Estructura de Macromoleculas, Centro Nacional de Biotecnologia (CSIC), Madrid, Spain; [5] X-Ray Unit, RIAIDT, University of Santiago de Compostela, Santiago de Compostela, Spain	**Improving the bio-recognition selectivity of nanosized layers with protein-polymer conjugates** R. Milani[1]*, Y. Liu[1], T. Nevanen[1], K. Kempe[2], P. Wilson[2], A. Paananen[1], L.-S. Johansson[3], J.J. Joensuu[1], M.B. Linder[3], D.M. Haddleton[2] [1]VTT Technical Research Centre of Finland Ltd, Espoo, Finland; [2]University of Warwick, Conventry, United Kingdom; 3Aalto University, Espoo, Finland	

16:15-16:30	**Transcriptomic profiling reveals gene expression changes in an ex vivo human placenta model following exposure to engineered nanomaterials** Savvina Chortarea[1]*, Manser P[1] Fortino V[2], Wick P[1], Greco D[3] and Bürki-Thurnherr T[1] [1] Laboratory for Materials-Biology Interactions, Empa, Swiss Federal Laboratories for Materials, Science and Technology, St Gallen, Switzerland; [2] Institute of Biomedicine, University of Eastern Finland, Joensuu, Finland; [3] Institute of Biomedical Technology, University of Tampere, Tampere, Finland	**Nanoscale sensor devices: from a molecule to a whole cell detection** Larysa Baraban1,2*, Bergoi Ibarlucea1,2, Julian Schütt1, M. Medina-Sanchez3, W.M. Weber2,4, O.G. Schmidt3, T. Mikolajick2,4, and G. Cuniberti1,2 1 Institute of Materials Science and Max Bergmann Center for Biomaterials, Dresden University of Technology, 01062 Dresden, Germany; 2 Center for Advancing Electronics Dresden (CfAED), Germany; 3 Institute for Integrative Nanosciences, IFW Dresden, 01069 Dresden, Germany; 4 gGmbH Namlab Dresden, Germany	Graphene Flagship WP11 meeting (Apollon Room)
16:30-16:45	**Dynamic Photopolymerization Produces Complex Microstructures on Soft Hydrogels in a Moldless approach to Generate a 3D Intestinal Tissue Model** Albert G. Castaño[1], Maria García-Díaz[1], Gizem Altay[1], Núria Torras[1], Elena Martínez[1,2,3]* [1]Institute for Bioengineering of Catalonia (IBEC), The Barcelona Institute of Science and Technology (BIST), Barcelona, Spain; [2]Centro de Investigación Biomédica en Red (CIBER), Madrid, Spain; [3]Dep. of Electronics and Biomedical engineering, University of Barcelona (UB), Barcelona, Spain	**Can pulsed electric field change the fate of proteins binding?** Djamel Eddine Chafai1*, and Michal Cifra3 1Institute of Photonics and Electronics of the Czech Academy of Sciences, Chaberska 57, 18251, Prague 8, Czechia	
16:45-17:00	**Luminescent nanoparticles release from biocompatible polymeric fibers** Benedetta Del Secco*, Liviana Mummolo, Maria Letizia Focarete, Andrea Merlettini, Chiara Gualandi, Luca Prodi, Nelsi Zaccheroni University of Bologna, Bologna, Italy	**A slab waveguide microscopy platform for label-free study of biological nanoparticles** Mokhtar Mapar[1]*, Björn Agnarsson[1], Vladimir Zhedanov[1] and Fredrik Höök[2] [1] Department of Physics, Chalmers University of Technology, Göteborg, Sweden; [2] Boreskov Institute of Catalysis, Russian Academy of Sciences, Novosibirsk, Russia	
17:00-17:15	**Circadian flowering: from solar zenith to focused light within cells** Dimitrios Gkikas*, Chrysanthi Chimona and Sophia Rhizopoulou Department of Botany, Faculty of Biology, National and Kapodistrian University of Athens, Athens 15781, Greece	**The new type of bipyramidal-Au@SiO2 nanoparticles – synthesis and Raman application** Karol Kołątaj*, Andrzej Kudelski University of Warsaw, Department of Chemistry Warsaw, Poland	

17:15-17:30	**END OF SESSION**	**Solution Processed Multi-layer Metal Oxide Transistors** Hendrik Faber[1]*, Emre Yarali[1], Yen-Hung Lin[2], Ivan Isakov[2], Satyajit Das[2], Thomas D. Anthopoulos[1] [1] Division of Physical Sciences and Engineering, King Abdullah University of Science and Technology, Thuwal 23955-6900, Saudi Arabia; [2] Department of Physics and Centre for Plastic Electronics, Imperial College London, Blackett Laboratory London SW7 2BW, United Kingdom	

Nanoreactors with Intracellular Activity

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Therapeutic cell mimicry is an approach, which aims at substituting for missing and/or lost cellular function by mimicking one or more specific cellular activities, e.g. by performing encapsulated biocatalysis to convert a substrate into the required product. However, only few published reports exist demonstrating intracellular activity of these nanoreactors. An example in this context are core-shell particles containing glucose oxidase-loaded liposomal subunits. Their intracellular activity was confirmed by the production of hydrogen peroxide resulting in a drop in viability of RAW 264.7 macrophages [1]. Although active, the assemblies have a relatively large size, limiting cellular internalization combined with the inability to escape endosomal and lysosomal compartments. Therefore, ~200 nm hybrid vesicles (HV) consisting of a mixture of phospholipids and the amphiphilic polymer poly(cholesteryl methacrylate)-*block*-poly(2-(dimethylamino) ethyl methacrylate) (pDMAEMA) were considered [2]. The pDMAEMA block is known to facilitate lysosomal escape via the proton sponge effect. These HVs were found to be more toxic than liposomes, but were generally more efficiently internalized. Further, the HVs were efficiently escaping the lysosomes, illustrating that these assemblies possess the potential to widen the portfolio of vesicular nanocarriers for cytosolic drug delivery.

In an attempt to benefit from the properties of pDMAEMA, but reduce the cytotoxicity of the HVs, current efforts focus on HVs immobilized onto carrier particles coated with a cytosolic degradable polymer membrane.

Taken together, HVs are promising artificial organelle candidates broadening the potential applicably of therapeutic cell mimicry.

[1] B. Thingholm et al., *Small* volume 12, Issue 13, 1806 - 1814 (2016)
[2] W. Zong and B. Thingholm et al., *Langmuir* ”Just Accepted” (2018)

Cellular responses under static and dynamic conditions of polymeric micropatterned substrates fabricated via ultrafast laser direct writing

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Conventional cultures have been proven inadequate to provide sufficient levels of oxygen and nutrients to the interior of the scaffolds, and mechanical stimulation to the cells [1]. On the contrary, dynamic cultures realized with the aid of microfluidics reflect more appropriately the *in vivo* environment of cells in tissues such as the normal fluid flow within the body, consistent nutrient delivery, effective waste removal and mechanical stimulation due to fluid shear forces [2,3]. The purpose of the present work is to fabricate a novel microfluidic platform for the study of the combined effect of fluid shear forces and culture substrate morphology on cell proliferation and directionality [4,5]. A successful fabrication of polymeric micropatterned substrates was accomplished via ultrafast laser direct writing. Under static conditions, the cytoskeleton of the Schwann cells was elongated along the direction of the microgrooves whereas a random orientation noticed on the flat PET (polyethylene terephthalate). Interestingly, under flow conditions, cells appeared to be oriented parallel to flow on the flat PET. Under flow conditions combined with the microgrooves, cells oriented along the direction of the microgrooves and parallel to flow (synergistic effect). However, by applying a flow rate perpendicular to microgrooves, cells oriented along the direction of the microgrooves and perpendicular to flow (antagonistic effect). The ability to control cell alignment *in vitro* could potentially be used in the fields of tissue engineering and regenerative medicine.

[1] Leclerc, E., et al. Biomaterials 27.4, 586 (2006)
[2] Gómez-Sjöberg, R., et al. Analytical chemistry 79.22, 8557 (2007)
[3] Mehling, M., et al. Current opinion in Biotechnology 25, 95 (2014)
[4] Stratakis, E., et al. Biomicrofluidics 5.1, 013411 (2011)
[5] Ranella, A., et al. Acta biomaterialia 6.7, 2711 (2010)

Acknowledgments: This work was supported from funding by State Scholarship Foundation (IKY) within the framework of the Action "Doctoral Research Support" (MIS 5000432), ESPA 2014-2020 Program, CN: 2016-ESPA-050-0502-5321 and Onassis Foundation through the G ZM 039-1/2016-2017 scholarship grant.

Nanocellulose-based cell culture platforms

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Nanocellulose is a well-known natural based nanomaterial that shows great promise for biomedical applications. Advantages of the nanocellulose include biocompatibility, biodegradability, gel-forming capability, low-cost and large-scale production possibility of wood-based nanocellulose. Furthermore, nanocellulose-based bionanocomposites have shown potential in biomedicine due to added antibacterial properties, improved mechanical strength, and controlled drug delivery functionality. First commercial biomedical products, wound dressings based on bacterial nanocellulose, are already available.

Nanocelluloses are divided to cellulose nanocrystals, cellulose nanofibers and bacterial nanocellulose. Here we have studied thin hydrogel films made of wood-based cellulose nanofibers. Cellulose nanofibers with different carboxylate contents were obtained by TEMPO-mediated oxidation that is one of the most common chemical pretreatments of cellulose to add carboxylate groups on the fibril surface. To understand the mechanical characteristics of films in different salt environments existing in body and in cell culture, their surface stiffness and twater absorption properties in liquids with increasing divalent ion, Ca^{2+}, concentrations was studied

The nanocellulose fibers surface charge, controllable by the carboxylate content, defines film's water absorption capacity when in contact with the liquid with low multivalent ion concentration. Increased calcium ion concentration of the liquid in contact with the nanocellulose film increases ionic crosslinking of the nanocellulose fibrils and as a result reduces the water absorption capacity of the film. In cell culture media, which has 1.8 mM $CaCl_2$ concentration, the surface stiffness value of the films was in the same range as those of skin tissue. These type of soft hydrogel films are especially interesting for those applications that require contact with soft tissues such as skin.

Stimuli-Responsive Surfaces for Biological Applications

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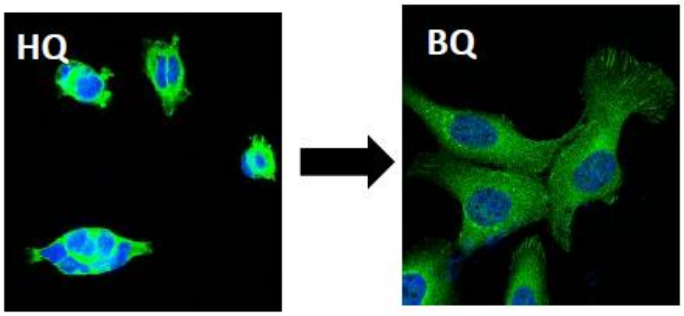
Dynamic molecular interfaces that allow the control of biological interactions and cell behavior in culture [1] using an external stimulus are relevant for applications in a broad spectrum of scientific areas, such as biology, material sciences and medicine.

In this line, stimuli-responsive self-assembled monolayers (SAMs) are used to confer switchable physical, chemical, or biological properties to surfaces through the application of external stimulus.

To obtain spatially and temporally tunable surfaces, we present microcontact printed SAMs of an electroactive hydroquinone-benzoquinone (HQ-BQ) molecule that are used as a dynamic interface to immobilize different functional molecules either via Diels–Alder (DA) or Michael thiol addition (MA) interfacial reactions upon the application of a low electric potential. [2]

This dynamic interface has then been used for two different biological applications: (1) Control of lipid bilayers mobility to study membrane proteins and (2) Study cell adhesion with a spatio temporal control.Actually, membrane proteins are notoriously difficult to characterize, (i.e. image by AFM) because they diffuse faster than the scanning speed of conventional AFMs. With such a dynamic interface we allow a control in the mobile fraction of lipid bilayers with an electrochemical external input (temporal control), which is relevant for the study of membrane proteins.



Cell adhesion is an important and complex biological process and its control is very important to understand cell behavior. Here we have exploited the interfacial reactions MA and DA to immobilize pegylated RGD functionalized peptides containing thiol or cyclopentadiene groups which allow controlling cell attachment once the SAM has been oxidized to BQ. Moreover, a quantitative analysis of cell attachment by immunostaining the focal adhesions have been performed to compare MA and DA platforms. The versatility of this biocompatible platform opens up for new possible innovative applications within the biomedical field.

[1] (a) Witold I. Tatikewicz, A. R. Kyvik, *ACS Appl. Mater. Inter.*, just accepted (2018); (b) E. Perez del Río, I. Ratera, J. Guasch, et al. *ACS Omega*, 3, 5273−5280 (2018)

[2] Adriana R. Kyvik, et. al. *J. Phys. Chem. B.,* 122, 4481−4490 (2018)

Optoelectronic control of single cells using organic photocapacitors

Marie Jakešová[1*], Malin Silverå Ejneby[2], Tony Schmidt[3], Johan Brask[2], Vedran Derek[1], Magnus Berggren[1], Rainer Schindl[3], Fredrik Elinder[2], Daniel Simon[1] and Eric Daniel Głowacki[1]

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Light-mediated control of electrophysiology at the single cell level is a powerful tool for basic research and enabling novel biomedical technologies. Herein we report on organic electrolytic photocapacitors (OEPCs) [1], a thin-film semiconductor optoelectronic device that transduces optical light pulses into transient potentials in electrolytes. The devices consist of a semi-transparent conductor layer covered with metal-free phthalocyanine, and N,N'-dimethyltetracarboxylic bisimide, which function as the electron-donor and electron-acceptor layers, respectively. This metal/donor/acceptor stack produces an open circuit potential in electrolyte solution of 300 mV upon illumination using light in the NIR tissue transparency window 630-680 nm. We have performed single-cell electrophysiological recordings on *xenopus laevis* oocytes, as well as human embryonic kidney cells, finding photoinduced changes of membrane potential on the order of tens to hundreds of millivolts. The magnitude and duration of the transient voltage induced across the membrane depends on the light intensity used, the capacitance of the back electrode and the waveform of the light pulse. We find also photoinduced shift in the i-v characteristics of voltage-gated ion channels enabling their opening at more negative potentials, which is ultimately important for determination of action potential triggering mechanism. The amplitude and time window of transient voltages accessible is appropriate for a wide degree of electrophysiological control of single cells.

[1] D. Rand, et al. *Advanced Materials* (2018) DOI: 10.1002/adma.201707292

Amyloid Designable Peptide Materials and Their Use as Scaffolds

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Amyloid self-assembly refers to the conversion of specific proteins and peptides from their native functional states into long unbranched fibers that are characterized by a cross-beta sheet quaternary structure. Amyloid formation has been associated with a range of human disorders, including Alzheimer’s disease, prion and Parkinson’s disease. Fibrous amyloid structured aggregates are not only involved in misfolding and disease, but can also be exploited for the formation of novel functional amyloid biomaterials. Amyloid biomaterials have significantly advantageous properties, which among others include their easy fabrication, and the capacity to tune their properties by changes at their sequence level. Naturally occurring peptide sequences extracted from amyloid proteins or beta-sheet protein regions can self- assemble outside the context of the entire sequence into amyloid fibrils and can serve as scaffolds for novel biomaterials. Peptide sequences GAIIG and GAITIG are part of the amyloid-beta (Aβ) peptide, linked to Alzheimer’s disease, and the adenovirus fiber shaft, respectively.

In this study we took advantage of their unique self-assembling properties and with the aid of computational methods we applied suitably selected modifications at flexible positions, to tune the properties of amyloid forming peptides in order to discover novel functional biomaterials in two different applications. In the first application, our computational and experimental results suggest interaction of a designed beta-breaker peptide GAIPIG with Aβ, delaying the aggregation of the peptide $A\beta_{1-40}$ *in vitro* and considering it as a potential inhibitor of amyloid formation. In the second application, we present novel amyloid biomaterials that are capable of binding and capturing cesium ions at neutral and low pH conditions, enabling their use as scaffolds for the removal of cesium ions from nuclear waste or blood.

[1] C. Kokotidou et al. *FEBS Letters* **592** 1777-1788 (2018)

[2] K. Papanikolopoulou. *J Biol Chem* **280**, 2481–2490(2005)

Transcriptomic profiling reveals gene expression changes in an *ex vivo* human placenta model following exposure to engineered nanomaterials

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With the rapid growth of nanotechnology, potential human exposure to engineered nanomaterials (ENMs) is expected to increase, thus raising concerns of possible adverse health effects in particular for sensitive populations such as pregnant women and the developing fetus. There is increasing evidence from animal studies that ENMs may affect pregnancy and fetal health by interfering with placental development and function. However, the underlying mechanisms are largely unknown and verification in human placental tissue is urgently needed to exclude species-specific differences. Therefore, our aim in the present study was to investigate the impact of two common commercial ENMs *i.e*. copper oxide (CuO; 10-20 nm) and polystyrene nanoparticles (PS; 70 nm) on human placental function and physiological signaling using the *ex vivo* human placenta perfusion model. Subsequently, global gene expression profiling was performed following a 6 h exposure to sub-cytotoxic doses of CuO (10 µg/ml) and PS (25µg/ml). Interestingly, 779 genes were differentially expressed upon PS exposure, while 431 were affected by CuO treatment. A total of 230 genes were commonly modulated after both ENMs exposures, compared to untreated placentas. Most differentially affected canonical pathways were related to hormone and chemokine/cytokine signaling. In addition, genes affecting the differentiation of stem cells, vascular functions and the regulation of the immune system were also disrupted, further supporting that ENMs may interfere with placental function. The observed dysregulation of cytokines, hormones and angiogenic factors may be associated with increased risk of pregnancy complications and disorders *such as* pre-eclampsia or intrauterine growth restriction. QRT-PCR validation of the obtained data is ongoing.

Dynamic Photopolymerization Produces Complex Microstructures on Soft Hydrogels in a Moldless approach to Generate a 3D Intestinal Tissue Model

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Epithelial tissues contain three-dimensional microstructures that guide cell self-organization at the tissue level. In the small intestine, crypts and finger-like villi microstructures improve its absorbance function, provides specific microenvironments for the microbiota and compartmentalize cell types [1–3]. Despite its physiological relevance, this architecture is neglected in the standard *in vitro* models of the small intestine, questioning the predictive capacity of current drug development preclinical tests [4].

We in here have engineered a simple, single-step fabrication strategy to produce biomimetic scaffolds faithfully replicating the 3D complex architecture of the small intestinal epithelium in soft synthetic hydrogels. By using a set-up that combines photolithography with dynamic reaction-diffusion polymerization processes, anatomically correct villi-like scaffolds can be easily produced directly on Transwell® filter inserts. In addition, we copolymerize poly(ethylene glycol) diacrylate polymer with acrylic acid, which we show improves the control of the reaction-diffusion processes that govern the free-radical polymerization of highly-diluted polymeric solutions. Moreover, acrylic acid provides the scaffold material with tunable ligand densities while maintaining soft mechanical properties, therefore further extending the potential of this fabrication technique. Previous studies reported about combining sequential polymerization steps to produce complex 3D structures in hard resists [5]. However, to our best knowledge, our method is the first work that provides experimental evidence that such structures can be obtained in soft hydrogels. Improving the prediction capabilities of cell-based assays is a growing strategy to lead to more efficient drug development processes. As 2D-based systems are showing their limits, new 3D strategies are gaining acceptance among the scientific community. The methodology described in our work aims to further accelerate this trend by providing a feasible strategy to routinely incorporate 3D structures mimicking microtopographies at the tissue level in cell culture systems.

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[2]. M.N. Marsh, J.A. Swift, *Gut*, 10 940–949 (1969).
[3]. P. Kelly, I. Menzies, R. Crane, I. Zulu, C. Nickols, R. Feakins, J. Mwansa, V. Mudenda, M. Katubulushi, S. Greenwald, M. Farthing, *Am. J. Trop. Med. Hyg.* 70, 412–419 (2004).
[4]. A. Abbott, *Nature*, 424, 870–872 (2003).
[5]. T.S. Shim, S.-M. Yang, S.-H. Kim, *Nat. Commun.,* 6, 6584 (2015).

Luminescent nanoparticles release from biocompatible polymeric fibers

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Nanomedicine and in particular the area of drug delivery has gained increasing interest in last decades. The controlled release of a drug at the therapeutically optimal rate and dose is a major concern, and new carriers are needed for a sustained release. Among many approaches proposed to reach this aim, polymeric nanofibers represent a promising tool. Indeed, they can be easily produced by a cost-effective and scalable electrospinning process in the form of non-woven mats, which can be eventually implanted in the human body to release in-situ the embedded therapeutics.

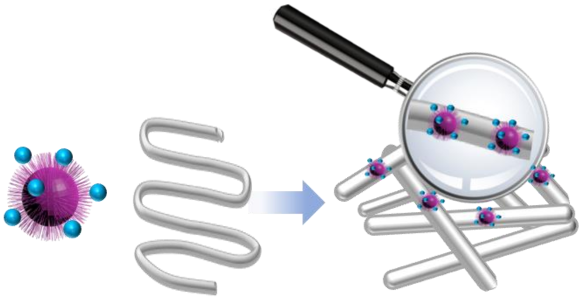

Figure 2 Cartoon of the electrospun nanoparticles inside polymeric fibers

We decided to take advantage of the synergistic action of the above-mentioned polymeric nanofibers with 'drug' luminescent silica core/PEG shell nanoparticles (NPs), that have been studying since a few years as imaging agent[1], carriers[2] and lately as theranostic materials. Firstly, we decorated the shell of the NPs with a peptide sequence known to be able to selectively recognize a sequence over-expressed by the hepatic cancer cells. Suspensions of core-shell luminescent silica NPs in a polymeric solution of poly(lactide-*co*-glycolide) copolymer (PLGA 50:50 w/w) were electrospun and two different nanofibers mats was obtained: the first one embedding NPs without superficial derivatizations and the second one functionalized with the peptide.

The release of the NPs in PBS at 37 °C from the nanofibers mats was studied and followed by spectrofluorimetric measurements. The release profiles were compared and each of them was correlated with fiber degradation profiles in the same phisiological conditions. The obtained data demonstrate the possibility to design and control the release kinetics of non-cytotoxic NPs[3] from a bioresorbable nanofibrous mat, opening up a wide number of potential biomedical application.

[1] E.Rampazzo et al. *Nanoscale*, 4, 824 (2012)
[2] N.Zaccheroni et al. *Chem. Commun*, 50, 15259 (2014)
[3] L.Prodi et al. *Nanoscale*, 5, 7897 (2013)

Circadian flowering: from solar zenith to focused light within cells

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A model of floral reflectance of floral tissues [1] bearing papillae epidermal cells was achieved by combined microscopic structures and optical properties of petals; the model theory was based on concepts of physical laws, analytic geometry, vector analysis and micro-optics. It has been argued that the focal regions of incident light can be viewed in central regions into exposed, epidermal papillae cells of living tissues [1]. Notably, the perceived floral colours result from both selective absorption of light by plant pigments and light reflection coordinated with structural components and micro/nano-optics of living tissues [2]. The model is also shown to fit experimental data of floral reflectance [1]. Particular attention was given to light focused within epidermal cells of flowers with respect to blossom regulated by photoperiod, which acts to insure that flower opening occurs during suitable, environmental conditions. it appears that solar light is selectively channeled into sites containing light absorbing pigments and the subsequent paths of light beams depend on optical properties and structural elements of plant tissues [3-5]. Light focal regions within the exposed epidermal cells of petals may trigger circadian oscillator linked to floral expansion. The model [1] indicates that light focal regions, within the epidermal cells, are diurnally shifted over nanoscale distances (< 2 nm) that can be linked to solar zenith positions; such submicron features and optical properties of living tissues may have applications to the rapidly growing and promising field of biomimetics.

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PARALLEL SESSIONS – WS5 Session V on Minos II

Invited Talk

Lab-on-a-Chip & 3D-printing technologies for molecular diagnostics

E. Gizeli[1,2*], G. Papadakis[1], A. Pantazis[1], K. Parasiris, M. Ntogka

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The development of miniaturized micro-nano-bio systems has revolutionized bioanalytical sciences. In particular, it has impacted point-of-care diagnostics, where portable, fast and efficient systems are required for the analysis of genetic markers in human, agro/food and environmental specimen. For the handling of small samples, i.e., from few hundred to several tenths of microliters, microfluidics have been developed and applied to sample concentration, target nucleic acid amplification and detection based on colorimetric and electrochemical, optical or acoustic biosensing methods.

In our group, we have developed a lab-on-a-chip based on standard micro-nanofabrication methods and demonstrated its applicability to the genetic analysis of *Salmonella* in milk based on acoustic detection. The use of acoustic biochips, normally used in mobile phones as frequency filters, is a very attractive alternative for biosensing as indicated by recent advances in the field [1]. Starting from as little as 1-5 cells in 25 gr of sample, the EU-imposed minimum limit of detection (LOD), we demonstrated that, thanks to the use of nano-immuno particles, isothermal amplification and ability for acoustic detection in unpurified samples, it is possible to reach the above LOD in a total analysis time of 4 hours; this is a huge improvement to the currently 24 hrs required using standard lab-based methodologies.

In a different approach, 3D-printing was employed as an efficient prototyping method to build miniaturized systems for the genetic detection of target molecules in human samples. Optimized 3D-printed micro-reactors in the form of open wells or enclosed miniaturized tubes have been manufactured and employed in combination with isothermal amplification and colorimetric detection for specific gene analysis in human samples such as saliva, blood and nasal swab The attractive fabrication cost, fast prototyping and robustness of the developed miniaturized 3D-printed systems together with the demonstrated high LODs (<10copies) in real crude samples hold promise for the future application of this method as a companion diagnostic and/or point-of-care system for both developed and low resource areas.

Acknowledgements: This work is funded by the EU Horizon 2020 through ICT 20-2015 project LoveFood2Market (No 687681) and FET-Open CATCH-U-DNA (No 737212).

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Invited Talk

Engineering Conjugated Polymers for Biosensing/Interfacing

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Conducting both ionic and electronic charge carriers, conjugated polymers are impacting on a large variety of biology-related applications as the electronic material interfacing living systems. A device type that has predominantly utilized these materials as its active component is the organic electrochemical transistor (OECT) – an electrolyte gated transistor used for ionic-to-electronic signal transduction. In this talk, I will present a comprehensive study on the thin film properties of a series of conjugated polymers and evaluate the concomitant performance of electrolyte gated transistors comprising these materials. I will highlight the so far neglected influence of water transferred during the injection of electrolyte ions on the performance of OECTs. Establishing structure-property relationships in these systems, we show for the first time, enhancements and advantages for bio-analyte sensing. The biosensor is an OECT based on an n-type polymer which incorporates hydrophilic side chains to enhance ion transport/injection and to facilitate enzyme conjugation. Highlighting the materials properties that enable enhanced ion-to-electron transduction, this work provides an understanding of materials-device performance relations for the development of low-cost, rapid, label-free point of care assays.

Photonic crystal-based sensor for label-free detection of fibrinopeptide B

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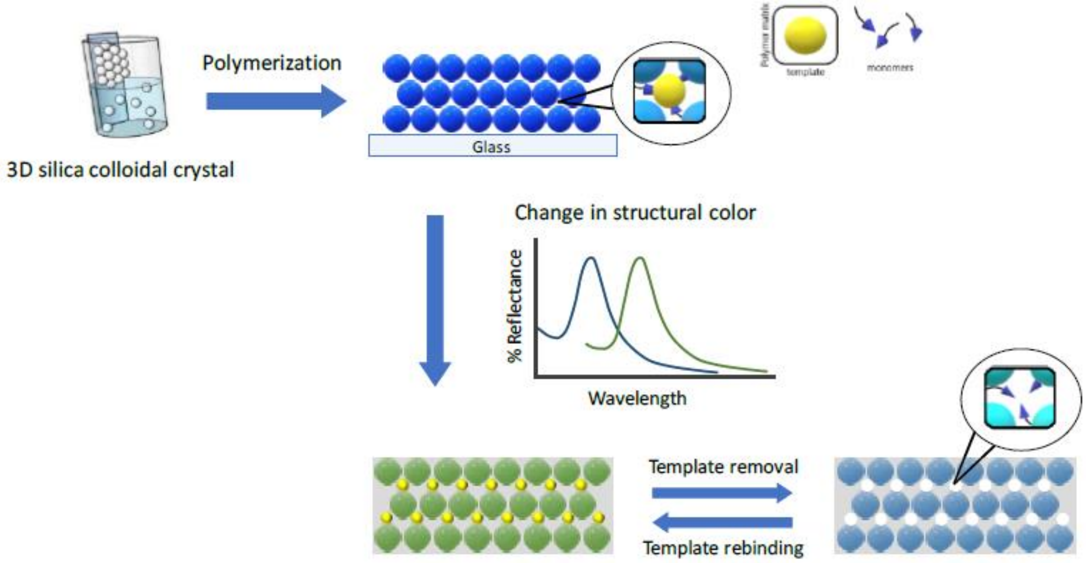
Point-of-care devices for testing biomarkers of disease are characterized by quick readable signals giving accurate and sensitive responses without any sample treatment or use of complex instruments. Herein, an innovative strategy is presented for convenient detection of fibrinopeptide B, a biomarker of venous thromboembolism. The sensor is developed based on a merge between molecular imprinting technique and photonic crystals.

Highly ordered colloidal array of monodispersed silica nanoparticles was used to construct the molecularly imprinted photonic polymer (MIPP). To prepare the sensing layer with specific binding cavities, the hierarchical porous structure is used as mold to cast the plastic recognition elements. The MIPP contains the molecular imprints of fibrinopeptide B and exhibits optical properties that change upon detection of the target biomarker (Scheme 1). The application of such label-free sensor with high selectivity and stability as well as easy operation might offer an auspicious method for rapid and real-time detection of fibrinopeptide B.



Scheme 1 – Schematic representation of the MIPP.

Acknowledgements: The authors gratefully acknowledge the financial support from STRIP2SENSE (NORTE-01-0145-FEDER-024358) and IBEROS (INTERREG POCTEP/0245_IBEROS_1_E) projects.

Improving the bio-recognition selectivity of nanosized layers with protein-polymer conjugates

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High-performing biosensing devices should possess both high *sensitivity* and *selectivity.* This means that not only the device should be able to recognize small concentrations of target analyte, but also that the recognition event should not be triggered by non-target elements, thus avoiding false positives. This is particularly important e.g. for biological fluid or food samples, where small concentrations of target analyte may be embedded in complex non-target environments [1].

It was previously shown that bioengineered fusions of protein A with hydrophobins can be used to prepare thin layers for immunoglobulin biosensing, where protein A modules provide the recognition function while hydrophobin units allow easy immobilization [2]. Here we demonstrate that the specificity of these sensing layers can be significantly improved by co-assembling them with hydrophobin–antifouling polymer bioconjugates, to form layers where the surface portions between immobilized protein A units are occupied by the antifouling polymer.

The reduction of non-specific adsorption was assessed in competitive binding tests in a Quartz Crystal Microbalance, by exposing the assembled layers to mixtures of BSA and immunoglobulin. The results showed that the presence of the antifouling polymer reduced significantly the ability of BSA to act as a competitor, even when present in a very large excess (15000 vs. 80 nM).

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Nanoscale sensor devices: from a molecule to a whole cell detection

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Synergy between, physics, material sciences and biotechnology during last decade has led to a tremendous scientific progress in the fields of biodetection and nanomedicine. This tight interaction led to the emergence of a new class of bioinspired systems that enables to bring the area of biosensorics *e.g*. for cell or molecular diagnostics and analytics to the new level. The advances are expected in terms of (i) possibility of early diagnostics of diseases due to the increased sensitivity of the detectors, (ii) real time and high throughput analysis offered by combination of integrated electronics and microfluidic approach, and (iii) establishing the new functional formats for the bioassays. One of the most promising candidates for the future diagnostics are the electronic nanobiosensors that have attracted great attention in the last decades since they provide rich quantitative information for medical and biotechnological assays without pre-treatment and specific optical labelling of the detected species. One dimensional nanostructures, in particular semiconductor and metallic nanowires, are considered as highly efficient sensor elements due to their high surface-to-volume ratio, which simplifies the detection of biochemical species down to single molecules.

Here we focus on two subsystems for the analysis at the micro- and nanoscale, represented by (a) silicon nanowires based field effect transistor and (b) metal nanowires assembled as nanocapacitor. We demonstrate the applicability of the systems for the detection single molecules, *e.g.* influenza or Ebola viruses [1-3], biochemical reactions [4], as well as classify the blood cells in a cytometry format.

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Can pulsed electric field change the fate of proteins binding?

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Nano/Microsecond pulsed electric field (ns/µs PEF) treatments of mammalian cells have been shown to permeabilize both plasma and organelle membranes, disturb intracellular vesicles, induce cellular blebbing, swelling, alter intracellular Ca^{2+} homeostasis, damage cytoskeleton and other effects [1]. Cytoskeleton filaments, especially microtubules (MT), are of a great importance for cellular trafficking and cell division. MT are formed from tubulin heterodimer subunits in a dynamic polymerization process [2]. The control of this process is of a great interest for medical applications. To contribute to the mechanistic understanding of PEF action on MT, we analyze how PEF modulates tubulin's zeta potential and MT polymerization in this study.

ZetaPALS from the Brookhaven Instruments Corporation (USA) was used to determine the isoelectric point of tubulin and the Zeta potential of our samples before PEF treatment and after PEF treatment. Later on, the control and the treated samples with PEF were subjected to the polymerization process. The kinetics of tubulin assembly to MT was monitored by standard method of absorbance at 370 nm. Based on the isoelectric point and zeta potential measurements, the results clearly show that pulsed electric field modifies the surface charge of tubulin. Additionally, the polymerization kinetics of PEF treated tubulin was different from in control tubulin sample as it was assessed by absorbance.

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Acknowledgements: Authors acknowledge support by Czech Science Foundation, project no. 17-11898S and the COST EMF-MED (Action BM1309). Authors also participate in the exchange project between Czech and Slovak Academy of Science SAV-18-11.

A slab waveguide microscopy platform for label-free study of biological nanoparticles

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Our understanding of Biological nanoparticles (BNPs) such as protein, viruses and extracellular vesicles plays a key role in our fight against incurable diseases. Most of the current BNP characterization methods are either based on ensemble measurement techniques, unable to differentiate the subtle differences and heterogeneities in the sample, or based on fluorescent labelling which is prone to bleaching and limits the studies to targets with available fluorescently labelled counterpart. Label-free microscopy techniques that are capable of identifying minuscule changes in the faint signal from sub 100 nm nanoparticles can provide a solution to unravel the diversity of BNPs without requiring fluorescent labels.

Here we present a novel microscopy platform that facilitates label-free investigation BNPs on the single particle level. The platform consists of a single-mode slab waveguide that allows for diffraction-limited evanescent-field microscopy of nanoparticles with or without fluorescent labels at a low background. We describe the fabrication process of such device with silica core layer that is compatible with inverted microscopes and equipped with microfluidics for controlled liquid handling.

We demonstrate the capabilities of the platform for the study of BNPs by comparing labelled (fluoresce) and label-free (scattering) detection of 40 nm virus-like particles using lipid vesicles as well as monitoring of the binding dynamics of cholera-toxin B (CTB) to GM1 modified, surface-bound, lipid vesicles. We further suggest a model to quantify the bound concentration of CTB using the change in the scattering signal before and after CTB adsorption.

The new type of bipyramidal-Au@SiO_2 nanoparticles – synthesis and Raman application.

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Warsaw, Poland

SHINERS measurements were introduced by Tian et al. in 2010 as the new approach to analyze various surfaces [1]. In this method Raman spectrum is measured from an investigated substrate covered with gold nanoparticles protected by a thin layer of silica or alumina. In this work, we present the synthesis of bipiramidal Au@SiO_2 core shell nanoparticles as the new type of SHINERS nanoresonators.

The synthesis of bipiramidal Au@SiO_2 nanoparticles, we firstly obtained bipiramidal gold nanoparticles according to a modified method developed by Weizmann [2]. Deposition of thin silica layer on obtained bipiramidal nanoparticles was carried out by the hydrolysis of tetraethoxysilane catalyzed by ammonium solution [3]. Synthesized bipiramidal Au@SiO_2 nanoparticles were presented in Figure 1.

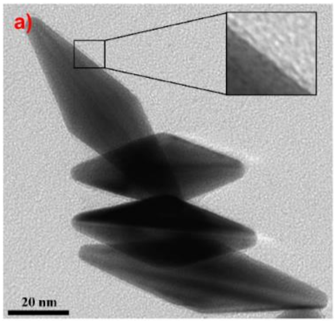

Fig. 1. TEM micrograph of synthesized bipiramidal *Au@SiO_2 nanoparticles*

Obtained Au@SiO_2 nanoparticles were afterwards successfully used as nanoresonators in Raman measurements of 4-mercaptobenzoic acid and 2-mercaptoethanesulfonate. Synthesized anisotropic nanoparticles were approximately 10 times more efficient raman nanoresonators than typical spherical ones. Obtained bipyramidal Au@SiO_2 were also used for detection of Thiram pesticide deposited on tomato fruit. Limit of detection of Thiram were estimated to be 1.2 ng/cm^2.

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Solution Processed Multi-layer Metal Oxide Transistors

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Solution processable metal oxide (MO) semiconductors are finding increased usage in (opto-)electronic devices such as thin-film transistors (TFTs) and integrated circuits, solar cells and memory devices. Research into novel precursor formulations, alternative deposition techniques, post-deposition treatments and improved device architectures allowed for great advances in device performance and reduced process temperatures [1].

Recently, we demonstrated the deposition of ultra-thin (< 10 nm) continuous metal oxide films of e.g. In_2O_3, ZnO or Ga_2O_3, via spin coating and low temperature annealing [2-3]. TFTs based on layer stacks of bilayer hetero-junctions as well as quasi-superlattice arrangements consisting of up to 5 individual layer stacks, were not limited by the intrinsic mobility of their material constituents but rather by the structural and electronic properties at the MO interfaces [2]. By transferring these principles to a deposition technique more suitable for large area, high-throughput manufacturing, we demonstrated high performance In_2O_3/ZnO hetero junction TFTs in which one component (In_2O_3) was deposited via ultrasonic spray pyrolysis (SP) and the top layer via spin coating [3]. The computer controlled deposition and fine droplet sizes make SP ideally suited for up-scalability without sacrificing quality.

Here, our early work is extended and we report on the fabrication of multilayer TFTs wherein all active channel components are deposited via spray pyrolysis in ambient atmosphere at low temperatures. The resulting TFTs exhibit high electron mobility values exceeding 50 cm^2/Vs and channel on/off current ratios on the order of 10^7. The growth kinetics of the individual oxide layers during spray deposition and the impact of solvents will be discussed as well as first insights into bias stability of these high performance devices.

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	WS5 Session VI – Chairs: E. Stratakis *Room*: Minos
18:00-18:30	(WS5-Invited) Printed nanoelectronics: there's plenty of room out there **Thomas Anthopoulos*** **King Abdullah University of Science and Technology (KAUST), KAUST Solar Centre, Division of Physical Sciences and Engineering, Kingdom of Saudi Arabia**
18:30-19:00	(WS5-Invited) The implication of using conductive nitrides as alternative plasmonic materials: going beyond TiN and ZrN **Panos Patsalas*** **Aristotle University of Thessaloniki, Greece**
19:00-19:30	(WS5-Invited) Development of semiconducting polymers for electrochemical transistors in organic bioelectronics **Iain McCulloch*** **King Abdullah University of Science and Technology (KAUST), KAUST Solar Center (KSC), Thuwal, 23955-6900, Saudi Arabia; Department of Chemistry and Centre for Plastic Electronics, Imperial College London, London SW7 2AZ, United Kingdom**
19:30	**CONFERENCE CLOSING CEREMONY** **(STUDENT AWARDS & CLOSING REMARKS)**

WS5 Session VI on Minos II

Invited Talk

Printed nanoelectronics: there's plenty of room out there

Prof. Thomas Anthopoulos

King Abdullah University of Science and Technology (KAUST)
KAUST Solar Centre, Division of Physical Sciences and Engineering
Kingdom of Saudi Arabia

In silicon microelectronics the ability to downscale critical dimensions of its building block, the field-effect transistor, has proven extremely successful over the past sixty years in increasing the device density and performance and as a result, the computational power of modern microprocessors. These extraordinary developments have been achieved through a virtuous circle of scientific and engineering breakthroughs which have led to the proliferation of information & communication technologies with an extraordinary impact on our daily life and society. However, adopting silicon's approach of scaling to emerging technologies such as printed electronics, has proven challenging both in terms of technology and economics. This talk will focus on progress being made downscaling emerging forms of large-area electronics through new materials and fabrication paradigms and their application in the ever expanding ecosystem of the internet of everything.

Invited Talk

The implication of using conductive nitrides as alternative plasmonic materials: going beyond TiN and ZrN

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The nitrides of the group IVb-Vb-VIb transition metals (TiN, ZrN, HfN, VN, NbN, TaN, MoN, WN) constitute the unique category of conductive ceramics. Having substantial electronic conductivity, exceptionally high melting points and covering a wide range of work function values, they were considered for a variety of electronic applications, which include diffusion barriers in metallizations of integrated circuits, Ohmic contacts on compound semiconductors, and thin film resistors, since early eighties. Among them, TiN and ZrN are recently emerging as significant candidates for plasmonic applications due to their refractory character and CMOS compatibility. So the possible plasmonic activity of the rest of transition metal nitrides (TMN) emerges as an important open question. All these nitrides tend to form films and nanostructures of extremely fine grains, when polycrystalline, due to their refractory character. In addition, TaN, WN and MoN were found to be metastable and they are stabilized in the cubic structure by the incorporation of point defects. As a result, there is an interplay between the beneficial effect of the point defects in terms of structural stability and the deterioration of the plasmonic performance due to the subsequent increase of electron losses.

In this work, the optical properties of VN, NbN, TaN, WN, and MoN polycrystalline and epitaxial films will be reviewed [1] and will be critically evaluated by comparing them with *ab initio* calculations of the band structure of the ideal cubic crystals. Their optical performance will be also correlated with their Raman spectra, which are sensitive to the existence of structural defects. Based on the presented results it is proposed that NbN and MoN can be two very promising candidates for near and far UV plasmonics, respectively, while TaN can be also a viable alternative, albeit exclusively in epitaxial form. On the other hand, thermally stable IR plasmonic conductors might be the ternary compounds $Ti_xSc_{1-x}N$, $Ti_xAl_{1-x}N$ and $Ti_xMg_{1-x}N$.

It is also demonstrated that the deterioration of plasmonic response of most conductive nitrides is stronger for the case of point defects and fibrous grains as opposed to grain boundaries in fully-dense polycrystalline films produced by mild ion assistance [2]. Therefore, there is the unexpected conclusion that in some cases polycrystalline films outperform the epitaxial films, which incorporate point defects.

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Invited Talk

Development of semiconducting polymers for electrochemical transistors in organic bioelectronics

Iain McCulloch[1,2]

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[2]*Department of Chemistry and Centre for Plastic Electronics, Imperial College London, London SW7 2AZ, United Kingdom.*

Organic electrochemical transistors (OECTs) have been shown to be promising devices for amplification of electrical signals and selective sensing of ions and biologically important molecules in an aqueous environment, and thus have potential to be utilised in bioelectronic applications. The sensitivity, selectivity and intensity of the response of this device is determined by the organic semiconducting polymer employed as the active layer. Until now, most OECTs have been fabricated with commercially available conducting poly(3,4-ethylenedioxythiophene) (PEDOT:PSS) as the active layer, and therefore operated in depletion mode with limited modulation. This work presents the design of new organic semiconducting materials which demonstrate significant improvements in OECT performance, through operation in accumulation mode, with high transconductance and low operating voltage.

We discuss here the design, synthesis and performance of novel intrinsic semiconducting polymers for efficient accumulation mode OECT devices. Key aspects such as ion and charge transport in the bulk semiconductor and operational voltage and stability of the devices are addressed in order to elucidate important structure-property relationships. A range of new semiconducting polymers, designed to exhibit facile electrochemical doping of either holes or electrons, facilitate ion penetration and migration, as well as have aqueous compatibility are reported. Optimisation of a series of polymer parameters including electrochemical doping, charge carrier mobility and capacitance are discussed. This approach leads to the design of polymers that can outperform state-of-the-art PEDOT:PSS based depletion mode devices with peak transconductances above 20 mS, peak currents in the mA regime, on/off ratios above 105 and excellent switching times below 1 ms. In addition, we demonstrate that polymers with sufficiently high electron affinities and low ionisation potentials can achieve charge carrier ambipolarity, with both p and n-type device operation.

NanoBio2018 Conference Closing Ceremony

STUDENT AWARDS

PROGRAM_POSTER PRESENTATIONS

NOTES

Tuesday, 25th September 2018: Coffee Break (before Lunch): All the Poster Presenters of POSTER SESSION I could place their Poster on the Poster Stands – Go to Registration Desk for adhesive material

Wednesday, 26th September 2018: During the Coffee break (before Lunch time)
NOTE: All the Poster Presenters of POSTER SESSION I should remove their Poster!
All the Poster Presenters of POSTER SESSION II could place their Poster on the Poster Stands – Go to Registration Desk for adhesive material!

POSTER PRESENTATION PROGRAM

POSTER SESSIONS will take place DAY 2 and DAY 3 of the Conference
POSTER SESSION I: 18:00 – 20:00 & POSTER SESSION II: 18:00 – 20:00
(as shown on the main NANOBIO2018 Program)
NanoBio2018 Poster Committee for POSTER SESSION I: Anne M. Andrews, Antonios G. Kanaras, Athanasia Kostopoulou, Joao Mano, Anna Mitraki, Annamaria Petrozza and Minas Stylianakis
NanoBio2018 Poster Committee for POSTER SESSION II: Luigi Colombo, Insung S. Choi, Yulia Galagan, Sahika Inal, Lina Papadimitriou, Anthi Ranella, and Lucien Weiss

POSTER SESSION I Tuesday, 25th September 2018	POSTER SESSION II Wednesday, 26th September 2018
WS1: P1 up to P25 WS2: P1 up to P4 WS3: P1 up to P10 WS4: P1 up to P4 WS5: P1 up to P8	WS1: P26 up to P51 WS2: P1 up to P4 WS3: P11 up to P21 WS4: P5 up to P9 WS5: P9 up to P17

WORKSHOP 1
NANOBIOMATERIALS AND NANOMEDICINE

WS1-P1	**Composite active surfaces for biosensing applications** V. Dinca[1]*, A. Palla Papavlu[1], A. Vasilescu[2], M. Filipescu[1], S. Brajnicov[1], A. Bonciu[1,2] and M. Dinescu[1] [1]National Institute for Lasers, Plasma and radiation Physics, Bucharest, Romania [2]International Center of Byodinamics, Bucharest, Romania
WS1-P2	**Effect of Myoglobin on Photoluminescence of ZnO-Gd2O3 Films** I.A. Hayrullina[1]*, T.F. Sheshko[1], I.A. Nagovitsyn[2,3], G.K. Chudinova[2,4], A.G. Cherednichenko[1], E.A. Sarycheva[1] [1]RUDN University - Peoples' Friendship University of Russia, Moscow Miklukho-Maklaya str.6, Moscow, Russia, [2]Natural Science Center of General Physics Institute RAS, Moscow, Russia [3]Semenov Institute of Chemical Physics RAS, Moscow, Russia [4]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Moscow, Russia

WS1-P3	**Nanoparticle-mediated Enzyme Replacement Therapy and Autophagy Modulation: a new perspective for Krabbe disease** Ambra Del Grosso [1,2]*, Lucia Angella[2], Marianna Galliani [2,3], Nadia Giordano[2,4], Ilaria Tonazzini[1], Melissa Santi[3], Matteo Caleo[2,4], Giovanni Signore3 and Marco Cecchini1,2 [1]NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, Piazza San Silvestro 12, 56127 Pisa (ITALY) [2]NEST, Scuola Normale Superiore, Piazza San Silvestro 12, 56127 Pisa (ITALY) [3] Center for Nanotechnology Innovation@NEST, Istituto Italiano di Tecnologia, Piazza San Silvestro 12, 56127 Pisa (ITALY) [4]CNR Neuroscience Institute, via G. Moruzzi 1, 56124 Pisa, (ITALY)
WS1-P4	**Gold Nanoparticles Against Clinically Isolated Pathogens** Rokas Žalnėravičius[1, 2]*, Arūnas Jagminas[1], Marija Kurtinaitienė[1], Vaclovas Klimas[1] and Algimantas Paškevičius[3] [1]State Research Institute Centre for Physical Sciences and Technology, Vilnius, Lithuania [2]Department of Chemistry and Bioengineering, Vilnius Gediminas Technical University, Vilnius, Lithuania [3]Laboratory of Biodeterioration Research, Nature Research Centre, Vilnius, Lithuania
WS1-P5	**Silver Nanowire Endoscopy for Single-Cell Investigation** Monica Ricci[1]*, Beatrice Fortuni[1], Tomoko Inose[2], Susana Rocha[1] and Hiroshi Uji-i[1,2] [1]KU Leuven, Celestijnenlaan 200F 3001 Leuven, Belgium [2]RIES, Hokkaido University, Sapporo, 001-0020, Japan
WS1-P6	**Probing surface-driven interactions of fluorescently labeled hyaluronic acid with nanomaterials** Liviana Mummolo*, Damiano Genovese, Francesco Palomba, Luca Prodi University of Bologna, Bologna, Italy
WS1-P7	**Phage-based capture and concentrating system for single step detection of pathogens in liquid samples** Domenico Franco[1]*, Sebastiano Trusso[2], Laura M. De Plano[3] , Enza Fazio[1] , Maria G. Rizzo[3], Santina Carnazza[3], Fortunato Neri[1] and Salvatore P. P. Guglielmino[3] [1] Department of Mathematical and Computer Sciences, Physical Sciences and Earth Sciences, University of Messina, Messina, Italy [2]IPCF-CNR Institute for Chemical-Physical Processes, Viale Ferdinando Stagno d'Alcontres 37, 98158, Messina, Italy [3]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Messina, Italy
WS1-P8	**In vivo Hepatotoxicity and its Molecular Mechanisms of Gd2O3:Eu3+ Dual-modal Nanoprobe** Cunjing Zheng, Xiumei Tian, Fukang Xie*, Li Li Department of Histology and Embryology, Zhongshan School of Medicine, Sun Yat-san University, Guangzhou 510080, China
WS1-P9	**Downregulation of receptor for advanced glycation end products (RAGE) in the aorta of APOE-deficient mice using P-selectin targeted RAGE-shRNA lipoplexes** Cristina Ana Constantinescu[1]*, Elena-Valeria Fuior[1], Daniela Rebleanu[1], Geanina Voicu1, Mariana Deleanu[1], Monica Tucureanu[1], Elena Butoi[1], Ileana Manduteanu[1], Virginie Escriou[2,3,4,5], Maya Simionescu[1], Manuela Calin[1] [1]Institute of Cellular Biology and Pathology "Nicolae Simionescu", Bucharest, Romania, [2]CNRS, Unité de Technologies Chimiques et Biologiques pour la Santé (UTCBS) UMR 8258, Paris, France, [3]INSERM, UTCBS U 1022, Paris, France, [4]Université Paris Descartes, Sorbonne-Paris-Cité University, UTCBS, Paris, France, [5]Chimie ParisTech, PSL Research University, UTCBS, Paris, France

WS1-P10	**Studies on transfection efficiency and toxicity of different nanocarriers of shRNA-expressing plasmid on human valvular interstitial cells** Daniela Rebleanu[1], Cristina Ana Constantinescu[1], Geanina Voicu[1], Agneta Simionescu[1,2], Ileana Manduteanu[1], Manuela Calin[1]* [1]Institute of Cellular Biology and Pathology "Nicolae Simionescu" of Romanian Academy, Bucharest, Romania [2]Department of Bioengineering, Clemson University, United States of America
WS1-P11	**Nanopatterns of Surface-bound ephrinB1 Ligands produce Multivalent Effects on EphB2 Receptor Clustering** Verónica Hortigüela[1], Enara Larrañaga[1]*, Francesco Cutrale[2], Anna Seriola[3], María García-Díaz[1], Anna Lagunas[4,1], Jordi Andilla[5], Pablo Loza-Alvarez[5], Josep Samitier[1,4,6], Samuel Ojosnegros[2], Elena Martínez[1,4,6] [1]Institute for Bioengineering of Catalonia (IBEC), Barcelona, Spain; [2]University of Southern California, Translational Imaging Center, Los Angeles, CA, USA; [3]Center of Regenerative Medicine in Barcelona, Barcelona, Spain; [4]Centro de Investigación Biomédica en Red (CIBER), Madrid, Spain; [5]ICFO-Institut de Ciencies Fotoniques, Castelldefels, Spain; [6]Dep. of Electronics and Biomedical Engineering, University of Barcelona (UB), Barcelona, Spain
WS1-P12	**Poly(ethylene oxide) as Protective Barrier of Carbon Nanotubes against Protein Adsorption-Molecular Dynamics Study** Z. Benková[1,2]*, P. Čakánek[1]*, M. N. Dias Soeiro Cordeiro[2] [1]Polymer Institute, Slovak Academy of Sciences, Dúbravská cesta 9, 845 41 Bratislava, Slovakia [2]LAQV@REQUIMTE, Department of Chemistry and Biochemistry, Faculty of Sciences, University of Porto, Rua do Campo Alegre 687, Porto, Portugal
WS1-P13	**Solvent Mediated Effects in Nanoassembly of Amyloidogenic Peptides** Nikolay Blinov* and Andriy Kovalenko University of Alberta and Nanotechnology Research Centre, Edmonton, Canada
WS1-P14	**Antibody-free magnetic lateral flow immunoassay for quantitative amyloid beta detection** Monserrat Rivas[1], Jose Carlos Martínez[1], María Salvador[1], Amanda Moyano[2], María C. Blanco-López[2], Apostolos C. Tsolakis[3], Eleftherios Halevas[3] and George Litsardakis[3] [1]Departamento de Física & IUTA, Universidad de Oviedo, Gijón, Spain; [2]Departamento de Química Física y Analítica, Universidad de Oviedo, Oviedo, Spain; [3]Department of Electrical & Computer Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece
WS1-P15	**Immobilization and Electrochemical Behavior of Hemoglobin on Hybrid Graphite/TiO2 electrodes** Efstathios Deskoulidis*, Vasilios Georgakilas and Emmanuel Topoglidis Department of Materials Science, University of Patras, Rion 26504, Greece
WS1-P16	**Self-assembly of anionic liposomes on cationic biodegradable polymer particles** Andrey Sybachin*, Vasiliy Spiridonov, Olga Novoskoltseva, Nikolay Melik-Nubarov and Alexander Yaroslavov Lomonosov Moscow State University, Chemistry Department Polymer Division, Russia
WS1-P17	**A novel characterization of silver nanoparticles using Artemisia Annua: green synthesis, characterization and anti-malarial activity** Elisabetta Avitabile[1]*, Cristina D'Avino[1], Ioannis Tsamesidis[1], Serenella Medici[2] and Antonella Pantaleo[1] [1]Department of Biomedical Sciences, University of Sassari, Italy 2Department of Chemistry and Pharmacy, University of Sassari, Sassari, Italy

WS1-P18	**Enhanced Vibrational Circular Dichroism signal as a result of interaction between water soluble gold nanocluster and CoCl2** Sarita Bhattacharya* and Thomas Bürgi Department of Physical Chemistry, University of Geneva, Geneva, Switzerland
WS1-P19	**Effect of CNT with mechanical strain on cell differentiation** Eliška Mázl Chánová[1,2]*, Petr Knotek[3], Jan Svoboda[2], Petr Kutálek[4], Jana Kredatusová[2], Dana Kubies[2] and Ying Yang[1] [1]Institute for Science&Technology in Medicine, Keele University, Stoke-on-Trent, UK; [2]Institute of Macromolecular Chemistry AS CR, Prague, CR; [3]Dpt. of General and Inorganic Chemistry, University of Pardubice, Pardubice, CR; [4] Joint Laboratory of Solid State Chemistry of IMC AS CR and University of Pardubice, Pardubice, CR
WS1-P20	**Characterization of magnetic nanoparticles coated with chitosan derivatives for tissue engineering application** Adriana Gilarska[1,2]*, Sylwia Fiejdasz[1], Szczepan Zapotoczny[2], Maria Nowakowska[2] and Czesław Kapusta[1] [1]AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Mickiewicza 30, 30-059 Kraków, Poland [2]Jagiellonian University, Faculty of Chemistry, Gronostajowa 2, 30-387 Kraków, Poland
WS1-P21	**VCAM-1 TARGETED NARINGENIN-LOADED LIPID NANOEMULSIONS REDUCE MONOCYTE ADHESION TO ACTIVATED ENDOTHELIAL CELLS** Elena-Valeria Fuior[1]*, Geanina Voicu[1], Mariana Deleanu[1,2], Daniela Rebleanu[1], Cristina Ana Constantinescu[1,3], Florentina Safciuc[1], Maya Simionescu[1], Manuela Calin[1] [1]Institute of Cellular Biology and Pathology “Nicolae Simionescu” of the Romanian Academy, Bucharest, Romania; [2] UASVM, Faculty of Biotechnologies, Bucharest, Romania; [3]UASVM, Faculty of Veterinary Medicine, Bucharest, Romania
WS1-P22	**Effects of Ag/TiO2 and Ag/N-TiO2 nanoparticles on human lung epithelial cells** Daniela Rebleanu[1]*, Cristina Ana Constantinescu[1], Geanina Voicu[1], Mariana Deleanu[1], Carmen Gaidau[2], Madalina Ignat[2], Aurora Petica[2], Manuela Calin[1] [1] Institute of Cellular Biology and Pathology “Nicolae Simionescu” of Romanian Academy, Bucharest, Romania; [2]R&D National Institute for Textiles and Leather (INCDTP)–Leather and Footwear Research Institute (ICPI) Division, Bucharest, Romania
WS1-P23	**Effect of Carbon Nanotubes on Zirconium Ceramics Used for Biomedical Applications** Sergei Ghyngazov*, Sergei Shevelev National Research Tomsk Polytechnic University, Tomsk, Russia
WS1-P24	**Synthesis, physico-chemical characterization and anticancer potential of flavonoid chrysin-loaded hybrid PCL and PHB nano-formulations**. E. Halevas[1]*, C. Kokotidou[2], A. Mitraki[2], G. Litsardakis[1], A. Pantazaki[3] [1] Department of Electrical & Computer Engineering, Aristotle University of Thessaloniki, 54124, Thessaloniki, Greece. [2] Department of Materials Science and Technology, University of Crete, 70013, Heraklion, Greece [3] Department of Chemistry, Aristotle University of Thessaloniki, 54124, Thessaloniki, Greece.
WS1-P25	**Graphene Acid: Ready-to-derivatize Biocompatible Nanocarrier Towards Biomedical Applications** Jan Belza*, Katerina Polakova, Tomas Malina, Aristides Bakandritsos, Veronika Sedajova and Radek Zboril Regional Centre of Advanced Technologies and Materials, Department of Physical Chemistry, Faculty of Science, Palacky University Olomouc, 17. Listopadu 1192/12, 771 46 Olomouc, Czech Republic

WS1-P26	**Addition of graphene nanoparticles to PDMS matrix significantly improve hemocompatibility of samples** Nina Recek[1]*, Karthika Prasad[2], Alenka Vesel[1] [1]Department of Surface Engineering and Optoelectronics, Jožef Stefan Institute, Ljubljana SI-1000, Slovenia [2]Science and Engineering Faculty, Queensland University of Technology, Brisbane QLD 4000, Australia
WS1-P27	**Interactions of mitoxantrone-modified superparamagnetic iron oxide nanoparticles with biomimetic membranes and cells.** Dorota Nieciecka*, Krystyna Kijewska and Paweł Krysinski Department of Chemistry, University of Warsaw, Pasteur 1, 02-093 Warsaw, Poland
WS1-P28	**Fe3O4 nanoparticles formation by ball milling of hematite** Elena Lysenko*, Anatoliy Surzhikov Tomsk Polytechnic University, Tomsk, Russia
WS1-P29	**Gold Coated Cobalt Ferrite Nanoparticles via Methionine Inducted Reduction** Agne Mikalauskaite*, A. Jagminas State research institute Center for Physical Sciences and Technology, Vilnius, Lithuania
WS1-P30	**Magnetic field sensible nanocomposites based on cross-linked sodium alginate and maghemite** Vasiliy Spiridonov*,Andrey Sybachin, Irina Panova, Olga Novoskoltseva and Alexander Yaroslavov Lomonosov Moscow State University, Chemistry Department Polymer Division, Russia
WS1-P31	**Fluorescent Carbogenic Nanoparticles** Dr Marta Krysmann* University of Central Lancashire, School of Pharmacy and Biomedical Sciences, Preston, UK
WS1-P32	**PEGylating magnetic nanocrystals clusters through electrostatic interactions** A. Kolokithas-Ntoukas[1]*, G. Mountrichas[2], S. Pispas[2], R. Zboril[3], K. Avgoustakis[4], A. Bakandritsos[3] [1]University of Patras, Materials Science Dept., Rio, Greece; [2]Theoretical and Physical Chemistry Institute N.H.R.F., Athens, Greece; [3]Regional Centre of Advanced Technologies and Materials, Olomouc, Czech Republic; [4]University of Patras, Pharmacy Dept., Rio, Greece
WS1-P33	**Multiplex analysis of tumor markers using surface enhanced Raman spectroscopy (SERS).** Anna Balzerová, Václav Ranc, Radek Zbořil Regional Centre of Advanced Technologies and Materials, Department of Physical Chemistry, Faculty of Science, Palacký University in Olomouc, 17 listopadu 12, CZ-77146 Olomouc, Czech Republic
WS1-P34	**Evaluation of milk-derivate exosomes as natural liposomes in theragnostic.** González M.I.[1,2], Sobrino G.[1,2], Cañadas M. [1], Desco M.[1,2,3,4], Salinas B.[1,2,3] [1] Inst. de Investig. Sanitaria Gregorio Marañón, Experimental Medicine and Surgery Unit, Madrid, Spain; [2] Centro Nacional de Investigaciones Cardiovasculares Carlos III, Advanced Imaging Unit, Madrid, Spain; [3] Universidad Carlos III de Madrid, Bioengineering and Aerospace Engineering Dept, Madrid, Spain; [4] Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Spain
WS1-P35	**In situ synthesis of silver nanoparticles on organic and inorganic colloidal particles for theranostic applications** Bogdan Parakhonskiy[1,2]*, Anatolii Abalymov[1], Ekaterina Lengert[1,2], Maria Saveleva[1,2], Alexey Yashchenok[3], Yulia Svenskaya[2], Andre Skirtach[1] [1]Ghent University, Ghent, 9000, Belgium; [2] Saratov State University, Saratov, 410012, Russia; [3] Skoltech center of Photonics & Quantum Materials, Skolkovo Institute of Science and Technology, 143026 Moscow, Russia

WS1-P36	**Ultrasound-responsive Smart Liposomes as Theranostic agents for Treatment of Glioblastoma multiforme** Rishi Rajat Adhikary* and Rinti Banerjee Indian Institute of Technology Bombay, Mumbai, India
WS1-P37	**Antibacterial Layer-by-Layer assemblies based on Graphene** Ella Gibbons[1], Antonios Kelarakis[2], Marta Krysmann[1] [1]School of Pharmacy and Biomedical Sciences, University of Central Lancashire, Preston, United Kingdom; [2]School of Physical Sciences and Computing, University of Central Lancashire, Preston, United Kingdom
WS1-P38	**Production of antibacterial polymeric materials** Graham M Reid[1]*, Shauna Flynn[1,2], Laura Quinn[2], Eoin Casey[2], Susan Mulansky[3] and Susan M Kelleher[1] [1]School of Chemistry, University College Dublin, Dublin 4, Ireland [2]School of Bioprocessing Engineering, University College Dublin, Dublin 4, Ireland [3]Institute of Food and Biochemical Engineering, Technische Universität Dresden
WS1-P39	**Shell-dependent antimicrobial efficiency of cobalt ferrite nanoparticles** Simonas Ramanavicius*, Rokas Zalneravicius and Arunas Jagminas State research institute Center for Physical Sciences and Technology, Vilnius, Lithuania
WS1-P40	**Fe-doped C-dots combining exceptional optical, magnetic and antimicrobial properties** Joanna Stachowska[1], Antonios Kelarakis[2]*, Marta Krysmann[1] [1]School of Pharmacy and Biomedical Sciences, University of Central Lancashire, Preston, United Kingdom [2]School of Physical Sciences and Computing, University of Central Lancashire, Preston, United Kingdom
WS1-P41	**Preparation and characterization of Pistacia lentiscus var. Chia essential oil-loaded poly(lactic acid) nanoparticles as novel wound healing agent** I. Vrouvaki[1]*, E. Koutra[2], M. Kornaros[2], K. Avgoustakis[1], F. N. Lamari[1], and S. Hatziantoniou[1] [1]University of Patras, Department of Pharmacy, Patras, Greece [2]University of Patras, Department of Chemical Engineering, Patras, Greece
WS1-P42	**Polysaccharides-based Capsules Loaded with Magnetic Nanoparticles** Elżbieta Gumieniczek-Chłopek [1,2]*, Joanna Odrobińska[2], Czesław Kapusta[1], Szczepan Zapotoczny[2] [1] Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, Cracow, Poland [2] Faculty of Chemistry, Jagiellonian University, Cracow, Poland
WS1-P43	**Designing of Highly Programmable and Modular Nanorobotic Platform for Smart Drug Delivery** Soumyananda Chakraborti* and Jonathan G Heddle Malopolska Centre of Biotechnology, Jagiellonian University, Krakow, Poland
WS1-P44	**Electrospun Nanofibers as Controlled-Release Carriers of Echinochrome A** Stefanos Kikionis[1], Elena A. Vasileva[2], Natalia P. Mishchenko[2], Sergey A. Fedoreyev[2], Vassilios Roussis[1] and Efstathia Ioannou[1]* [1]Section of Pharmacognosy and Chemistry of Natural Products, Department of Pharmacy, National and Kapodistrian University of Athens, Athens, Greece [2]G.B. Elyakov Pacific Institute of Bioorganic Chemistry, Far-Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia
WS1-P45	**Injectable Dual release Nanoformulation based Hydrogel for Blood Borne Bacterial Infections** Vimal Rohan K [1]*, Rohit Srivasatava[2]* [1]Academy of Medical Sciences, Pariyaram, Kerala, India

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WS1-P46	**Nanoengineered Dual Release Graft for Pain and Inflammation Management in Osteoarthritis** Bavya M C[1]*, Rohit Srivasatava[2]* [1,2]Indian Institute of Technology, Bombay, India
WS1-P47	**Promiscous phage-peptide as possible approach to a multiple drug targeted therapy** Laura M. De Plano[1]*, Domenico Franco[2], Maria G. Rizzo[1] , Santina Carnazza[1], Marco S. Nicolò[1] and Salvatore P. P. Guglielmino[1] [1] Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina,Viale F. Stagno d'Alcontres 31, 98166, Messina, Italy; [2]Department of Mathematical and Computer Sciences, Physical Sciences and Earth Sciences, University of Messina, 98166, Messina, Italy
WS1-P48	**Biomonitoring air pollution in leaves of carob tree** Sophia Papadopoulou*, Maria-Sonia Meletiou-Christou, Sophia Rhizopoulou Department of Botany, Faculty of Biology, National and Kapodistrian University of Athens, Athens 15781, Greece
WS1-P49	**Synthesis of new materials containing ZnO doped particles for purification of waste waters** Viorica-Elena Podasca*, Mariana-Dana Damaceanu Petru Poni Institute of Macromolecular Chemistry, 41 A Grigore Ghica Voda Alley, 700487 Iasi, Romania
WS1-P50	**A colorimetric sensing platform for HIV-1 viral nucleic acids based on self assembly of single-component DNA functionalized gold nanoparticles** Abbas Karami, Masoumeh Hasani* Faculty of Chemistry, Bu-Ali Sina University, Hamedan 65174, Iran
WS1-P51	**Theoretical study of water interaction with functionalized benzene molecules** Rafaela-Maria Giappa*, Emmanuel Klontzas and George Froudakis University of Crete, Department of Chemistry, Crete, Greece

Poster Code: WS1-P1

Composite active surfaces for biosensing applications

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The ecology and ecotoxicity testing to biopharmaceutical production or medical diagnostics are based on design and processing of bioactive surfaces, including cell optical biosensors, detection of specific compounds such as lyzosime. These types of biosensors are made by immobilizing whole algal, bacterial or mammalian cells on various supports. In this work, we present the use of functional graphene oxide (GO) and bacterial layers of Micrococcus lysodeikticus (ML) obtained by laser methods as an optical biosensor for the detection of lysozyme in serum. ML was used as an enzymatic substrate for Lysozyme (i.e. enzyme upregulated in inflammatory diseases). The laser-deposited bacterial interfaces were characterized by Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Fourier-Transformed Infrared Spectroscopy (FTIR), Raman and optical microscopy and were compared with control interfaces deposited via layer-by-layer on the same substrate. ML-GO modified interfaces retained their functionality and sensitivity to lysozyme's lytic action. The optical biosensor detected lysozyme in undiluted serum in the clinically relevant range up to 10 mu g mL(-1), in a fast and simple manner.

Poster Code: WS1-P2

Effect of Myoglobin on Photoluminescence of ZnO-Gd_2O_3 Films

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Extensive use of ZnO nanostructures in biosensors is caused by the combination of specific optical and electrical characteristics which can be controlled in different ways. ZnO nanostructures can be successfully combined with other materials by means of alloying, creating nanocomposites, heterostructures, hybrid structures which provide an opportunity to get the various structures composite materials including the creation of variety platforms for use in biosensors. Gd-doped ZnO thin films with Gd/Zn ratio fixed at optimum value 0,7 mass. % have been prepared by sol–gel method at optimum annealing temperature of 380°C and the dopant influence on the structural and photoluminescent (PL) properties of films was recognized. SEM-images of the films have shown formation of the developed fibre structure.

Addition of the Gd^{3+} ions leads to increasing of photoluminescence (PL) intensity at 380-385 nm supposedly due to formation of the additional defects - oxygen vacancies. Deposition of myoglobin (10^{-8} - 10^{-12} M) onto surface of the ZnO-Gd^{3+} films from water solution in general leads to PL increasing what is more. PL intensity depends on the concentration of myoglobin. PL is minimal for myoglobin - 10^{-12} M, and then it increases by 50 and 70 units for 10^{-10} and 10^{-8}M. It should be noted out that interaction with myoglobin 10^{-8} and 10^{-10} M occurs with bathochromic shift of the PL ZnO on 2 and 4 nm for 10^{-8} and 10^{-10} M concentration, respectively

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Poster Code: WS1-P3

Nanoparticle-mediated Enzyme Replacement Therapy and Autophagy Modulation: a new perspective for Krabbe disease

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Globoid cell leukodystrophy (GLD) is a rare, rapidly progressing childhood leukodystrophy triggered by deficit of the lysosomal enzyme galactosyl-ceramidase (GALC) and characterized by the accumulation of the cytotoxic sphingolipid psychosine (PSY) in the nervous system. No resolutive cure is currently available for this lysosomal storage disorder (LSD), and treatment is symptomatic and supportive only.

Enzyme replacement therapy (ERT) would be a very promising choice to treat GLD, but the presence of the blood-brain barrier forbids GALC translocation into the central nervous system (CNS). To overcome this issue, we encapsulated GALC stabilized as cross-linked enzyme aggregates in poly(lactic-co-glycolic acid) nanoparticles (NPs) functionalized with CNS targeting ligands (g7, Angiopep-2 and Tf2 peptide). We demonstrate that our NPs are mainly uptaken in lysosomes and can restore the enzymatic activity in GLD cellular models.

However, the recent literature strongly suggests that GALC-deficiency correction is not sufficient to completely rescue the GLD phenotype. Thus, supportive therapies specifically addressing secondary targets of the disease might be needed to improve the final therapeutic outcome.

The idea that a group of disorders as LSDs, mainly characterized by accumulation of undigested macromolecules within the cell, should be regarded as disorders of autophagy is already becoming established. However, differently to many other LSDs, little is known about autophagy in GLD. In a recent publication, we activated autophagy by lithium administration in a GLD in vitro model and obtained an improvement of cell viability in presence of PSY [1]. Here, we show preliminary results of an in vivo study in which the spontaneous GLD murine model (the twitcher mouse) is treated with lithium. Finally, data are discussed in view of the possible usage of the autophagy modulation in combination with a main GALC-deficiency correcting therapy to achieve the complete GLD phenotypic rescue.

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Poster Code: WS1-P4

Gold Nanoparticles Against Clinically Isolated Pathogens

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Over the years, natural and chemically synthesized antibiotics have been used to control infections resulting from community environments. Currently, there is a growing demand for the synthesis of nanomaterials that would replace widely applied antibiotics due to their antimicrobial properties. Available reports show that metal nanoparticles (NPs) such as Ag, Au, Cu, Zn, Si and metal oxide nanoparticles including TiO_{2-x}, ZnO, CuO, Cu_2O, Co_3O_4, MgO, ZrO_2, Ni_2O_3 or normal spinel structure ferrites $[M^{2+}][Fe^{3+}]O_4$ where M^{2+} is the metal ion as Zn^{2+}, Mn^{2+}, Cu^{2+}, Co^{2+} [1] were identified to exhibit antimicrobial activity against multi-drug resistance pathogens. The molecular mechanisms for antibacterial effect of nanoparticles are still being investigated, but there are two more popular proposed possibilities in this regard: (a), free metal ion toxicity arising from dissolution of the metals from the surface of nanoparticles and (b), oxidative stress via generation of reactive oxygen species (ROS) on the surfaces of nanoparticles. Identifying previously published papers of our research group, it is worth mentioning that we have synthesized quite different antimicrobial agents such as ultra-small gold NPs and nanoclusters. The antibacterial activities of these nanomaterials were tested *in vitro* against gram-negative *Acinetobacter baumannii*, *Salmonella enterica* and gram-positive *Micrococcus luteus*, methicillin-resistant *Staphylococcus aureus* bacteria (Fig. 1).

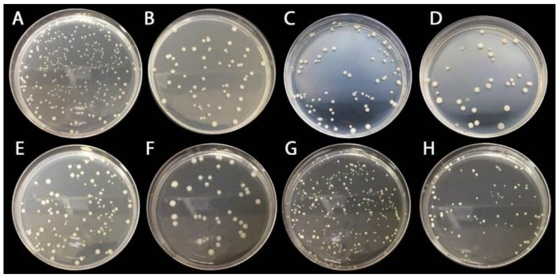

Fig.1. Photographs showing the antimicrobial activity of Au@Met nanocrystals for growth inhibition of gram-negative (a-b) *A. baumannii*, (c-d) *S. enterica* (top row) and gram-positive (e-f) methicillin-resistant *S. aureus*, (g-h) *M. luteus* (bottom row) microorganisms.

[1] E. Hoseinzadeh, et al. *18*, 120-128, (2017).

Poster Code: WS1-P5

Silver Nanowire Endoscopy for Single-Cell Investigation

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Surface Enhanced Raman Scattering (SERS) is gaining increasing attention for intracellular studies thanks to its sensitivity and fingerprinting capabilities, which provide chemical and structural information.

To this end, SERS investigation in living cells has mainly been demonstrated by delivering metal nanoparticles (NPs) in the cellular environment via endocytosis.[1,2] Such approach, however, is highly invasive for the cell due to high particle density required for plasmonic enhancement and limits the SERS-based probing to compartments involved in the endocytic pathways, such as endosomes and lysosomes.

In this contest, our group has previously demonstrated that silver nanowire - (AgNW-) mediated endoscopy holds great potential as alternative non-invasive technique to detect SERS signal from the intracellular environment with high spatial resolution and time control.[3]

In this contribution, we further improved the SERS capabilities of our endoscopy probe by introducing gold nanostructures on the AgNWs and demonstrated their site-specificity by staining different cellular locations and obtaining highly resolved fingerprints of the related dye molecules. Furthermore, we applied this method to sense the chemical environment of specific cellular compartments, such as nucleus, cytoplasm and cellular membrane.

Our approach enables the specific detection of species with high sensitivity and spatio-temporal control, holding great potential in studying chemical and structural dynamics of distinct biomolecules in single living cells.

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Poster Code: WS1-P6

Probing surface-driven interactions of fluorescently labeled hyaluronic acid with nanomaterials

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Hyaluronic acid is a natural glycosaminoglycan spanning a wide range of molecular weights. Its properties depend on the presence of hydrophobic residues on the chain and on the possibility to establish H-bonds. HA is drawing an increasing attention in nanomedicine, because of its biocompatibility and ease of manipulation. In addition, it is largely distributed in the human body and it is involved in several processes [1].

We recently found that HA can play an important role in favoring the internalization of exogenous nanomaterials. We propose a detailed investigation of the interactions between HA and various kinds of silica nanoparticles, upon tuning the molecular weight of HA and the size and surface chemistry of silica nanoparticles [2]. We monitor the fate of HA by labelling it with Rhodamine isothiocyanate dyes (HA@R). HA@R is deeply quenched in water, but in presence of nanoparticles the photophysics of the rhodamine linked to the hyaluronic acid changes dramatically, showing a strong enhancement of luminescence.

The results provide an insight into the interactions taking place between this widely distributed biopolymer and a range of nanomaterials, including a mechanistic understanding of the driving forces leading to the high affinity towards specific nanomaterial surfaces.

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[2] E. Rampazzo, et al. Nanoscale, 5, 7897-7905 (2013)

Poster Code: WS1-P7

Phage-based capture and concentrating system for single step detection of pathogens in liquid samples

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One of the most encountered problems in environmental monitoring for infection prevention is the efficient detection of bacterial contaminant when it is present at low concentration. For this purpose, detection tools, able to simultaneous separation, concentration and discrimination of microorganisms in several sample matrices, are requested. In this work, commercial magnetic beads (ScreenMAG-Amine 1.0µm, Chemicell GmbH) has been functionalized with M13 phage clones specifically selected by Phage-display to bind surface of *S. aureus* [1], *P. aeruginosa* [2] and *E. coli*, some of the most common pathogens responsible for contaminations of water, beverage and food. The captured bacteria were concentrated on a CaF_2 slide and detected by visible micro-Raman spectroscopy. Specifically, the large amount of information present in Raman vibrational spectra was evaluated by multivariate technique, including principal component analysis (PCA) and Hierarchical Cluster Analysis (HCA) [3]. The Raman spectra of each bacterium are highly specific because each microorganism has a unique spectral pattern, which is the result of the vibrational information obtained from macromolecules of the bacterial cell. The sample testing process, including data acquisition, required less than an hour and has a limit of detection of 10^2 CFU/ml of liquid sample. The proposed system is an alternative diagnostic tool that enables a rapid, high sensitive and specific detection of pathogenic bacteria.

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Poster Code: WS1-P8

In vivo Hepatotoxicity and its Molecular Mechanisms of $Gd_2O_3:Eu^{3+}$ Dual-modal Nanoprobe

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Objective: To explore the mechanism of hepatotoxicity induced by *in vivo* application of $Gd_2O_3:Eu^{3+}$ dual-modal contrast nanoparticles.

Methods: LO2 hepatic cell was *in vitro* cultured with $Gd_2O_3:Eu^{3+}$ nanoparticles for 12h, 24h and 48h. CCK8 method was used to evaluate the inhibition rate of cell proliferation cultured with different concentrations of nanoparticles. LO2 cells were incubated with 10μM nanoparticles for 24h prior being analyzed by flow cytometry for their apoptosis rate. Liver organ was harvested 1day after injection of nanoparticles via tail veins of Balb/c mice. Cleavage caspase 3 protein in liver tissue section was detected by immunohistochemistry. In order to explore the hepatotoxicity mechanism of nanoparticles, the expressions of mRNA of p53, Bal-2 and Bal-xL were detected by RT-qPCR.

Results: The activation of caspase3 protein indicated liver cell apoptosis after injection of $Gd_2O_3:EU^{3+}$ nanoparticles. The mechanism of it was through upregulating the expression of p53 gene, and downregulating the expression of Bcl-2 and Bcl-xL genes.

Conclusion: The mechanism of hepatic toxicity induced by Gd2O3:EU3+ nanoparticles was through activating p53 along with inhibiting Bcl-2 and Bcl-xL， as a result inducing the hepatic apoptosis of caspase3 protein.

Poster Code: WS1-P9

Downregulation of receptor for advanced glycation end products (RAGE) in the aorta of APOE-deficient mice using P-selectin targeted RAGE-shRNA lipoplexes

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Introduction. During the vascular inflammation process, endothelial cells (EC) express both the receptors for advanced glycation end products (RAGE) and the cell adhesion molecule, P-selectin that initiate and perpetuate inflammation by promoting leukocyte infiltration into the vascular wall. We hypothesize that we could use P-selectin as a target for nanotherapy to efficiently silence RAGE exposed on the vascular activated endothelial cell membrane. **Methods.** P-selectin targeted cationic liposomes (Psel-lipo) were prepared, characterized and subsequently used to form lipoplexes with plasmids that contain different RAGE-shRNA sequences (Psel-lipo/RAGE-shRNA). The distribution of lipoplexes in different organs was assessed by an IVIS Imaging System at 1 hour after intravenous (i.v.) injection of fluorescently-labelled lipoplexes into ApoE$^{-/-}$mice. The ability of P-selectin targeted lipoplexes to transfect the vascular endothelium was assessed by IVIS at 48 hours after i.v. injection of lipoplexes made with the pEYFP plasmid that codes for a fluorescent protein. To silence the expression of RAGE, a mixture of five plasmids that contain different RAGE-shRNA sequences was used to obtain Psel-lipo/RAGE-shRNA lipoplexes that were i.v. injected 2 times/week for 4 weeks in ApoE$^{-/-}$mice. As controls, lipoplexes made of non-targeted liposomes and plasmids containing RAGE specific shRNA sequences or between targeted liposomes and a control shRNA plasmid were used. After sacrifice, blood and tissue samples were collected and further processed into homogenates. The RAGE expression and the pro-inflammatory cytokines (IL-1β, TNF-α, IL-6, MCP-1) and chemokine (MCP-1) in tissue homogenates were determined by Western-blot and ELISA assay, respectively. Biochemical parameters of blood plasma were also determined. **Results.** 1) Psel-lipo/RAGE-shRNA lipoplexes bind specifically to the aorta of ApoE$^{-/-}$ mice; 2) Psel-lipo/pEYFP lipoplexes induce the expression of yellow fluorescent protein in the aorta of ApoE$^{-/-}$ mice at 48 hours after administration; 3) the treatment with Psel-lipo/RAGE-shRNA specifically downregulated RAGE in the aorta and liver of ApoE$^{-/-}$ mice; 4) treatment with lipoplexes did not significantly alter the weight of the mice, the liver and kidney function, the plasmatic parameters and the production of inflammatory cytokines. **Conclusion.** P-selectin targeted RAGE-shRNA lipoplexes bind specifically to the aorta and downregulate RAGE expression in aorta and liver of ApoE-deficient mice. **Acknowledgements.** Study supported by UEFISCDI, PN-II-RU-TE-2014-4-1837 project.

Poster Code: WS1-P10

Studies on transfection efficiency and toxicity of different nanocarriers of shRNA-expressing plasmid on human valvular interstitial cells

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RNA-interference (RNAi) holds high potential to silence the expression of a specific target gene. Short hairpin (sh) RNA is an attractive RNAi tool due to its relatively low rate of degradation and has the advantage that it is synthesized within the cell after transfection with a plasmid containing a specific shRNA sequence. The aim of this study is to investigate the transfection efficiency and cytotoxicity of different shRNA plasmid nanocarriers (lipid-based or PEI-based nanoconjugate). PEGylated cationic liposomes comprising different cationic lipids, a helper lipid (e.g. DOPE) and a PEG functionalized lipid, and a nanoconjugate of fullerene-PEI (C60-PEI) were obtained in order to find the best nanocarrier for efficient delivery of a plasmid to human valvular interstitial cells (VIC). Lipoplexes/polyplexes were obtained by complexing cationic liposomes and C60-PEI with a plasmid shRNA at various charge ratios (R) and N/P ratios, respectively and further characterized for size (by dynamic light scattering), zeta potential (by electrophoretic mobility), morphology (by electron microscopy, TEM) and the capacity to protect shRNA (by agarose gel retardation assay). Transfection efficiency was evaluated after exposing VIC, isolated from human aortic valve, for 48 hours to different lipoplexes/polyplexes between cationic liposomes/C60-PEI and a plasmid encoding a fluorescent protein (pEYFP) by fluorescence microscopy and flow cytometry. The cytotoxicity studies were performed by XTT assay after exposing VIC to different types of lipoplexes/polyplexes. The results are: 1) hydrodynamic size of lipoplexes/polyplexes varies as function of R ratio and N/P ratio between 100 and 1600 nm; 2) morphology of lipoplexes analyzed by TEM revealed the appearance of multilamellar vesicles with concentric lamellar structures; 3) packaging and protection of nucleic acids by the complexation with different types of nanocarriers depend on nanocarrier' s composition and R or N/P ratio 4) transfection efficiency and viability of VIC is dependent on lipoplexes/polyplexes nature and R or N/P ratio. In conclusion, nanocarriers capable to function as efficient transfection vectors for shRNA plasmid delivery in VIC have been developed. **Acknowledgements.** This work is supported by the Competitiveness Operational Programme 2014-2020, Priority Axis1/Action 1.1.4/, Financing Contract no.115/13.09.2016/ MySMIS:104362.

Poster Code: WS1-P11

Nanopatterns of Surface-bound ephrinB1 Ligands produce Multivalent Effects on EphB2 Receptor Clustering

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Herein we present a nanostructured surface able to produce multivalent effects of surface-bound ephrinB1 ligands on the dynamics of oligomerization of EphB2 receptors [1]. We create ephrin B1 nanopatterns of regular size (< 30 nm in diameter) by using self-assembled diblock copolymers. We then use an enhanced version of the Number and Brigthness technique, which can discriminate with molecular sensitivity the oligomeric state of diffusive species, to quantitatively track the EphB2 receptor oligomerization process in real time [2]. The results demonstrated that stimulation through surface-bound ligands with a random distribution was not sufficient to activate the receptor signalling. Conversely, when nanopatterned on our substrates, ligands effectively induced receptor oligomerization. In addition, surface-induced ligand clustering by our nanopatterning approach accelerated the dynamics of receptor oligomerization process when compared to antibody-induced ligand clustering. Such an efficiency was induced even when ligand surface coverage was 9-fold lower in the nanopatterned presentation. Therefore, our ligand presenting platform is thought to induce multivalent ligand-receptor interactions, and might be a useful strategy to precisely tune and potentiate receptor responses. This feature can benefit applications such as the design of new bioactive materials and drug-delivery systems.

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Poster Code: WS1-P12

Poly(ethylene oxide) as Protective Barrier of Carbon Nanotubes against Protein Adsorption-Molecular Dynamics Study

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Besides being important constituents in nanotechnical devices due to the exceptional electronic, thermal, and mechanical properties, carbon nanotubes (CNTs) have found important role in biomedicine as biosensors, biomolecular recognition devices, molecular transporters especially in cancer therapy and diagnoses [1]. In order to achieve the solubility of CNTs and to prevent undesired protein adsorption, CNTs are coated by hydrophilic polymer. Layers formed by poly(ethylene oxide) (PEO) chains belong to the most frequently used protective barriers [2].

In present study, molecular dynamics simulations have been employed to shed light on the interactions between PEO coated CNTs and oligopeptides of various affinity for water. Oligoglycine, oligovaline, oligoserine, oligoaspartate, and oligolysine are chosen as the representatives of small nonpolar, large nonpolar, small neutral polar, and negatively and positively charged polar protein moieties, respectively. The focus is on the effect of PEO coating, presence of water, and physiological concentration of NaCl on the interaction between CNTs and the oligopeptides. The influence of the oligopeptides on the structural properties of PEO layers as well as the structural deformation of the oligopeptides induced by the coated and uncoated CNT are investigated.

This study is supposed to help to understand the controversial experimental results concerning the protection of surfaces against protein adsorption by PEO chains.

Acknowledgements: This work was supported by grants SRDA-15-0323, VEGA 2/0055/16, VEGA 2/0098/16, Z.B. also thanks to FCT/MEC through national funds, and cofinanced by the European Union (FEDER funds) under the Partnership Agreement PT2020, through projects UID/QUI/50006/2013, POCI/01/0145/FEDER/007265, and NORTE-01-0145-FEDER-000011 (LAQV@REQUIMTE).

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Poster Code: WS1-P13

Solvent Mediated Effects in Nanoassembly of Amyloidogenic Peptides

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Many neurodegenerative diseases, including Alzheimer's and prion diseases, are characterized by aggregation of amyloidogenic biopolymers into nanofibrillar structures. Understanding the molecular mechanisms of aggregation and resolving atomistic structures of the fibrils are of importance for development of anti-neurodegenerative therapy. Naturally occurring fibrils with their unique physico-chemical properties inspire development of novel fibril-based nanomaterials for bio- and nanotechnological applications. Nanofibrils of different origin are characterized by common structural features and similar mechanisms of formation, including nucleated polymerization self-assembly. The aggregation pathways of the natural and synthetic nanofibrils are essentially mediated by solvation effects such as competition between hydrophobic and hydrophilic effects, specificity of solvent composition and thermodynamics state. Complexity of solvent conditions, and large spatial and multiple time scales involved make computational modeling of nanofibrils formation and prediction of their properties with conventional explicit solvent molecular simulations a very challenging problem.

In this context, many limitations of the explicit solvent methodology can be overcome by using statistical-mechanical, integral equation theory of molecular liquids, a.k.a. the three dimensional reference interaction site model with the Kovalenko-Hirata closure (3D-RISM-KH). The theory provides comprehensive information on microscopic solvation structure and thermodynamics in complex solvents, including buffers, salts, polymers, and ligand molecules at finite concentrations. We use the 3D-RISM-KH-based multiscale platform to study different aspects of nanoassembly, including conformational equilibria in the structural ensembles of biopolymers, formation of low-order oligomers and nanofibrils, and their physical and structural properties. In the context of self-aggregation of biomolecules implicated in neurodegeneration, the 3D-RISM-KH methodology is also used to map binding sites of anti-aggregation therapeutic agents and to predict their propensity to cross the blood-brain barrier (BBB) for efficient delivery.

In this paper, we review the recent applications of the 3D-RISM-KH methodology to study all stages of macromolecular aggregation, from sampling the conformational space of monomeric biopolymeric species and selection of aggregation prone-conformations to modeling low-order oligomers and fibrils. Thermodynamic stability and solvation structure of nanofibrils of different morphology are predicted for different solvent environments. A new methodology is introduced to describe solvent composition effects on conformational equilibrium in the structural ensembles of biopolymers. The methodology is used to predict effects of different solvation factors on the population of aggregation-prone species and the mechanisms of their aggregation.

Poster Code: WS1-P14

Antibody-free magnetic lateral flow immunoassay for quantitative amyloid beta detection

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Point-of-care diagnostic devices based on lateral flow immunoassay (LFIA) methods, such as pen- or strip-type tests are widely used due to their portability, ease of use and low cost, reporting a rapid yes-or-no answer. In order to couple these advantages with quantitative results that are required in many cases, superparamagnetic nanoparticles can be used as labels. Besides optical readout, they provide a magnetic signal, while they also constitute the media to bind several functional groups. Functionalization offers additional modalities, such as fluorescence, and the ability to bind antibodies for specific antigen detection.

Recently a magnetic detection and quantification LFIA method has been developed and demonstrated with superparamagnetic iron oxide nanoparticles (SPIONs) and a scanning magneto-inductive sensor, successfully quantifying prostate specific antigen (PSA) within the clinical range of interest [1]. On the other hand, silica coated SPIONs functionalized with Thioflavin-T (T-SPIONs), which is a fluorescence dye, have been shown to bind to monomers and oligomers of amyloid beta [2], a protein characteristic of Alzheimer's disease. These findings are combined in this work, by examining designs of magnetic LFIA with T-SPIONs at the test and the control line as well. The potential of the lateral and vertical flow method for quantification of a protein biomarker without using an antibody has been explored.

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Poster Code: WS1-P15

Immobilization and Electrochemical Behavior of Hemoglobin on Hybrid Graphite/TiO2 electrodes

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The electron mediator free communication between the cofactors of redox active proteins and a solid electrode surface could provide a simple and efficient method for studying fundamental protein function and structure and for developing novel electrochemical biosensors. In this work, a novel method of fabrication of hybrid Graphite/TiO2 electrodes for the immobilization of Hemoglobin (Hb) is presented. It is known that transparent, mesoporous TiO2 electrodes offer an ideal surface for protein immobilization from aqueous solutions with high binding stability and undetectable protein denaturation. However, their major disadvantage in order to be used for the development of electrochemical sensors is that they are essentially insulators for potentials more positive than -0.3 V. Graphite electrodes are widely used due to their high conductivity but are not optically transparent and therefore cannot be used for optical or spectroelectrochemical studies. Therefore Graphite and SiO2 were incorporated into the mesoporous TiO2 films in order to improve their electrical conductivity, achieve faster electron mobility and retain a lot of their transparency. Hybrid paste consisting of 20% of graphite paste and 80% of commercial (DyeSol) sol-gel TiO2 paste was fabricated and used for the preparation of hybrid Graphite/TiO2 film electrodes. The amount of Hb immobilized on their surface was monitored using UV-Vis and the characterization of the hybrid electrodes was carried out with SEM and XRD. The conductivity and the electrochemical properties of the hybrid films, with or without Hb immobilized on their surface, were examined via Cyclic Voltammetry (CV).

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Poster Code: WS1-P16

Self-assembly of anionic liposomes on cationic biodegradable polymer particles

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Spherical lipid bilayer vesicles (liposomes) are widely used for delivery of biological active substances. Hydrophilic compounds can be encapsulated into the inner water cavity of liposomes while the hydrophobic can be embedded into the liposomal membrane. We suggest electrostatic assembly of anionic liposomes with the use of polycationic colloid particles for concentration of liposomes within a small volume. This approach allows one to create multiliposomal carriers filled with different substances at desirable content ratios.

Small unilamellar liposomes, prepared from mixtures of anionic and zwitterionic lipids, were complexed with polylactide micelles composed of mixture of amino-terminated lactide and co-polymer of lactide and polyethyleneglycol (PLAMs). To control the complexation and properties of the resulting complexes, the multi-method approach was used including fluorescence spectroscopy, dynamic light scattering, laser microelectrophoresis, cryogenic transmission electron microscopy, differential scanning calorimetry, conductometry, etc..

The fraction of anionic lipid (α) in liposomes was found to be the critical factor that affects the aggregation stability of liposome/polyelectrolyte complexes, the reversibility of complexation and the integrity of polymer-bound liposomes. The use of PLAMs as carriers for the liposomes allowed us to obtain completely biodegradable multiliposomal compositions with low cyto-toxicity. The effectiveness towards breast carcinoma cells of the liposomal Cisplatin (antitumor drug) and liposomal drug form assembled on cationic carrier was demonstrated.

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Poster Code: WS1-P17

A novel characterization of silver nanoparticles using *Artemisia Annua*: green synthesis, characterization and anti-malarial activity

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Nowadays metal nanoparticles are raising increasing interest in the scientific community due to their chemical stability, good conductivity and biological activity [1-3]. In this context, silver nanoparticles (AgNPs) could represent new nano-tools for biomedical applications thanks to their promising properties [4]. A recent study focused the attention on the preparation of fluorescent AgNPs using a "green" synthesis approach for demonstrating their efficient antibacterial activity [5]. Following this suggestion, we have prepared AgNPs using *Artemisia annua* extracts (a modified version of [5]) to assess their possible use as anti-malarial agents. The "green" AgNPs have thus been tested against malarial parasite *Plasmodium falciparum*. Their TEM microscopy characterization displayed a homogenous size distribution in the range of 10-30 nm, useful for biomedical applications. *A. annua*-AgNPs have demonstrated significant *in vitro* activity against *P. falciparum* in infected red blood cells compared to AgNPs synthesized through a classical chemical approach. All the experiment have been carried out under different dose response conditions. Considering the results gathered, it emerges that the potential of *A. annua*-AgNPs could be exploited as a novel nanotechnological strategy for malarial treatment.

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Poster Code: WS1-P18

Enhanced Vibrational Circular Dichroism signal as a result of interaction between water soluble gold nanocluster and $CoCl_2$

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Vibrational circular dichroism (VCD) i.e. the differential absorption of left- and right-circularly polarized light by a chiral sample, is one of the powerful techniques to study the configuration as well as conformational state of molecules in solution. One of the major experimental challenges of VCD spectroscopy is the relatively small signals and hence search for alternative techniques to enhance the VCD signal is demanding. Helbing et.al have used elliptically polarized ultrashort laser pulses to increase the VCD signal (1). Domingos et.al. have shown to enhance the VCD signal of amino acids and oligopeptides by a factor of two by coupling the molecule to a paramagnetic metal ion (2). The same group has also shown the enhancement of VCD signal for open shell organic molecular system compared to closed shell system (3).

Based on the literature study we have tried to enhance the VCD signal for water soluble gold nanoclusters (4, 5) in order to better understand the structure of their surface layer, as such information is very hard to obtain for water soluble nanoclusters. For this study we have used glutathione and captopril as thiol ligand (SR) for synthesizing $Au_{25}(SR)_{18}$ nanocluster. An enhancement of at least one order of magnitude in VCD signal is observed when these nanoclusters were mixed with $CoCl_2$ solution. The increase in VCD signal of gold nanocluster stoichiometrically depends on the $CoCl_2$ added. Interaction of nanocluster and $CoCl_2$ is further studied by UV/vis, fluorescence and circular dichroism spectroscopy. All these study reveals a strong interaction between gold nanoclusters and $CoCl_2$.

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Poster Code: WS1-P19

Effect of CNT with mechanical strain on cell differentiation

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A major challenge in bone bioengineering is to develop scaffold materials which would provide mechanical support, and microenvironment for proliferation and differentiation of bone cells. In this study, we investigate the synergic effect of carbon nanotubes (CNT) in conjunction with mechanical strain applied in early stage of cell cultivation in order to accelerate mineralization of bone cells and osteogenesis of stem cells. Carboxyl and RGD groups have been introduced to CNT to improve their biofunctionality. Modified CNT were characterized using TGA analysis, Raman and Infrared spectroscopy, and XPS analysis providing an evidence of sufficient and reproducible surface functionalization of CNT.

The biocompatibility of the modified CNT (CNT-COOH and CNT-PEG-RGD) was assessed in cell cultures as free nanoparticles through viability assay. Furthermore, the functionalized CNT were immobilized to the Fn or NH_2-contained glass substrates, or incorporated into the PEO rich polymer film. The effect of CNT functionalization with RGD peptide on cell proliferation and formation of cell aggregates with hastened production of calcium deposits was studied with mesenchymal stem cells (MSC) and MG63 osteosarcoma cell line. The shear stress exerted by a Rocking Shaker during the culture was applied to test the synergetic effect for MSC differentiation.

It was confirmed both MG63 and MSC had good tolerance to both CNT-COOH and CNT-PEG-RGD at concentration of 0.005 mg/mL. The synergic effect of CNT with mechanical strain on acceleration of cell differentiation and formation of calcium deposits was proved with higher osteogenic marker expression of MSC in comparison to the control.

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Poster Code: WS1-20

Characterization of magnetic nanoparticles coated with chitosan derivatives for tissue engineering application

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Magnetic nanoparticles are widely studied for potential biomedical applications due to their unique properties. Superparamagnetic iron oxide nanoparticles (SPIONs) and, in particular, magnetite (Fe_3O_4) and maghemite (γ-Fe_2O_3) are of special interest. They can be characterized as non-toxic and biodegradable, therefore they can be useful in magnetic resonance imaging (MRI), drug delivery, hyperthermia or tissue repair [1]. However, the usage of superparamagnetic nanoparticles can be limited since they have a tendency to agglomerate. To prevent this process, various types of surface coating materials are used. One of them is chitosan – a linear polysaccharide obtained by deacetylation of chitin. This biopolymer can be successfully used in biomedicine because of its biocompatibility, biodegradability and antibacterial properties [2].

This work presents results concerning preparation and characterization of iron oxide magnetic nanoparticles coated with ionic derivatives of chitosan and their potential application as building blocks of hybrid magnetic scaffolds for tissue regeneration. Iron oxide nanoparticles were prepared using co-precipitation method and were surface-coated with cationic and anionic derivative of chitosan. In the next step, hybrid magnetic materials were fabricated by immobilization of polymer-coated SPIONs in hydrogel matrix. Properties of materials prepared were investigated using several methods, e.g. DLS, STEM, XRD, Moessbauer spectroscopy, VSM.

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Acknowledgments:

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Poster Code: WS1-P21

VCAM-1 TARGETED NARINGENIN-LOADED LIPID NANOEMULSIONS REDUCE MONOCYTE ADHESION TO ACTIVATED ENDOTHELIAL CELLS

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Introduction. Naringenin is a citrus flavonoid with well documented anti-atherosclerotic effects. However, the poor water solubility and reduced bioavailability are two major drawbacks for its therapeutic use. To overcome these limitations we encapsulated naringenin into lipid nanoemulsions (LN) that were directed to the cell adhesion molecule VCAM-1, expressed on activated endothelial cells (EC), with the purpose to reduce TNF-α induced EC-activation. **Materials and Methods.** Naringenin-loaded nanoemulsions (NAR-LN), either non-targeted or targeted to endothelium by coupling on the surface a VCAM-1-recognition peptide, were prepared by the ultrasonication method. The efficacy of peptide coupling and the incorporation of naringenin in LN were determined by HPLC. The size and zeta potential of LN were determined using dynamic light scattering (DLS) and electrophoretic light scattering (ELS), respectively. The cytotoxicity studies were performed by XTT assay after exposing the human endothelial cell (EC) line EA.hy926 to various concentrations of NAR-LN for 24 hours. The uptake of Rhodamine-PE labeled LN by EA.hy926 cells was assessed by flow cytometry and fluorescence microscopy. Next, we studied the functional role of EC treatment with NAR-LN on monocyte adhesion to EC, activated or not with TNF-α. **Results.** Both non-targeted and VCAM-1- targeted LN were taken up by the EC in a dose-dependent manner. A significant increase was noted in the uptake of endothelium-targeted LN upon exposure to TNF-α, unlike the uptake of non-targeted LN, which was independent of endothelial activation by TNF-α. This differential behavior suggests distinct mechanisms of internalization, with a specific pathway for the targeted LN. No deleterious effect of NAR-LN on cell viability at doses corresponding up to 100 µM naringenin/0.5 mM lipid were detected in our experimental set-up. NAR-LN exerted a two times higher percentage of inhibition of monocyte adhesion to the TNF-α activated endothelium as compared to free naringenin at the same concentration. **Conclusion:** Poorly water-soluble naringenin, can be successfully encapsulated in LN and targeted to activated EC. Their functional capacity to reduce monocyte adhesion to activated cells guides to further studies to search for their potential benefits in experimental atherosclerosis and diabetes. **Acknowledgements.** The study was supported by UEFISCDI, INTERA project contract no. 13PCCDI/2018.

Poster Code: WS1-P22

Effects of Ag/TiO_2 and Ag/N-TiO_2 nanoparticles on human lung epithelial cells

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Introduction. The potential human health risks following the exposure to inorganic nanoparticles (NPs) is a very important issue for their application in leather finishing industry. Therefore, the aim of our study was to investigate the effect of silver (Ag)-titanium dioxide (TiO_2) NPs on human lung epithelial cells. **Materials and methods**. Three formulations of photocatalytic NPs containing 0.53% Ag (Ag/TiO_2: NP1), 1.14% Ag (Ag/TiO2: NP2) and 1.62% Ag (Ag/N-TiO_2: NP3) were prepared by electrochemical deposition of Ag on the surface of TiO_2 and N-TiO_2 NPs and further characterized for size and zeta potential. Epithelial lung cells (A549 cells) were exposed for 24 hours to various Ag/TiO_2 and Ag/N-TiO_2 concentrations and cytotoxicity, cell death mechanisms, production of reactive oxygen species (ROS), the changes in activation/inactivation of p38 MAPK, JNK and ERK signaling pathways and the profile of inflammatory cytokine/chemokine were determined. **Results.** A549 cells show differential sensitivity to various concentrations of each NPs formulations. Thus, NP1 and NP3 are more cyto-friendly as compared to NP2. A significant increase (up to 5 folds) in ROS production by A549 cells, that was dependent on dose and NPs formulation, was determined. In addition, no significative effect on total or phosphorylated level of protein p38 MAPK and JNK was observed, irrespective of NPs' formulation. NP2 formulation induces an increase in total and phosphorylated level of ERK1/2 in lung epithelial cells at a concentration of 0.3 mg/ml. NP3 formulation does not induce the expression of highly pro-inflammatory cytokines IL-1 and TNF-α in A549 cells. **Conclusion.** The results suggest that NP3 is appropriate to be selected for coating the leather surface due to its properties that are more cyto-friendly as compared to other NPs formulations. **Acknowledgments**. The study was funded by UEFISCDI, PNIII_15/2015 under SIINN-ERA-NET Programme.

Poster Code: WS1-P23

Effect of Carbon Nanotubes on Zirconium Ceramics Used for Biomedical Applications

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Zirconium ceramics is used in biomedicine. It is a biocompatible material and has been successfully used for the manufacture of implants for humans. The use of various additives to improve the performance properties of zirconium ceramics is an urgent task. The effect of carbon nanotubes on the structural-phase state of zirconium ceramics and its mechanical properties is investigated. Nanopowders of stabilized zirconia were prepared using sol-gel technology. The powders had a crystalline structure and a particle size of not more than 20 nm. A composite of zirconia and carbon nanotubes in a ratio of 80 to 20% was made by mechanical stirring in a planetary mill AGO 2C. Compacts with a diameter of 9 mm and a thickness of 3 mm were made by uniaxial static pressing. The processes of compacts sintering were studied by dilatometry. The effects of the additive were determined by the method of comparing the characteristics of the ceramics without the additive and with the additive. It is established that the quality of ceramics, in addition to the amount of nanotubes introduced, depends on the pressing pressure. At a pressure of more than 600 MPa, the porosity of the ceramic is 20% greater than the porosity at a pressure of 80 MPa. We used a non-standard firing method in an electron beam. The porosity of the ceramic was 20% when sintered in an electron beam with energy of 1.4 MeV, which is essentially less than for thermal sintering. It is important to note that the introduction of carbon nanotubes has not been drastically worn in the mechanical properties of the ceramic. Thus, it has been shown that carbon nanotubes are a promising additive for the production of highly porous ceramic based on zirconia. The sintering method in an electron beam enhances this effect.

Acknowledgements

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Poster Code: WS1-P24

Synthesis, physico-chemical characterization and anticancer potential of flavonoid chrysin-loaded hybrid PCL and PHB nano-formulations.

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Chrysin (5,7-dihydroxyflavone) is a natural flavonoid presented in various plant extracts and honey [1,2]. Chrysin possesses important anti-cancer, antioxidant and anti-inflammatory properties [3]. In the majority of the human cancer cell lines tested, chrysin inhibits proliferation, induces apoptosis, and interferes with the TNF-α signaling pathway more effectively compared to other tested flavonoids [2]. Furthermore, chrysin has been proved to enhance doxorubicin-induced cytotoxicity in human lung epithelial cancer cell lines via depletion of glutathione [4]. However, due to its poor solubility, following oral intake by humans, chrysin exhibits low bioavailability and rapid excretion. In this work novel hybrid Polycaprolactone and Polyhydroxybutyrate nano-formulations stabilized with Poly(vinyl alcohol) were synthesized via the *oil-in-water* technique. The cytotoxic and anticancer potential of the empty and chrysin-loaded nanoformulations was also evaluated. Physico-chemical characterization of the synthesized empty and loaded polymeric nanocarriers was performed by particle size analysis, *z*-potential, FT-IR, and FE-SEM. The entrapment efficiency and release profiling of chrysin from the specific loaded nanocarriers was determined through *in vitro* drug release studies using HPLC. The novel nanomaterials exhibit enhanced chrysin solubility and bioavailability with improved anticancer reactivity setting the stage for the development of novel anticancer nanotechnology.

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Poster Code: WS1-P25

Graphene Acid: Ready-to-derivatize Biocompatible Nanocarrier Towards Biomedical Applications

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The biomedical applications of graphene and its derivatives, including bioimaging, biosensing, tissue engineering and drug/gene delivery, have grown rapidly in the past decade. A well-established biocompatible graphene derivative is graphene oxide (GO) which was successfully used in such applications. However, there is no standardized procedure of preparation of GO which results in a great variety of GOs that differ in the nature and quantity of the oxygenated species, since the surface chemistry is poorly controllable. Therefore, it is highly desirable to develop a material which links the benefits coming from the 2D nature of graphene and hydrophilicity, biocompatibility, controllable surface chemistry and effective functionalization at the same time.

Here, we present a novel graphene derivative called graphene acid, a 2D carboxylic acid, showing excellent colloidal stability in water. It is made by controllable substitution and defluorination of fluorographene yielding intermediate cyanographene. The -CN groups are further hydrolyzed producing graphene acid.[1] In this work we performed detailed *in vitro* cytotoxicity study on graphene acid showing superior biocompatibility at all studied concentrations (till 250 $\mu g \cdot ml^{-1}$) based on various cytotoxicity tests such as cell viability assay, analysis of induction of apoptosis, cell cycle and study of mitochondrial membrane potential; all established for NIH/3T3 and HeLa cell lines. Further, we propose the use of graphene acid as a gene delivery vector after its conjugation with cationic polymer polyethyleneimine forming nanoparticles possessing DNA-binding capabilities. These findings show that graphene acid may become a significant alternative to GO.

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Poster Code: WS1-P26

Addition of graphene nanoparticles to PDMS matrix significantly improve hemocompatibility of samples

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Combinations of different materials to produce composites, which have greater mechanical strength and flexibility or prove new functionality, are required in order to maximize the material properties for the specific target application [1].

Polydimethylsiloxane (PDMS)/ graphene composite and PDMS samples were tested for hemocompatibility. Samples were treated with plasma, using two different gases. Oxygen plasma resulted in hydrophilic rough surface, whenever hydrogen plasma resulted in nanostructured surface with moderate hydrophilicity, for both composite and polymer sample. AFM images show significantly different topology of the two materials after plasma treatment. Hydrogen plasma gives rough nanostructured morphology of composite, which in turns results in better hemocompatibility and no activation of platelets on the surface. After plasma treatment, XPS studies showed higher content of oxygen on the surface of oxygen plasma treated surfaces, but there was no significant difference in chemical composition of other elements present on the surface. Platelets activation on the surface was therefore dependent mostly on the surface morphology and roughness and not on the functional groups presented on the surface. The highest number of platelets activated on the sample surface was observed on flat untreated sample and oxygen plasma treated sample, whereas there was almost no platelets activated on hydrogen plasma treated nanostructured surface. Degree of cytotoxicity of the present materials did not show significantly elevated values of plasma treated material compared to control.

Addition of graphene nanoparticles to PDMS has a great potential in usage for medical implants, not only because of their excellent mechanical properties, but also because of the improved hemocompatibility of samples. Platelets tend to activate on flat, less rough surfaces with moderate hydrophilicity, wherever they do not adhere or activate on the hydrogen plasma treated nanostructured surface. Therefore plasma treatment of the samples is promising method for optimizing surface properties of the material to achieve better/improved hemocompatibility.

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Poster Code: WS1-P27

Interactions of mitoxantrone-modified superparamagnetic iron oxide nanoparticles with biomimetic membranes and cells.

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The nanoparticle carriers can interfere with the organization of the biological membrane, leading to passive penetration through the cell membranes. The study of the physicochemical properties of drug carrier-membrane interactions provides deeper understanding of the mechanisms involved in this phenomenon.

The purpose of our studies is to investigate the interactions of nanoparticles modified by anticancer drug with model cell membranes in hope to gain better understanding of their carrier capabilities as well as possible cytotoxicity

We report on the formation of conjugates of superparamagnetic iron nanoparticles (SPIONs) with the chemotherapeutic agent mitroxantrone (MTX). The SPIONs are synthesized from mixed iron oxides and are ca. 15 nm in diameter. Decoration of the SPION surface with MTX is accomplished with standard coupling chemistry techniques using sebacic acid as the coupling agent. The resulting SPION-MTX conjugate is characterized thermogravimetrically, spectroscopically and electrochemically. The interactions of the SPION-MTX conjugate with a model lipid layer formed as a LB film reveals that the nanoparticle exhibits a significant perturbative effect on the layer, as seen from translational diffusion (FRAP) measurements. Evaluation of the cytotoxicity of the conjugate relative to that of free MTX demonstrates that the SPION-MTX conjugate is more toxic than free MTX for both normal and malignant cell lines. These results underscore the importance of targeted delivery in the administration of chemotherapeutic agents.

Poster Code: WS1-P28

Fe_3O_4 nanoparticles formation by ball milling of hematite

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At present, there is a growing need to obtain nontoxic magnetic liquids based on magnetite, Fe_3O_4, and maghemite, γ-Fe_2O_3, for use in medicine in particular for drug transport. The chemical methods are widely used for the synthesis of iron oxide nanoparticles in the range of 10-100 nm.

In this work, it was shown that the Fe_3O_4 nanoparticles can be obtained by dry ball milling of hematite in a planetary mill when we use the milling time of 120 min and more at 2220 rpm rotation speed for vial. The structure of powder was characterized by scanning electron microscopy, X-ray diffraction and Brüner, Emmett, Teller analysis. In addition, the iron oxide was analyzed by thermomagnetometry method, which is thermogravimetric analysis in magnetic field. The saturation magnetization was measured at room temperature using the vibrating sample magnetometer.

According to the XRD data, the Fe_3O_4 spinel phase concentration increases with increasing the milling time. The results of the measurement of the magnetic properties of this powder showed an increase in the saturation magnetization due to the formation of magnetic phase. The crystallite size of magnetite was found to be 20 nm.

The thermomagnetometric analysis confirmed the presence of Fe_3O_4 phase due to its oxidation in the air in the furnace of thermal analyzer.

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Poster Code: WS1-P29

Gold Coated Cobalt Ferrite Nanoparticles via Methionine Inducted Reduction

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Among various functional nanostructures, gold coated and decorated magnetic nanoparticles (*Nps*) have inspired huge attention because of biological compatibility and recent potential applications in nanomedicine, bio-sensing, drug delivery, cells separation, etc. In fact, surface coating of superparamagnetic *Nps* with biocompatible polymeric, organic or precious metal shell is a familiar tool to tune the interactions between *Nps*, their saturation magnetization, surface energy and properties [1-3].

Functionalized superparamagnetic nanoparticles (*Nps*) recently are one of the most investigated research topics. In this study, we present an efficient protocol for gold deposition onto the surface of cobalt ferrite ($CoFe_2O_4$) *Nps* by a simple one-pot reduction of $AuCl_4^-$ ions with methionine amino acid, that in turn produce the biocompatible *Nps* stabilizing shell. In contrast to reported gold deposition recipes, the adopted herein is distinguished by the simplicity and evade of mono-gold crystallites nucleation and growth in the deposition solution bulk. This work was based on our observation that in contrast to other amino acids amino acid methionine is prone to reduce $AuCl_4^-$ species at the walls of glass vessel instead of nucleation the Au^0 particles in the solution bulk. In the presence of $CoFe_2O_4$ *Nps*, however, the covering of magnetic *Nps* instead of glass vessel walls was observed. The advantage of our functionalization method lies in its high yield, simplicity and avoidance of gold crystals formation.

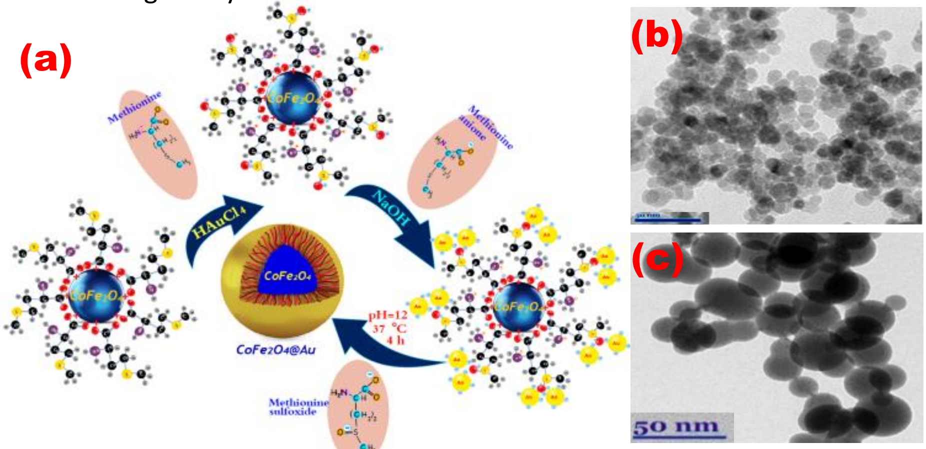

Fig. 1. Scheme (a) gold coated *Nps* via methionine induced, TEM images of nanoparticulated products synthesized by hydrothermal treatment before (b) and after (c) gold coated

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Poster Code: WS1-P30

Magnetic field sensible nanocomposites based on cross-linked sodium alginate and maghemite

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The materials with magnetically adjustable pool of properties are of great importance because of great potential of their use for biomedical applications. From one hand the magnetism of nanoparticles determine their applications as: 1) contrast agents in magnetic resonance imaging studies; 2) compositions for hyperthermia treatment of lesions in the body, and 3) the magnetic component of compositions for targeted drug delivery. From another hand the polymer matrix of the composite materials must provide stabilization of nanoparticles by preventing their aggregation and adhesion, solubility in physiological environments. In this report we present polymer composites of well defined maghemite nanoparticles and biocompatible anionic polysaccharide, sodium alginate cross-linked by Ca^{2+}-ions.

The proposed method of synthesis allows one to obtain water-soluble magnetic materials with controlled content of inorganic phase. Using this approach well defined maghemite nanoparticles with a narrow size distribution are formed. One of the major advantages of the proposed method is normal conditions of the synthesis. The role of crosslinked alginate macromolecules matrix is to restrict the growth and prevent the aggregation of forming magnetic nanoparticles. The average size of the resulted nanoparticles inclusions were 11 nm. The crystallography data has confirmed the maghemite structure of iron oxide nanoparticles. It was shown that the inorganic particles were bound to the polymer matrix by electrostatic interaction and by formation of coordination complexes. Magnetic properties of the obtained nanocomposites (saturation magnetization, residual magnetization, coercive force) were shown to depend on the maghemite content. Being dissolved in water nanocomposites formed aggregation-stable dispersions that were sensitive to the action of an external magnetic field. Stability against aggregation was ensured by overall negative surface charge of particles in the nanocomposite.

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Poster Code: WS1-P31

Fluorescent Carbogenic Nanoparticles

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Photoluminescent nano-systems have attracted much attention in last years from both academia and industry. They are widely used in everyday life as well as in highly specialized implementations such as optical analysis, photonics, chemical sensing, molecular tracing and cellular imaging. Recent advances in the field have expanded the library of available fluorescent materials (typically dyes, polymers or proteins) to include semiconductor nanocrystals (so called Quantum Dots) and carbogenic photoluminescent nanostructures (C-Dots). The latter class of materials share properties typical to the metal-containing Quantum Dots, with the advantage of being non toxic and highly biocompatible. C-Dots essentially hold great promise for various biological and biomedical applications. Current research efforts are focused on the development of well defined carbon based nanostructures with tunable size and functionalities and optimum fluorescent capabilities. Up to date, the synthetic strategies have focused on 'top down' and 'bottom down' approaches. The first strategy is based on nano-fragmentation of carbon source while the second one involves mild pyrolysis of organic molecular precursors. Most recently, emphasis is given to explore C-Dot based systems that exhibit dual photoluminescent emission. Those materials can selectively detect the presence of toxic compound even in minute quantities, while showing supreme bioimaging capabilities.

This talk will be focused on C-Dot based systems, *breakthroughs,* applications, and challenges.

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Poster Code: WS1-P32

PEGylating magnetic nanocrystals clusters through electrostatic interactions

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Condensed magnetite colloidal nanocrystal clusters (co-CNCs) display excellent attributes with regard to magnetic manipulation and contrast enhancement in MRI, in comparison to non-condensed systems [1]. However, the as-prepared nanocarriers lack colloidal stability upon drug loading and dispersion in blood-isotonic media and their efficient PEGylation remains a challenge, so far has only been attained through covalent conjugation [2] which requires cumbersome and lengthy time-consuming procedures.

In the present work an alternative route is presented for the efficient and facile PEGylation of these systems through electrostatic complexation with (a) double hydrophilic poly(cationic-b-ethylene glycol) block-copolymers and (b) Layer-by-Layer self-assembly techniques with the alteration of surface's charge with branched Polyethylenimine (PEI) and the subsequent electrostatic PEGylation with anionic poly(Aspartic-b-ethylene glycol) block-copolymers. After determination of the optimum ratios and mixing conditions, the electrostatically complexed systems appear to impart excellent entropic (steric) stabilization, similar to that of conjugation. Evaluation of the products was performed with dynamic light scattering (DLS), electrophoretic measurements (zeta potential), thermogravimetric analysis (TGA) and by salt-stability assays.

PEGylation through self-assembly constitutes a very attractive route in comparison to covalent methods, simplifying significantly the overall process. Its effective application on co-CNCs opens the way for further studies towards improved magnetically-engineered theranostics.

ACKNOWLEDGEMENTS

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Poster Code: WS1-P33

Multiplex analysis of tumor markers using surface enhanced Raman spectroscopy (SERS).

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Cancer is the major cause of death worldwide, so it is very important to develop methods for the detection of tumor markers in various clinical samples, such as blood. Immunoassays or immunohistochemistry based methods are usually employed and are considered as golden standards. However, their utilization could be, due to their sample requirements, limited in several cases. Other possibility for multiplex detection of cancer is the surface-enhanced Raman spectroscopy, or its modification, the so-called magnetically assisted surface amplified Raman spectroscopy (MA-SERS). Here, we present application of this method in the competitive simultaneous detection of two cancer markers - HER2 and EpCAM. The magnetic nanocomposite Fe_3O_4@Ag functionalized with antibodies (Anti-HER2, Anti-EpCAM) was used as the biosensor. The proposed method was based on competition between chemically labeled reference markers (Her2_Cy3 and EpCAM_Cy5) and unlabeled markers and was used to detect selected markers in human whole blood. MA-SERS application is an attractive alternative to other methods (electrochemical methods or SERS) used in multiplex detection due to the magnetic nanoparticles that allow rapid pre-concentration of the analyte by external magnetic field and simple separation of target substances from complex matrix.

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Poster Code: WS1-P34

Evaluation of milk-derivate exosomes as natural liposomes in theragnostic.

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Background: Synthetic liposomes are one of the most employed structures in nanotechnology. In their translation from bench to bedside, several complications appear, specially related to their biocompatibility and availability due to their artificial origin. Exosomes are natural nanovesicles (30-150 nm) of endosomal origin, with a proven active role in processes of oncogenesis and disease progression [1,2]. They are present in cellular environment and many biological fluids. Because of their lipid bilayer structure, nanometric size, easy production and high biocompatibility [3], we propose milk-derivate exosomes as natural substitute of synthetic liposomes for drug delivery and molecular imaging. In this work, we present the purification, characterization, *in vitro* and *in vivo* evaluation of this exosomes as promising natural liposome-like nanoplatform in theragnostics.

Methods: Exosomes from goat milk were isolated by ultracentrifugation and PD-10 columns. For the physicochemical characterization, nanometric size was measured by TEM and DLS. In order to evaluate pharmacokinetics properties *in vivo*, purified exosomes were radiolabeled with ^{99m}Tc in presence of $SnCl_2$ for 30 min at 37ºC, and then purified using Exosomes Spin Columns. Radioactive yield and purity degree of the sample were established by TLC (H_2O: MeOH 10:90) and *in vitro* stability assessed in PBS at 37ºC. *In vivo* blood half-life was stablished by blood extraction at different time points. *Ex vivo* biodistribution studies 24h post administration were quantified in gamma counter. In vivo tracking of the radioactive nanoparticles was performed by SPECT imaging in healthy mice at 5 min,10 min,15 min, 20 min, 30 min, 60 min, 3h, 5h, 24h and 48 h post injection. *In vitro* toxicity was evaluated in hepatocytes by MTT assays at different concentrations (0; 0.05; 0.5; 5 and 20 g/mL) and time points of incubation (24 h and 48h).

Results: Isolated exosomes showed a hydrodynamic size of 135.32 ± 9.12 nm by DLS, similar to core size observed by TEM (Fig.1A). *In vitro* MTT assays confirmed the biocompatibility of these natural nanoparticles. For the in vivo pharmacokinetic study, radiolabeling with $^{99m}Tc^{4+}$ was carried out with a purity higher than 95%. *In vitro* stability of ^{99m}Tc-exosomes showed values over 95%, even after 48h of incubation (Fig.1B). Blood half-life studies confirmed a short circulation half-life of 8 min (Fig.1C), according to the distribution of the radioactive exosomes observed by the in vivo tracking. *In vivo* SPECT imaging and biodistribution studies showed main accumulation in liver, spleen and bladder (Fig.1D).

Conclusions: We present for the first time the purification, characterization and radioactive labeling of goat milk exosomes for their *in vivo* evaluation as natural liposomes for theragnostic. These new nanoplatforms show a high stability and biocompatibility *in vitro*, with *in vivo* pharmacokinetic properties similar to those of other natural exosomes employed in drug delivery as natural liposomes [3]. SPECT imaging confirmed a fast blood clearance, similar to that of synthetic liposomes of similar shape and size.

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Poster Code: WS1-P35

In situ synthesis of silver nanoparticles on organic and inorganic colloidal particles for theranostic applications

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Development of theranostic micro- and nano-objects, which allow doing a quick diagnostics and can and provide appropriate treatment of diseases. However, there is a just limited number of structures which can combine a drug delivery and sensing function. In our work we focus on one of the perspective molecules detection method is the surface-enhanced Raman spectroscopy, provided by plasmonic resonance nanoparticles.

For this reason, the synthesis of nanoparticles in the matrix of perspective drug carrier will give a nice opportunity to add the additional sensor properties. The inorganic calcium carbonate porous particles with a porous structure are a very promising carrier due to their biocompatibility, cheap and degradability. The novel synthesis method of such particles allows formatting the porous structure with various size with the size range from 400 nm till microns[1].

Additional adsorption of the hydrogel molecules (like the alginate) with following crosslinking and elimination of the calcium carbonate template allows us to produce the hydrogel contained with size and shape replicated from calcium carbonate template[2]. For the following functionalization, we developed in situ synthesis of the silver nanoparticles in the matrix using the silver reaction: reduction of the silver from tollens reagent. The porous structure of the matrices and reduction time affected by the silver nanoparticles size and shape. This allows us not only to providing cheap nanoparticles in a large amount but control the size distribution and as results the optical properties of the whole system. We demonstrate the possibility of such containers as an analytic platform for detection molecule in low concentration via SERS effect.

For demonstration, a wide range of such containers applications as drug system the was encapsulated to study payload release dynamics via the medical ultrasound treatment. The biocompatibility, as well as cell uptake, were provided by test the particles in various cell lines from Hela for cancer application till osteoblastic cells for tissue engineering application.

We believe that such decorated with silver nanoparticles microspheres can be used for optical based detection of molecules, as well as a reservoir for the loading of a payload.

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Poster Code: WS1-P36

Ultrasound-responsive Smart Liposomes as Theranostic agents for Treatment of Glioblastoma multiforme

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The study presented here explores the use of pH-and ultrasound-responsive drug-loaded stealth liposomes that can act as theranostic contrast agents and can be used in the diagnosis and treatment of glioblastoma multiforme. While conventional treatment in glioblastoma multiforme is characterized by a poor prognosis, the advent of nanomedicine has allowed the spatial and temporal control in drug delivery.[1, 2] The present study uses stimulus responsive liposomes, nose-to-brain drug delivery and ultrasound to attain higher bioavailability of the drug across the blood brain barrier for the better treatment of glioblastoma. The liposomes prepared herein were characterized in terms of their size, stability, drug encapsulation and the potential to be administered intranasally. Drug release in vitro in simulated conditions demonstrated that the drug released faster from the nanoparticles in the simulated cerebrospinal fluid as compared to the simulated nasal fluid. This effect was accentuated in the presence of ultrasound. In addition to this, the liposomes exhibited high contrast in situ on B-mode ultrasound imaging in a tissue mimicking phantom. The nanoparticles developed were found to be safe and biocompatible on fibroblast (L929) cell lines while they also were cytotoxic to the tumor cells (U87MG cell line) as compared to free drug. Further, the higher bioavailability in the brain was determined through in vivo administration intranasally in Wistar rats. Thus, these smart nanoparticles are established to be theranostic agents and can be of great importance in the diagnosis and treatment of glioblastomas.

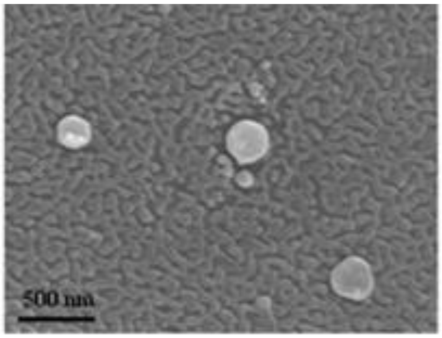

Figure 1: CryoFEG-SEM micrograph of the liposomes which can act as theranostic agents in the treatment of glioblastoma

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Poster Code: WS1-P37

Antibacterial Layer-by-Layer assemblies based on Graphene

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As values shift from a reliance on antibiotic treatments to a more focused approach to infection prevention, there has never been a greater requirement for durable, effective, and non-toxic antimicrobial coatings. Graphene based compounds (GBCs) have shown great promise for the development of a new generation of antimicrobial materials [1]. Although the exact mechanism of the antibacterial performance of GBCs has yet to be confirmed, it appears that it combines contributions associating with the physical insertion into bacterial membranes form one hand, along with the and production of reactive oxygen species, on the other hand. [2].

In this project, GBCs along with commercially available amphiphilic polymers were used as building units to generate layer-by-layer (LbL) assemblies. The antibacterial activity was tested against *Staphylococcus aureus* (Gram positive) and *Escherichia coli* (Gram negative), following the standard colony counting method. Interestingly, the multilayer systems were shown to inhibit bacterial growth by at least 99% compared to much lower values found for each one of the single-component systems. It is thus clear that the LbL assemblies exhibit synergistic antimicrobial effects that can be attributed to the interplay of their chemical composition, wettability and surface roughness.

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Poster Code: WS1-P38

Production of antibacterial polymeric materials

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The nanostructured topography of cicada wings has been shown to possess antibacterial properties.[1,2] Although the bactericidal mode of action is still not fully understood it has been shown to be based solely on the physical surface structure, making it an attractive route for controlling antibiotic resistant strains.[3,4] There is therefore an interest and an opportunity to fabricate nanostructured materials that maintain the bactericidal activity of the insect wing, and gain a better understanding of the mode of action of these surfaces and how to best fabricate the structure to effectively promote cell death. Our group is interested in producing nanostructured polymeric materials which could have applications in the coating of surfaces in a medical or food setting.

We have used block copolymer lithography to transfer a nanopattern to a Si substrate. Our cylinder forming poly (styrene - *block* - methyl methacrylate) polymer is thermally annealed over a neutral brush layer to microphase separate into perpendicular cylinder domains of approx. 20 nm in diameter, with a centre to centre spacing of approx. 40 nm. Using UV irradiation to remove the polymethyl methacrylate cores facilitates the backfilling of an $Fe(NO_3)_3$ hard mask. An oxidation step of the $Fe(NO_3)_3$ produces a final iron oxide hard mask that allows plasma etching of the underlying Si, producing a master template of hexagonally packed pillars that are then moulded in a specialised molding chamber using industrially relevant UV-curable polymers to produce nanopatterned polymer surfaces. The nanostructured silicon, and the corresponding polymer surfaces have been characterised by FESEM and AFM and demonstrate the resolution of our molding method. The bactericidal activity of both the moulds and Si master has been studied using static cultivation tests against *Pseudomonas fluorescens*.

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Poster Code: WS1-P39

Shell-dependent antimicrobial efficiency of cobalt ferrite nanoparticles

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Cobalt ferrite nanoparticles are attractive candidates for many biomedical applications such as magnetic resonance imaging, magnetic field-assisted drug delivery, magnetothermal therapy etc. One of research area which does not attract so many researchers attention is magnetic nanoparticles application as antibacterial agents [1][2].

In this study L-lysine and Oleic acid capped similar size $CoFe_2O_4$ magnetic nanoparticles were synthesized by thermal decomposition and hydrothermal synthesis methods. All particles were tested as antimicrobial agents for antibiotics resistant C. Albicans, C. Parapsilosis, E. Coli, S. Aureus microorganisms strains.

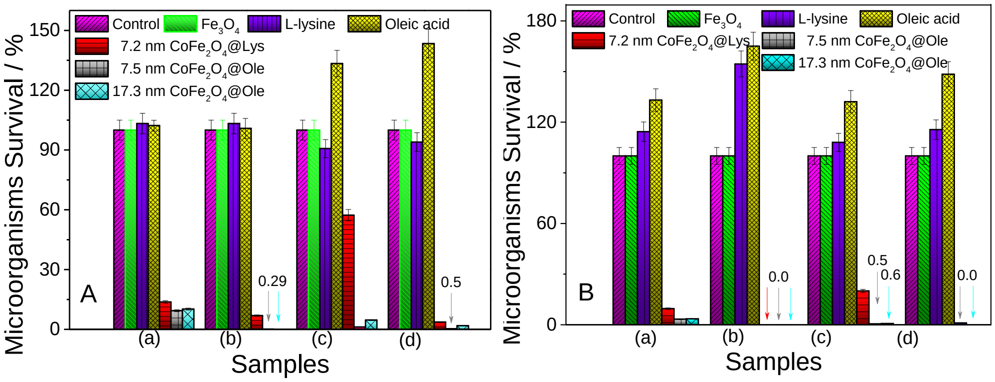

Fig. 1. Antimicrobial activities of the synthesized L-lysine and Oleic acid-functionalized cobalt ferrite nanoparticles against C. Albicans (a), C. Parapsilosis (b), E. Coli (c), and S. Aureus (d) after (A) 24 h and (B) 72 h incubation.

It was determined that all nanoparticles synthesized in this study showed significant antimicrobial efficacy for selected microorganisms strains (Fig. 1.). Investigating 7,2 - 7,5 nm diameter nanoparticles were observed that particles stabilized oleic acid were more efficient than L-lysine stabilized. It was also noticed that Oleic acid itself stimulates propagation of tested microorganisms strains.

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Poster Code: WS1-P40

Fe-doped C-dots combining exceptional optical, magnetic and antimicrobial properties

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Carbon nanoparticles constitute a new class of carbon-based materials which are easily synthesized via thermal or hydrothermal treatments of carbon rich precursors. These spherical nanoemitters are composed of an amorphous core with an approximate size of below 10 nm and exhibit exquisite biocompatibility, simplicity of surface modification, excellent chemical stability and broad excitation spectra (1-2). Their exceptional photoluminescent properties are related to the dual emissive mode with the excitation-wavelength-independent or dependent emission, attributed to the presence of organic fluorophores or carbogenic cores, respectively (3). The supreme optical properties of C-dots based materials are explored in a variety of applications such as bioimaging, solar cells, photocatalysis, colour printing. Incorporation of Fe to C-dots in a systematic manner affords access to a wide range of multifunctional materials that show remarkable optical, magnetic and antimicrobial properties, a combination not encountered in any other type of nanoparticles. Our results pave the way for the development of a new generation of advanced materials that can be precisely directed by a magnetic field. This can occur in otherwise inaccessible spots where they can effectively decompose organic pollutants and simultaneously act against harmful pathogens.

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Poster Code: WS1-P41

Preparation and characterization of *Pistacia lentiscus* var. *Chia* essential oil-loaded poly(lactic acid) nanoparticles as novel wound healing agent

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Dating back to the first century AD, ancient Greek physicians (Hippocrates, Dioscorides, Galenos) reported the therapeutic properties of *Pistacia lentiscus* var. *Chia* (mastic tree of Chios). The plant derivatives are well known for treatment of stomach disorders, preservation of oral hygiene and wound healing action. Extended research suggests that the essential oil possess mainly antimicrobial and anti-inflammatory properties, thus attracting considerable interest as a potential wound healing agent.[1] Issues like its poor water solubility and volatility, as well as its caustic nature when in large quantity, hinder the development of technological means for cutaneous administration. Further research has reported anticancer activity, raising significantly the demand of investigating possible means of administration.[2] Encapsulating the essential oil in nanoparticles (NPs) provides a method of protection and controlled release for the oil constituents enclosed in the core of the nanoparticles. In this study, poly(lactic acid) (PLA) is chosen as the most appropriate shell material due to its biocompatibility, biodegradability and hydrophobic nature, allowing thus the incorporation of oily compounds. A comparative study has been carried out for the investigation of surfactant type on produced nanoparticles, using poly(vinyl alcohol) and lecithin. Nanoparticles made by solvent evaporation method were evaluated according to mean size, shape, polydispersity index and zeta-potential. Encapsulation efficiency was determined utilizing GC-MS, technique of high accuracy and limited use in literature. Moreover, according to the results of stability and in vitro release study, polyvinyl alcohol-NPs demonstrate remarkably firmer structure in comparison with lecithin-NPs. The results of this research demonstrate a potential for a novel sustained release system of the particular essential oil, maintaining though the possibility of expansion by two means; investigation of the different biomedical applications and furthermore, encapsulation of a variety of essential oils.

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Poster Code: WS1-P42

Polysaccharides-based Capsules Loaded with Magnetic Nanoparticles

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Polysaccharides-based capsules with encapsulated magnetic iron oxide nanoparticles (MNPs) may lead to novel approaches in solving biomedical problems in various nanomedicine application, including magnetic drug delivery systems, magnetic resonance imaging, hyperthermia treatment and in iron deficiency therapy.[1] Considerable efforts have been dedicated to fabricate and characterize magnetic iron oxide nanoparticles synthesized by the thermal decomposition of iron (III) oleate which are dispersible in oils.[2]

Here, such MNPs were encapsulated in the oil core capsules with shells prepared of hydrophobically modified biopolymers.[3] Physicochemical properties as well as stability of the obtained iron oxide magnetic nanoparticles and capsules were investigated using various techniques. The MNPs were examined by light scattering and zeta potential measurements, infrared spectroscopy, X-ray diffraction, Mössbauer spectroscopy, magnetometry and Scanning Transmission Electron Microscopy (STEM). Fabricated capsules were examined with light scattering and zeta potential measurements and imagined by STEM.

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Poster Code: WS1-P43

Designing of Highly Programmable and Modular Nanorobotic Platform for Smart Drug Delivery

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Protein cages are amongst the most sophisticated protein-based architectures so far known. Their self-assembly from a small number of subunits into symmetrical, monodisperse shapes has inspired scientists from many disciplines.[1] Protein cages were also found useful for a variety of application including drug encapsulation and imaging agent. For example, ferritin can make well-defined monodisperse spheres that can be filled with drugs and they protect the drug from interaction with the outside world. This is very powerful strategy and actually protein cage-based drug delivery is now undergoing clinical trial.[2] However, one of the biggest challenges one would face working with protein cages is the limited number of modification one can achieve with protein cages, so generating highly programmable and modular protein cages are extremely difficult. Another challenge associated with protein cage is in the fact that for geometric and protein expression reasons almost all protein cages are made from only one or two proteins repeated many times which means that any change you make at one position is repeated all other equivalent positions. Overall this means although protein cages have great potential for drug delivery, however they allow only simple modification and therefore only simple functionality can be achieved.

In contrast to proteins, DNA nanostructure, specifically DNA origami, allows us to easily design any shapes that we want and has over 200 uniquely addressable strands that can, in principle be all modified with different modifications and can be individually exchanged giving modularity.[5] This means one can design a universal DNA origami system and then fine-tune its program by simply swapping out a small number of strands. Modifications that one can make include aptamers to give Boolean logic gates in response to binding of target molecules and also G-quadruplex structures that can target many cancer cells.

In my presentation I will discuss about highly programable hybrid nanorobot made of protein cage and DNA origami, which probably overcomes many of the problems discussed above. I already designed and produced a modular DNA origami container that has capacity to encapsulate a protein cage, we further modified the protein cage and filled its cavity with anti-cancer drug doxorubicin and cisplatin. Presently we are targeting our modular nano-robot container towards specific cancer cells through DNA origami staple strands modification with G-quadruplex structures which bind to the specific receptor which is overexpressed in cancer cells. The successful design will enable us to carry out two important fundamental research goals simultaneously, first, solving the problem of breaking the protein symmetry of multimeric protein assemblies and secondly, construction of higher order, complex nanometric structures for use as “smart” drug delivery systems.

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Poster Code: WS1-P44

Electrospun Nanofibers as Controlled-Release Carriers of Echinochrome A

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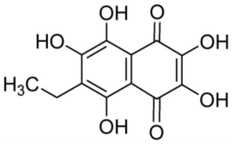
Echinochrome A (EchA) is a marine bioactive pigment isolated from sea urchins, exhibiting a wide spectrum of pharmacological activities, such as antioxidant, anti-diabetic and cardioprotective and is the active substance in the clinical drug Histochrome [1]. EchA is practically insoluble in water and therefore Histochrome is available only in ampoules in the form of echinochrome di- and tri-sodium salts, which dissociate and oxidize by air oxygen easily.



Echinochrome A

Water solubility is a key parameter in drug formulation since it highly influences drug pharmacokinetics and pharmacodynamics. One of the most efficient strategies to improve the dissolution and bioavailability of poorly water-soluble drugs is their incorporation into polymeric electrospun nanofibers. Electrospinning is a versatile, up-scalable technique for preparing controlled-release amorphous solid dispersions and polymeric nanofibers of poorly water-soluble drugs.

In the framework of our research interests towards the production of electrospun micro-nanofibrous composites, we have investigated the development of EchA-loaded nanofibrous polymeric matrices. EchA was successfully incorporated, in its amorphous state, in electrospun fibers of various biodegradable polymers. The produced nanofibers were characterized using SEM, FT-IR and XRD analyses. The *in vitro* modified release characteristics of EchA, in aqueous media (pH 1.2 and 6.8), from the electrospun nanofiber matrices showed modified and enhanced dissolution profiles, revealing that polymeric nanofibers represent a promising carrier for EchA that can increase its solubility and bioavailability, protect its hydroxyl groups from oxidation and preserve or enhance its pharmacological properties.

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Poster Code: WS1-P45

Injectable Dual release Nanoformulation based Hydrogel for Blood Borne Bacterial Infections

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Bacterial infections invading skin pose a great threat to mankind and should be addressed immediately. Bacterial recalcitrance and multidrug resistance is the underlying etiology which has worsened, escalating virulence rather than averting them. Unnecessary overconsumption of drug moieties by mankind has paved the way to bacterial chromosome alteration, gaining complete resistance over the consumed antibiotics. Furthermore, lack of proper infection management has led to relapse and its associated long term co-morbidities resulting in serious life threatening sequelae like; chronic septicemia, kidney disorders (pyelonephritis, renal damage) and several other toxic side reactions, which could be a leading cause for the rise in mortality rates. *Staphylococcus aureus (S.aureus), Echerichia coli (E.coli), Pseudomonas aeruginosa (P.aeruginosa)*, methicillin-resistant *Staphylococcus aureus (MRSA)* are the major nosocomial pathogens responsible for causing bacterial skin and implant related infections. Hence our pursuit was in developing a localized dual drug nanocomposite system coated with Schiff base assembly for the complete destruction of bacteria from skin, soft tissues and implant related surfaces. The presence of human serum albumin being encapsulated in nanoparticle, results in faster onset of healing, due to the presence of growth factors. The nanoparticles are finally incorporated in a carrier gel matrix which has reported antibacterial properties and together serve to be a carrier matrix for the ease of application.

The prepared [V-PCL] nanoparticle (np's) exhibited an average diameter of 90.4±65nm with a zeta potential of -34.2±6mV.Whereas, [HAS-PCL]np's was found to be in a size range of 120±55nm with-32.4±5mV stability. [V-PCL,HAS-PCL]UV gel was found to be extremely biocompatible towards L929cells on examination and was found to heal at a faster pace. Nanoparticle when examined through SEM was seen to deeply penetrate the dermis and ruin bacterial cell integrity. The antibacterial potential of the nanocomposite sytem was found several folds high when compared with only antibiotic. The rate of penetration was high with excellent patient compliance. [V-PCL, HAS-PCL]UV satisfied the rheological property to be applied on skin and smooth tissues. This work substantiates use of [V-PCL, HAS-PCL]UV for curing blood borne bacterial skin and implant related infections.

Poster Code: WS1-P46

Nanoengineered Dual Release Graft for Pain and Inflammation Management in Osteoarthritis

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Osteoarthritis (OA) is a progressive and degenerative joint disorder caused due to wear and tear of tissue joints and cartilages. The clinical syndrome is manifested by the inflammation of joints and tissue degeneration incapacitating the quality of life. To date, OA is regarded as the common multifactorial arthritis affecting millions of individuals especially women resulting disability in gait and increased agony with age advancement. Current treatment regimens include injection of high dose of steroids, oral intake of steroids and replacement surgeries. Intra-articular injection of heavy doses ultimately leads to severe side effects, whereas, when used topically results in hypersensitive reactions. Oral route due to poor availability cannot unable disease prognosis. Replacement surgeries are the final option with challenges such as low success rate, cost, and prolonged follow ups. To overcome the challenges the work presents nanoengineered dual drug release formulation against OA.

Osteoarthritic drug (DMOD), was encapsulated in polymeric nanoparticle, whereas, the pain relieving drug encapsulated in thermoresponsive polymeric nanoparticle(Np). The dual drug loaded nanoparticles were further incorporated into biodegradable gel chitosan serving as immobilizing matrix. Study reports the sustained release of DMOD from polymeric Np, and burst release of NSAID from thermoresponsive polymeric Np on application of heat pad. Cs gel served as a good immobilizing matrix and controlled the release of drug onto the target site. (D-PCL, A-PNVCL)Cs was found to be biocompatible to L929 cells. Rheology and inversion tests suggest the smooth extrudability of the gel, the ideal characteristic for intra-articular injection. The *in vivo* biocompatibility studies in wistar rats demonstrated significant compatibility of the material without causing any hypersensitive reactions to the animals.

The results suggest the matrix (D-PCL, A-PNVCL)Cs as a promising candidate to be used for curing osteoarthritis.

KEYWORDS : Osteoarthritis, Intra-articular, PCL NP, PNVCL NP, Diacerein, Aceclofenac.

Poster Code: WS1-P47

Promiscous phage-peptide as possible approach to a multiple drug targeted therapy

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Infectious diseases are one of the major causes of human mortality and disability worldwide, mainly due to emergence and rapid spread of drug-resistant bacteria. The design of new targeted drug delivery systems requires the discovery of probes capable of recognizing intra- and inter-specific variants of infectious bacteria. Phage display is a powerful tool that uses filamentous phage engineered for coat protein to select peptides that can bind to a wide range of antigens in whole-cell. Selected peptides, chemical synthetized or inside on engineered phage coat protein-VIII (pVIII), can be used as probes to functionalize delivery systems, without losing of its activity and selectivity. In this work, we show results related to peptides of M13 phage clones with 'promiscuous' ligands, able to identify intra and inter-species of pathogenic bacteria. Firstly, two M13 phage display libraries (pVIII-9aa and pVIII-12aa) were screened against bacterial membrane targets from *S. aureus*, *S. epidermidis*, *L. monocitogenes*, *E. coli* and *P. aeruginosa*, using affinity-selection procedures [1, 2, 3]. Then, reactive individual phage clones were amplified and investigated by cross-reactivity ELISA test, in order to verify the ability of engineered peptides to identify isolated clinical strains of their respective bacteria and in comparison with a panel of other bacterial species. We found that the promiscuous peptides, displayed in pVIII of phage clones named St.9IVS5 and 9IIIB5, 12IVB12 were able to selectively identify several strains of *S. aureus* and *S.epidermidis*, respectively. Other peptides showed instead reactivity for both Gram- and Gram+ bacteria. In particular, peptides, of phages clones named 9IIIB1, 9IIIB4 and 12IIIB4, were able to bind both *S. epidermidis* and *P. aeruginosa*, while the peptide LI-pep bond *P. aeruginosa*, *L. monocitogenes* and several strains of *E. coli*. Results appear intriguing in view of the development of therapeutic systems with a broad spectrum of action against bacterial infections.

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Poster Code: WS1-P48

Biomonitoring air pollution in leaves of carob tree

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In this study the effect of the quality of urban habitat on seasonal changes of photosynthetic pigments and spectral characteristics of the leaves of the wide spread, evergreen Mediterranean species *Ceratonia siliqua* L. (carob tree) was evaluated [2]. Compound leaves of *Ceratonia siliqua*, grown at two contrasting sites with different levels of air pollution [3], were collected throughout a year; one site is located in the Kaissariani Aesthetic forest (37.959328, 23.798508) and the other is an urban site near the Campus of the National and Kapodistrian University of Athens (37.971577, 23.757916) [1]. The accumulation of photosynthetic pigments (chlorophylls a and b, and carotenoids) of leaves was determined during their development (i.e. nine successively grown leaves along shoots). Leaf area, dry weight and specific leaf area were also determined. Leaf transmittance (T) and reflectance (R) spectra for both adaxial and abaxial leaf surfaces were measured between 250 and 2500 nm wavelengths (bandwidth 2 nm), using a UV-VIS spectrophotometer [3]. The calculated leaf absorbance / absorption (Abs) at wavelengths varying from 250 to 2500 nm Abs = 100 – (R + T) [4] is used to assess the effect of environmental quality of the two contrasting habitats in Athens, on leaf development of carob tree. Significance of the differences in optical properties was tested and the results have important implications for model simulation purposes [4]. For example, leaf chlorophyll content was found higher at the urban site in comparison with that of the aesthetic forest [1]. It is likely that chlorophyll content along with other ecophysiological parameters may be used as sensor for biomonitoring air pollution [1].

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Poster Code: WS1-P49

Synthesis of new materials containing ZnO doped particles for purification of waste waters

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One of the major environmental problems in today's world is chemical pollution of water, since polluted water represents a threat to wildlife, as well as to human health and welfare, given that it hinders the sustainable development of both society and economy. Different contaminants are released into water bodies along with the rapid industrialization. Dye effluent from textile industry is one of the most important sources of environmental pollution, since approximately 10,000 different dyes and pigments [1] are utilized by textile industry. Dyes are able to colour water even in very small concentration, as 1 ppm, waste water coming from the textile industry contains much higher amount of dyes, about 200 ppm [2]. These dyes absorb the sunlight and reduce the photosynthetic capability of aquatic plants and microorganism, but, on the other hand, many of these dyes are toxic, carcinogenic, and mutagenic [3]. In recent years, treatment of waste water by physical and chemical methods has been the main focus in many studies. Among these methods, photochemical catalysis appears as an emerging destructive technology leading to the total mineralization of many organic pollutants [4]. The main objective of this study is the synthesis of some new photocatalysts with high efficiency under UV and visible light, intended for waste water treatment by economical and time-efficient technology, using advanced materials with ZnO doped particles, obtained through photopolymerization. The materials will be tested with regard to their suitability for use in the photochemical purification of waste water by initiating the photochemical degradation of dyes contained in the polluted water sample.

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Poster Code: WS1-P50

A colorimetric sensing platform for HIV-1 viral nucleic acids based on self assembly of single-component DNA functionalized gold nanoparticles

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Abstract:

Gold nanoparticles (AuNPs) have been extensively employed as nanoscale-based platforms in biological studies and molecular diagnosis for rapid detection due to their unique physiochemical properties such as intrinsic chemical stability and biocompatibility. It has been reported that DNA interactions can be used to induce nanoparticle aggregation. In this vein, nucleic acid targets (RNA or DNA) have been widely detected using single strand oligonucleotide-functionalized AuNPs (DNA–AuNPs) systems. So DNA–AuNPs which can recognize the target of interest have been designed for detection of the complementary target DNA sequence [1-3].

Here, we utilized a DNA-directed assembly strategy for the colorimetric sensing of HIV-1 viral nucleic acids. By designing a proper self-complimentary linker AuNPs functionalized with oligonucleotides (DNA-AuNPs) could be assembled into an integrated network. The linker oligonucleotide is complementary to the strands bound on AuNPs and has self-complementary sequences which are responsible for the interactions between gold nanoparticles. Each particle can bind to every other particle through base pairing interactions in the single-component system. Our strategy utilizes AuNPs functionalized by oligonucleotides with unique sequences present on the HIV-1 RNA virus and linker strands with sequences capable of forming self complementary. The assembly process and the following significant color change from red-to-very low pink occur in the absence of target HIV-1 viral nucleic acids. However, in the presence of the target viral nucleic acids, the linker probe, is simply duplexed and cannot be linked to the DNA-AuNPs. Therefore, the solution color will remain red.

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Poster Code: WS1-P51

Theoretical study of water interaction with functionalized benzene molecules

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Abstract:

With two thirds of the Earth's surface covered by water and thirteen thousand trillion liters in the form of vapor and droplets in the atmosphere, it is evidently clear that water is ubiquitous and of paramount importance for many physical and chemical functions of nature. Apart from being the most abundant molecule, water has drawn a lot of scientific and technological attention due to its chemical and physical complexity. A major area of study which is closely associated with the peculiar properties of water is its adsorption by Metal Organic Frameworks (MOFs) and is related with various applications such as selective adsorption and dehumidification. MOFs are compounds consisting of inorganic metal ions or metal clusters linked by organic ligands through coordination bonds, that stand out for their ultrahigh porosity (up to 90% free volume) and extended internal surface areas (beyond 6000 m^2/gr). Stretching the limits of their physical properties, MOFs' composition, structure and pore metrics can be varied, granting them versatile performances in various research fields. In the scope of deliberately tuning the functionalities of a MOF, water uptake performance is possible to be enhanced by surface modification.

Induced by the fact that many MOF structures have a phenyl group as an organic linker and by taking into account previous studies that introduced different organic functional groups onto the organic ligands in MOFs, we conducted a series of ab-initio and DFT calculations on the interactions of water with strategically selected functionalized benzene molecules. The study of the interaction of aromatic molecules with water is of paramount importance and in need of thorough investigation as binding in these complexes has a complicated, yet not fully understood nature. Aiming to shed light on the nature of these interactions, we herein report the calculated binding energies between a water molecule and a series of functionalized benzenes, pointing out the dimers with the strongest interactions, in an attempt for more targeted functionalization of the organic moieties in MOF structures.

WORKSHOP 2
PEROVSKITE OPTOELECTRONICS & SOLAR CELLS

WS2-P1	**Online Monitoring the Crystallization Process of CH3NH3PbI3 Probed by Femtosecond Transient Absorption Spectroscopy** Efthymis Serpetzoglou[1,3,*], Ioannis Konidakis[1], Apostolos Panagiotopoulos[2,4], Temur Maksudov[2,4], Emmanuel Kymakis[2], Emmanuel Stratakis[1,4] [1]Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH), Heraklion, Crete, Greece [2]Center of Materials Technology and Photonics, Electrical Engineering Dept, Technological Educational Institute (TEI) of Crete, Heraklion, Crete, Greece [3]Physics Department, and [4]Department of Materials Science and Technology, University of Crete, Greece, Heraklion, Crete, Greece
WS2-P2	**Photoluminescence Spectroscopy of Halide Perovskites** Stuart Thomson*, Maria Tesa and Anna Gakamsky Edinburgh Instruments, Livingston, UK
WS2-P3	**Different Morphologies of All-Inorganic Perovskite Nano/Microparticles: Physical Properties and Anion Exchange** Konstantinos Brintakis[*], Maria Sygletou, Athanasia Kostopoulou and Emmanuel Stratakis Institute of Electronic Structure and Laser, Foundation for Research and Technology - Hellas, Heraklion, Greece
WS2-P4	**Magnetic Behaviour of Rutile-type CrMO4 (M = Nb, Ta) Materials Prepared from Single-molecular Precursors** Martina Vrankić[1*], Marijana Jurić[1], Lidija Androš Dubraja[1], Jasminka Popović[1], Damir Pajić[2] and Jure Dragović[2] [1]Ruđer Bošković Institute, Zagreb, Croatia [2]Department of Physics, Faculty of Science, University of Zagreb, Zagreb, Croatia

Poster Code: WS2-P1

Online Monitoring the Crystallization Process of $CH_3NH_3PbI_3$ Probed by Femtosecond Transient Absorption Spectroscopy

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The last decades organic and inorganic lead halide perovskites have attracted scientific interest due to their unique properties as light absorber films and their potential of being the main component of next generation photovoltaics. Based on this, several studies are focused in optimizing the perovskite quality, and thus, improving the device performance, lifetime and stability. Herein, we present recent findings on the in-situ investigation of the charge carrier dynamics of different $CH_3NH_3PbI_3$/HTL configurations during the perovskite crystallization process by means of time-resolved transient absorption spectroscopy (TAS). Namely, the corresponding charge extraction and recombination processes are monitored under inert atmosphere conditions for three different thermal annealing temperatures, i.e. 90 ^oC, 100 ^oC and 110 ^oC, while two different types of HTL polymers were employed. In particular, we utilized the hydrophilic PEDOT:PSS and the more hydrophobic PTAA polymers. In the case of PTAA, the carrier trapping and charge injection processes were found to be faster at every temperature when compared to the corresponding time components of the PEDOT:PSS polymer.[1-3] More importantly, the in-situ monitoring of the TAS dynamics revealed that for the lower crystallization temperature of 90 ^oC, the annealing period needed for the optimum perovskite formation and enhanced dynamics is similar for both $CH_3NH_3PbI_3$/HTL architectures. Rather differently, for the higher, and thus, the more rapid crystallization temperature of 110 ^oC, the optimum charge extraction dynamics were obtained at significantly shorter annealing periods for the PEDOT:PSS polymer, when compared to the corresponding PTAA configurations.[3] Such findings are rationalized in terms of the surface nature of the employed polymers and the obtained perovskite grain size.

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Poster Code: WS2-P2

Photoluminescence Spectroscopy of Halide Perovskites

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Halide perovskites are a promising new class of materials for a wide variety of optoelectronic applications such as photovoltaics, light emitting diodes, lasers and optical sensing. They have received widespread attention due to their many attractive synthetic and photophysical properties, namely: solution processability, high tunability, long charge carrier lifetimes and high charge carrier mobilities.

Photoluminescence (PL) spectroscopy is a powerful tool for the investigation and optimisation of the properties of perovskites. Using PL spectroscopy we have investigated the photophysics of several halide perovskite photovoltaic absorbers and light emitters. Using time-resolved PL, the influence of annealing time on the charge carrier lifetime of the photovoltaic absorber $CH_3NH_3PbI_3$ was investigated, while temperature dependent PL was employed to determine the orthorhombic and cubic phase transition temperatures of $CH_3NH_3PbI_3$.

PL spectroscopy is particularly well suited to study perovskite emitters. Steady state and time-resolved PL was used to determine the chromacity coordinates and carrier lifetimes of the promising two dimensional white light emitter α-(DMEN)$PbBr_4$. In addition, the temperature dependence of the PLQY of $CsPbBr_3$ was measured using a novel variable temperature integrating sphere.

Poster Code: WS2-P3

Different Morphologies of All-Inorganic Perovskite Nano/Microparticles: Physical Properties and Anion Exchange

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All-inorganic perovskites have attracted a tremendous interest due to their excellent physical properties and promising future applications. New age photovoltaics cells, bright LEDs, other energy related applications and sensitive sensors are amongst them [1]. Working on these aspects, the choice of the appropriate phase and shape of the studied material, as well as its comprehensive characterization, play a significant role for the next steps of exploitation. Here, we report different morphologies of all-inorganic lead halide perovskites in nanometer and micrometer scale synthesized by colloidal re-precipitated methods. We report structures such as Cs_4PbBr_6 hexagonal nanoparticles, $CsPbCl_3$ nanosheets, $CsPbBr_3$ nanowires [2], $CsPbBr_3$ and $CsPbCl_3$ nano/microcubes, $CsPbBr_3$ microrods and $CsPb_2Br_5$ microtiles and present some of their interesting structural and optical properties. Furthermore, anion exchange procedures such as laser- and gas-assisted methods have been utilized to alter the stoichiometry of lead halide perovskites nanocrystals (NCs) in solutions or embedded into PDMS matrix [3].

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Poster Code: WS2-P4

Magnetic Behaviour of Rutile-type $CrMO_4$ (M = Nb, Ta) Materials Prepared from Single-molecular Precursors

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Mixed-metal oxides are an important class of advanced materials, due to their stability, low cost, low toxicity, useful photophysical properties and wide range of technological applications, whereby the effect of structure and morphology of these materials correlates their magnetic behaviour.[1] Up to now, solid-state, sol–gel or hydrothermal preparation protocols have been explored for controlling structural and microstructural characteristics of targeted mixed-metal oxides. However, more traditional preparation routes of obtaining highly crystalline materials usually use high temperature treatment, which can often increase the particle size and decrease the surface area. The possibility of using heterometallic oxalate-based compounds as single-source molecular precursors through thermal decomposition process in reproducible synthesis of nanomaterials, that provides excellent control of the stoichiometry and crystallite size in the nanoregime, has been considered only recently.[1]

Herein we show a potential of $[Cr_2(bpy)_4(\mu\text{-}O)_4Nb_2(C_2O_4)_4]\cdot 3H_2O$ (**1**) and $[Cr(bpy)_2(H_2O)(\mu\text{-}O)Ta(C_2O_4)_3]_2\cdot 3.5H_2O$ (**2**), well-defined and structurally characterized compounds,[2,3] to act as single-molecular precursors for the preparation of the phase-pure highly-crystalline $CrNbO_4$ and $CrTaO_4$ nanosize powders. Detailed evolution of crystalline phase composition as a function of heat-treatment during the decomposition of **1** and **2** was carried out by the means of powder X-ray diffraction (PXRD). The crystallite size and lattice strain were calculated from the PXRD line-broadening analysis performed during the Rietveld structure refinement. A low temperature magnetic transition was observed in both samples, for $CrNbO_4$ at 9.3 K and for $CrTaO_4$ at 3.5 K, whereas a spin-glass like behaviour was observed for the $CrTaO_4$ as suggested from the ZF and ZFC curves.

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	WORKSHOP 3 **TISSUE ENGINEERING & REGENERATIVE MEDICINE**
WS3-P1	**Biodegradable and bioactive scaffold for bone tissue engineering**. Malagón Escandón AM[1]*, Saniger Blesa JM[2], Badillo Ramírez I[2], Arenas Alatorre JA[3], Chaires Rosas CP[1], Vázquez Torres NA[1], Piñón Zárate G[1], Hernández Téllez B[1], Herrera Enríquez M[1], Castell Rodríguez AE[1]. [1] Department of Cell and Tissue Biology from the Faculty of Medicine, UNAM, Avenida Universidad 3000, C.P. 04510, Ciudad de México, CDMX. [2] Center for Applied Sciences and Technological Development (CCADET), UNAM Circuito exterior s/n C.P. 04510 Ciudad de México, CDMX. [3] Institute of Physics (IFUNAM), Sendero Bicipuma, Coyoacán, Ciudad de México, CDMX.
WS3-P2	**Analysis of the degree of crystallinity during laser cladding of bioactive glass coatings on ultrafine-grained metallic substrates** Szymon Bajda[1]*, Michal Krzyzanowski[1, 2,] Jakub Sroka[1, 3], Szczepan Witek[1] and Patryk Steczkowski[1] [1]AGH University of Science and Technology, Krakow, Poland; [2]Birmingham City University, Birmingham, United Kingdom; [3]The University of Sheffield, Sheffield, United Kingdom
WS3-P3	**Calcium phosphate mineralization of poly (N, N-dimethylacrylamide) (PDMAM) hydrogels** Constantine Ioannides[1]*, Georgios Bokias[2,3] and Nikolaos Bouropoulos[1,3] [1]Department of Materials Science, University of Patras, Patras, Greece [2]Department of Chemistry, University of Patras, Greece [3] Foundation for Research and Technology Hellas, Institute of Chemical Engineering and High Temperature Chemical Processes, Patras, Greece
WS3-P4	**Self-Assembling peptides with RGD motifs as scaffolds for tissue engineering** Graziano Deidda[1,2],* Maria Farsari [1,2], Anna Mitraki [1,2] [1]Department of Materials Science & Technology, University of Crete, Heraklion, Greece; [2]Institute of Electronic Structure and Laser, IESL-FORTH, Heraklion, Greece
WS3-P5	**Protein-based Hydrogel for laser-induced Fabrication of Microstructures** Amirbahador Zeynali*, Giuseppe Chirico and Maddalena Collini Biophysics and Biophotonics group, Department of Physics "G. Occhialini", Universita' Milano-Bicocca, Milano, Italy
WS3-P6	**Biodegradable prosthesis created by electrospinning for the treatment of extrahepatic bile duct injuries** Alan Isaac Valderrama Treviño[1]*, Nadia Adriana Vázquez Torres1, Rodrigo Banegas Ruiz[2], Andrés Eliú Castell Rodríguez[1], Eduardo E. Montalvo-Javé[3] [1] Laboratory of experimental immunotherapy and tissue engineering, Faculty of Medicine, Universidad Nacional Autónoma de México, Mexico; [2] Service of Hand Surgery and Microsurgery. Rehabilitation Hospital "Luis Guillermo Ibarra Ibarra". Mexico City, Mexico; [3] Department of HPB Surgery, General Hospital of Mexico, Mexico City, Mexico
WS3-P7	**Engineering cell adhesion and orientation via ultrafast laser fabricated microstructured substrates under static and dynamic conditions** Eleftheria Babaliari[1,2]*, Paraskevi Kavatzikidou[1], Despoina Angelaki[1,3], Anna Mitraki[1,2], Anthi Ranella[1], Emmanuel Stratakis[1,2] [1] Foundation for Research and Technology - Hellas (F.O.R.T.H.), Institute of Electronic Structure and Laser (I.E.S.L.), Heraklion, Crete, Greece [2] Department of Materials Science and Technology, University of Crete, Heraklion, Crete, Greece [3] Department of Physics, University of Crete, Heraklion, Crete, Greece

WS3-P8	**Co-flow microfluidic system for the production of tuneable elastic Gelatin methacrylate microparticles** Francesco Pappalardo[1]*, Jopeth Miranda Ramis[1], Marta Alvarez Paino[1], Kevin Shakesheff1, Morgan R Alexander[2,] Felicity RAJ Rose[1] [1]Division of Regenerative Medicine and Cellular Therapies, School of Pharmacy, Centre for Biomolecular Sciences, University of Nottingham, University Park, Nottingham, NG7 2RD, United Kingdom [2]Division of Advanced Materials and Healthcare Technologies, School of Pharmacy, University of Nottingham, Nottingham NG7 2RD, United Kingdom
WS3-P9	**Direct Laser Printing of Cells on Tissue Constructs based on Porous Collagen Scaffolds** C.V. Leva[1], M. Chatzipetrou[1], D. Zareifi[2], A. Gravanis[3], L. Alexopoulos[2], D. S. Tzeranis[3]* and I. Zergioti[1] [1]Department of Physics, National Technical University of Athens, Zografou, Greece [2]Department of Mechanical Engineering, National Technical University of Athens, Zografou, Greece [3]Institute of Molecular Biology and Biotechnology, Foundation for Research and TechnologyHellas, Herakleion, Greece
WS3-P10	**Octacalcium phosphate: Synthesis, characterization and stability studies in calcium alginate beads** Emmanouela Mystiridou[1,2]*, Eleni-Anna Oikonomou[1] and Nikolaos Bouropoulos[1,2] [1]Department of Materials Science, University of Patras, Patras, Greece [2]Foundation for Research and Technology Hellas, Institute of Chemical Engineering and High Temperature Chemical Processes, Patras, Greece
WS3-P11	**Surface and morphological investigation of synthesized nanostructured ridges from electrospun Polyvinyl Alcohol – Egg Albumin blend using Atomic Force Microscopy** Jopeth Ramis[1,2]*, Bryan Pajarito[3] [1] Department of Chemical Engineering, Technological Institute of the Philippines, 363 P. Casal St. Quiapo, Manila, Philippines. [2] Division of Regenerative Medicine and Cellular Therapies, School of Pharmacy, University of Nottingham, University Park, Nottingham, United Kingdom [3] Polymer Research Laboratory, Department of Chemical Engineering, University of the Philippines, Diliman, Quezon City, Philippines
WS3-P12	**Polarization-resolved multi-photon microscope supporting live cell imaging** S. Psilodimitrakopoulos[1], A. Lemonis[1], L. Mouchliadis[1], D. Tzeranis[2], M. Nikou[3], D. Xydias[1,2], K. Karali[1,2], A. Gravanis[4,5] and E. Stratakis[1,2]* [1]Foundation for Research and Technology – Hellas (F.O.R.T.H.), Institute of Electronic Structure and Laser (I.E.S.L.), Heraklion, Crete, Greece; [2]Institute of Molecular Biology and Biotechnology, Foundation for Research and Technology - Hellas, Heraklion 71003, Greece; [3]Department of Biology, University of Crete, Heraklion 71003, Greece; [4]Department of Materials Science and Technology, University of Crete, Heraklion, Crete, Greece; [5]Department of Pharmacology, School of Medicine, University of Crete, Heraklion 71003, Greece.
WS3-P13	**Applications of non-linear imaging microscopy in biology** Evangelia Gavgiotaki [1,2]*, Vassilis Tsafas [1,3] , Meropi Mari[1] and George Filippidis[1] [1] Institute of Electronic Structure and Laser, Foundation for Research and Technology, Heraklion, Greece [2] Medical School, University of Crete, Heraklion , Greece [3] Department of Physics, University of Crete, Heraklion, Greece
WS3-P14	**Electrospun Fibrous Matrices for the Treatment of Orthopedic Diseases** A. R. Tsiapla[1]*, V. Bakola1[,2], V. Karagkiozaki[1,2] and S. Logothetidis[1] [1]Nanotechnology Lab LTFN (Lab for Thin Films – Nanobiomaterials –Nanosystems – Nanometrology) Aristotle University of Thessaloniki, Thessaloniki, Greece [2]BL Nanobiomed P.C. Thessaloniki, 54655, Greece
WS3-P15	**Drug-loaded Nanoparticles for the Therapy of Orthopedic Implant Infections** A. R. Tsiapla[1]*, V. Bakola[1,2], V. Karagkiozaki[1,2] and S. Logothetidis[1] [1]Nanotechnology Lab LTFN (Lab for Thin Films – Nanobiomaterials –Nanosystems – Nanometrology) Aristotle University of Thessaloniki, Thessaloniki, Greece

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WS3-P16	**Composite hydrogel based biomaterials functionalized with calcium carbonate for biomedical application** Anatolii Abalymov[1]*, Maria Saveleva [2], Bogdan Parakhonskiy[1] and Andre Skirtach[1] [1]Faculty of Bioscience Engineering Ghent University, Ghent, Belgium [2]Saratov State University, Saratov, Russia
WS3-P17	**BIOCOMPATIBILITY AND ANTIMICROBIAL ACTIVITY OF THYMOL-FUNCTIONALIZED 3D SCAFFOLDS** K. Parkatze[1,2]*, M. Chatzinikolaidou[1,3], E. Koufakis[3], M. Farsari[1] and M. Vamvakaki[1,3] [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, 700 13 Heraklion, Crete, Greece; [2]Department of Chemistry, University of Crete, 710 03Heraklion, Crete, Greece; [3]Department of Materials Science and Technology, University of Crete, 710 03 Heraklion, Crete, Greece
WS3-P18	**HIGHLY EFFICIENT AND BIOCOMPATIBLE PHOTOINITIATORS FOR MULTI-PHOTON POLYMERIZATION** K. Parkatze[1,2]*, G. Noirbent[5], D. Ladika[1,4]*, M. Chatzinikolaidou[1,3], D. Gray[1], F. Dumur[5], M. Farsari[1] and M. Vamvakaki[1,3] [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, 700 13 Heraklion, Crete, Greece; [2]Department of Chemistry, University of Crete, 710 03Heraklion, Crete, Greece; [3]Department of Materials Science and Technology, University of Crete, 710 03 Heraklion, Crete, Greece; [4]Department of Physics, University of Crete, 710 03 Heraklion, Crete, Greece; [5]Aix Marseille University, CNRS, ICR, UMR 7273, F-13397 Marseille, France
WS3-P19	**Influence of micro/nano-patterned surfaces on neuronal cell response** Papadimitriou Lina[1]*, Karali Kanelina[1], Angelaki Despoina[1, 2], Lanara Christina [1, 2], Kapaj Gentjan[1], Kavatzikidou Paraskevi[1], Stratakis Emmanuel[1, 2], Ranella Anthi[1] [1] Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, Greece; [2] University of Crete, Greece
WS3-P20	**Biocompatibility and potential cytotoxicity of silicalite-1 and nanodiamond-BMP-7 coatings for orthopedic implants** Ivana Kopova[1]*, Ivan Jirka[2], Stepan Potocky[3,4], Bohuslav Rezek[3,4], Lucie Bacakova[1] [1] Institute of Physiology of the Czech Academy of Sciences, Prague, Czech Republic; [2] J. Heyrovsky Institute of Physical Chemistry of the Czech Academy of Sciences, Prague, Czech Republic; [3] Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic; [4] Faculty of Electrical Engineering, Czech Technical University, Prague, Czech Republic
WS3-P21	**Biocompatibility of artificial rod and cone photoreceptors with human-like spectral sensitivities** Seok Hwan Kim[1]*, Byeongho Park[2] , Heehong Yang[3], Hyun Seok Song[4], Tai Hyun Park[3],and Jae Hun Kim[2] [1]Seoul National University Boramae Medical Center, Seoul, Korea; [2]Korean Institute of Science and Technology, Seoul, Korea; [3] School of Chemical and Biological Engineering Seoul National University, Seoul, Korea; [4]Korea Basic Science Institute, Daejeon, Korea

Poster Code: WS3-P1

Biodegradable and bioactive scaffold for bone tissue engineering.

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In recent years there has been a progress in conventional treatments for bone defects because tissue engineering and regenerative medicine present alternatives to restore or replace lost bone, this through the use of scaffolds in combination with autologous or mesenchymal cells. However, a therapeutic approach that can be considered as the gold standard and used as a routine treatment has not yet been found.

Therefore, we propose extracellular matrix-based bioscaffolds derived from bovine cancellous bone, in combination with mesenchymal cells of Wharton's gelatin, which have shown *in vitro* e *in vivo* the ability to differentiate into multiple mesoderm, ectoderm and endoderm lineages, anti-inflammatory and immuno-modulatory effects that favors its allogenic use as well as the secretion of trophic and paracrine factors that induce the endogenous mechanisms of bone repair.

The obtaining of decellularized scaffolds have been successfully carried out in other organs and tissues; the effectiveness of its biosafety has also been previously evaluated *in vivo* and FDA approved.

In the specific case of bone, a more complex treatment is needed because is necessary decellularized, demineralized and hydrolyzed collagen protein with methods to allow maintaining the architecture and porosity of the scaffold that will favor colonization vascularization and degradation.

The present work was made in order to obtain a temporal scaffold that succeeds in degradation in an inversely proportional way to the synthesis of extracellular matrix and the maturation of the bone by the cells of the host.

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Poster Code: WS3-P2

Analysis of the degree of crystallinity during laser cladding of bioactive glass coatings on ultrafine-grained metallic substrates

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Nowadays, titanium alloys are commonly used for manufacturing of medical implants due to their exceptional mechanical properties and biocompatibility. However, the release of such elements as aluminium and vanadium from the alloys can be harmful to human health [1]. One of the possible solutions could be replacing the titanium alloys with ultrafine-grained commercially pure titanium (cpTi). The yield and also the ultimate strength of cpTi can exceed 1000 MPa [2]. One of the most promising methods in manufacturing of medical implants with improved biological fixation is laser cladding in which bioactive glass coatings are imposed on metallic substrates [3]. The heat treatment of the glass may lead to growth of the crystalline phase, which directly affects its resulting bioactivity. Although, the crystalline phase does not directly inhibit development of a hydroxy carbonate apatite (HCA) layer, the crystallized fraction of the material increases HCA onset time. This is highly undesirable in biomedical applications, since this layer is mandatory to form a proper bonding between human tissue and the implant. A sequentially coupled finite element (FE) model of laser cladding has been developed by applying element birth and death technique to calculate the transient temperature fields and crystallinity degree in cladded layers. The concentrated heat source from the laser beam moving along the metal surface has been represented by a Gaussian distribution of the heat flux. It has been shown, that increasing of the scanning speed greatly reduces the obtained amount of the crystallized phase. Preheating of the metallic substrate aimed at improving the susceptibility to cracking has not influenced significantly the crystallized volume fraction. The developed FE based numerical model is capable to support an optimal design of such advanced multi-layered structural materials using the laser cladding technique.

Acknowledgments:

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Poster Code: WS3-P3

Calcium phosphate mineralization of poly (N, N-dimethylacrylamide) (PDMAM) hydrogels

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Synthesis of hybrid materials, composed of hydrophilic polymers and calcium phosphate compounds has been a subject of great interest in recent years due to their biomedical applications especially as scaffolds in tissue engineering [1,2]. In the present work, hydrogels of poly(N,N-dimethylacrylamide) (PDMAM) at a 2 mol% and 5 mol% covalent crosslinking were synthesised and their mineralization ability with respect to calcium phosphate salts was evaluated in vitro. Mineralization experiments were performed at a Ca/P ratio of 1.66 while the concentration of calcium was kept at 0.05, 0.1 και 0.2M with the respective phosphate concentrations at 0.03, 0.06 και 0.12M. The pH of the solutions was adjusted at 7.4. The experiments were performed by immersing the polymeric substrates into calcium solutions for 24 hours, then they washed thoroughly with water and finally incubated into phosphate solutions for 48 hours. Control experiments (in the absence of polymeric substrates) were run in parallel. The mineralized samples were characterized using FTIR spectroscopy, X-Ray diffraction and SEM microscopy. The results showed that at low (0.05M) and medium (0.1M) calcium and the respective phosphate concentrations the metastable phase of octacalcium phosphate (OCP) was formed inside both polymeric substrates. In contrast, control experiments showed the formation of hydroxyapatite. The samples which were mineralized at higher concentrations (0.2M) showed the presence of hydroxyapatite both in polymeric substrates and control samples. Morphological characterization revealed the presence of octacalcium phosphate in the form of leaflets or elongated plates while hydroxyapatite showed a needle-like morphology. Finally, rheological studies of the mineralized and pristine hydrogels showed that loss and storage modulus were higher in mineralized samples, indicating enhancement of their mechanical properties.

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Poster Code: WS3-P4

Self-Assembling peptides with RGD motifs as scaffolds for tissue engineering

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INTRODUCTION

We used a combination of theoretical and experimental approaches towards such rational designs. [1] [2] The cell attachment motif RGD and a Cys residue were projected to be incorporated to this central motif in order to allow respectively cell adhesion and metal nanoparticle binding. [3] Alternatively, photosensitive residues such as Tyr and Trp were contrived to be inserted at the C-terminus in order to fabricate fully biocompatible scaffolds via Multi Photon Stereolithography (MPS).

EXPERIMENTAL METHODS

We monitored the assembly of the peptide-derived networks and their morphology through: X-ray diffraction, TEM, FESEM and AFM. Cell-culture experiments used for viability were: MTT assay and LIVE/DEAD test. An ultraprecise femtosecond (220 fs) laser was used to fabricate structures via MPS.

RESULTS AND DISCUSSION

The designed RGD S.A. peptides proved to be appropriate building blocks to form higher order assembled networks. (Fig. 1). [2] Cys-containing S.A. scaffolds could be efficiently attached to a hybrid zirconia-derived composite in a 3D fs laser fabrication named “scaffold-on-scaffold” strategy for cell attachment (Fig. 2a). In addition, preliminary results indicate that S.A. peptides containing Tyr and Trp responded positively to 1P- and 2P- irradiation (Fig. 2b).

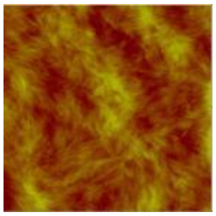

Figure 1: AFM analysis showed clearly the fibril formation of the peptides

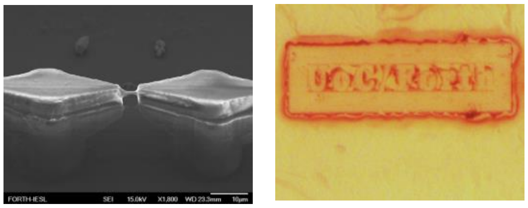

Figure 2: 3D structures produced by the 2PP technique. A) Zirconia-based “scaffold-on-scaffold” sandwich. B) Fabrtication for soft tissue engineering

CONCLUSION

These S.A. peptides will subsequently be studied for in vitro and in vivo models as they are amenable to offer open-ended possibilities towards multifunctional tissue engineering scaffolds of the future.

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Poster Code: WS3-P5

Protein-based Hydrogel for laser-induced Fabrication of Microstructures

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There is an increasing interest in the design of micron-size, geometrically well defined, microstructures for applications in life sciences. The need of low toxicity and biocompatibility push the scientific interest towards the development of manufacturing methods to obtain three-dimensional (3D) structures with biopolymers. This trend is now followed by different research disciplines with various materials and methods.

Here we present our study on fabrication of 3D micron-sized structures, by means of the technique of laser direct writing (LDW) on bio-based hydrogels system. LDW is a process that exploits the absorption of single or multiple photons to induce polymerization or crosslinking of organic matrices. In particular, multi-photon fabrication methods allow to achieve high spatial resolutions (1 micrometer) that meets the requirements of nano-biotechnology research. In the context of the application to Medicine and Biology, our efforts were focused in the first part of the project on writing Bovine Serum Albumin (BSA) protein solutions directly under irradiation of 80MHz pulsed-laser (wavelength = 790nm). To trigger the photo-crosslinking in optimal way, BSA solution is doped via Methylene Blue (MB) dye as a photo-initiator. This biocompatible structures are building-blocks of an approach which give rise to 3D-printing technologies.

With respect to our optical instrument, based on a 3D nano-positioning of the sample under a fixed focused laser beam, our preliminary results indicate that we can reach of one-micrometer accuracy of writing in the volume of the hydrogel with 3D spatial control. We are currently optimizing the writing protocols by tuning the protein-dye ratio and the bio-scaffolds developing procedure in order to normalize all the steps needed to efficiently and accurately build microstructures in this bio-polymeric matrix.

Poster Code: WS3-P6

Biodegradable prosthesis created by electrospinning for the treatment of extrahepatic bile duct injuries

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Today, the treatment of choice for symptomatic vesicular lithiasis is through laparoscopic surgery, which is performed in 85-90% of cases and has an open surgery conversion rate of approximately 2-5%. The approximate frequency of major bile duct injuries is 1 to 5 in 1000 and in recent years around 0.4 to 0.86% have been reported. 70% of the injuries occur due to misinterpretation of the anatomy, anatomical variants that are observed between 10-15% of patients.

Objective

To develop and characterize a biodegradable tubular prosthesis by electrospinning to be replaced by a portion of the common bile in porcine.

Material and methods

Biodegradable prostheses were manufactured by electrospinning using a biomaterial copolymer, physical tests were performed; drop angle, degradation time, electron microscopy, Young's modulus and biological tests; cell proliferation, cell viability, cytotoxicity. Subdermal biological implantation was performed in rabbits evaluating the degree of inflammation and biological response.

We used 9 pigs of the Landrace breed with a weight between 15 and 25 kg, under general anesthesia and with ventilatory support the replacement of the common bile duct was performed in 6 pigs by open surgery, they were given with follow-up at 5 months with clinical evaluation, tests from laboratory; blood count, liver function tests, amylase, lipase and imaging tests; CPRE, Spyglass.

Results

The prosthesis has an adequate physical, mechanical and biological behavior that favors cell migration and adhesion, allowing the regeneration of the biliary epithelium and bile flow.

Conclusions

This therapeutic alternative based on tissue engineering could provide an innovative treatment for bile duct injuries that preserve the function of the Vater papilla.

Poster Code: WS3-P7

Engineering cell adhesion and orientation via ultrafast laser fabricated microstructured substrates under static and dynamic conditions

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Cell responses depend on the stimuli received by the surrounding extracellular environment, which provides the cues required for adhesion, orientation, proliferation, and differentiation at the micro and the nano scales. Another important issue to be considered is the role of static vs dynamic conditions at the cellular-substrate environment. Dynamic cultures realized with the aid of microfluidics reflect more appropriately the *in vivo* environment of cells in tissues such as the normal fluid flow within the body, consistent nutrient delivery, effective waste removal and mechanical stimulation due to fluid shear forces. In this study, discontinuous microcones on silicon (Si) and continuous microgrooves on polyethylene terephthalate (PET) substrates were fabricated via ultrashort pulsed laser irradiation at various fluences, resulting in microstructures with different magnitudes of roughness and varying geometrical characteristics. At the same time, positive replicas of the silicon microstructures were successfully reproduced via soft lithography on the biodegradable polymer poly(lactide-co-glycolide) (PLGA). A comparison of the role of topography, chemistry and stiffness of the substrates (Si vs polymeric) on the cellular responses was achieved. Furthermore, a novel microfluidic platform was fabricated in order to assess the combined effect of fluid shear forces and culture substrate morphology on cell proliferation and directionality on the PET substrates. It is shown that the micropatterned substrates enable control over cellular adhesion, proliferation, and orientation. Specifically, Schwann cells appeared to be oriented along the direction of the microgrooves and microspikes. Moreover, under flow conditions combined with the microgrooves, cells appeared to be oriented along the direction of the microgrooves and parallel to flow. The ability of this micropatterned strategy to control the cellular adhesion and growth and thus to engineer cell alignment *in vitro* could be potentially useful in the field of regenerative medicine and tissue engineering.

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Poster Code: WS3-P8

Co-flow microfluidic system for the production of tuneable elastic Gelatin methacrylate microparticles

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In this study, a microfluidic system involving co-current flow for the production of Gelatin Methacrylate (GelMA) microparticles has been designed as an approach for high-yield production of microparticles showing consistent monodispersity and mechanical properties. The experiments were designed using a Central Composite – Response Surface Methodology to evaluate effects of experimental factors on diameter and Young's modulus. Characterisation of microparticle size distribution was performed under phase contrast microscopy and confirmed with Dynamic Light Scattering, obtaining diameters ranging from 170-760 µm with Span and CV% not higher than 0.35 and 20%, respectively. Morphology was evaluated with environmental Scanning Electron Microscopy, showing an increasingly ordered porous surface in inverse proportion to the microparticle diameter. Furthermore, assessment of Young's modulus via force spectroscopy showed a tuneable surface modulus from 26-130 kPa, which is inversely related to the microparticle diameter. Culture of immortalised human mesenchymal stem cells across different microparticle sizes confirmed approximately 80% cell viability after one week, thereby showing good biocompatibility of the material. The co-flow microfluidic method is a reliable approach for the production of GelMA-based microparticles, which exhibit fine-tuned morphological and mechanical properties, in a high-throughput scale, highlighting its applicability in tissue engineering and regenerative medicine.

Poster Code: WS3-P9

Direct Laser Printing of Cells on Tissue Constructs based on Porous Collagen Scaffolds

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Over the past decade several 3D printing techniques translated from the fields of microelectronics and material processing into the emerging fields of biological and biomedical engineering. 3D printing techniques, including cell printing, enable the fabrication of complex biological constructs of tunable structure at spatial resolution not achievable by conventional fabrication techniques.

This work describes the application of Laser Induced Forward Transfer (LIFT) in the direct deposition of cells at specific locations on porous collagen scaffolds (PCS), similar to grafts utilized in clinical applications of induced regeneration. We demonstrate that optimized LIFT protocols can deposit various kinds of cells, including liver cell lines and primary fibroblasts, which subsequently stay viable in PCS for at least 5 days. LIFT printing delivered tunable cell densities at specific locations of PCS grafts and enabled controlled cell seeding into several kinds of PCS that vary in key physicochemical properties including chemical composition, mean pore diameter and cross-linking. Our findings demonstrate that LIFT cell printing in PCS provides a novel enabling technology for patient-specific organ-specific tissue construct fabrication with exciting applications in the development of in vitro tissue models or generative medicine grafts.

Poster Code: WS3-P10

Octacalcium phosphate: Synthesis, characterization and stability studies in calcium alginate beads

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Octacalcium phosphate (OCP - Ca8H2(PO4)6·5H2O) has been proposed to be a transient compound in the formation of apatitic calcium phosphate minerals in hard tissues such as bones and teeth. In comparison with the thermodynamically most stable hydroxyapatite (HAp - Ca10(PO4)6(OH)2), OCP is more soluble and less stable at physiological conditions and has unique biological properties. Preparation of bone substitute materials based on OCP is of great interest due to its osteoconductive, biodegradable and possibly osteoinductive characteristics [1]. Calcium alginate beads are biocompatible and biodegradable biopolymers. They have been used to encapsulate cells, drugs and nanoparticles for many biomedical applications [2]. Encapsulation of calcium phosphate compounds into calcium alginate matrices is of great importance in bone tissue engineering. In the present study, synthetic pure OCP was prepared. Next, the pure OCP crystals were entrapped into calcium alginate beads and their stability in normal saline solutions was studied up to four months. Octacalcium phosphate was synthesized with two different methods: (a) Precipitation from aqueous solutions. In particular, calcium acetate solution of 0.04M was added dropwise into a solution of sodium acid phosphate dihydrate of 0.04M, at 60°C while the pH was adjusted at 5, and (b) Hydrothermal method through reaction at 95°C between calcium chloride dihydrate and di-sodium hydrogen phosphate using urea as a precipitation agent. To investigate the influence of alginates matrices on the transformation of OCP to HAp, calcium alginate beads (2%, 4% and 6% w/v) loaded with 6% w/v OCP were prepared using the ionotropic gelation method and next were immersed in NaCl (0.15M) solution for four months. Control experiments in the absence of alginate were performed in parallel. It was found that synthesis of OCP in aqueous solutions proceeds through the formation of the intermediate phase brushite while in the case of hydrothermal synthesis no precursor phase was observed. XRD studies of OCP loaded calcium alginate beads revealed that alginate matrices preserve the OCP transformation to HAp into NaCl (0.15M) solutions up to four months in comparison with the control experiments. The results show that calcium alginate matrices have the potential to preserve OCP transformation to HAp making these materials good candidates for bone tissue engineering applications.

Acknowledgments

Emmanouela Mystiridou and Nikolaos Bouropoulos acknowledge the support of this work by NSRF 2014-2020 BITAΔ _(MIS 5002469).

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Poster Code: WS3-P11

Surface and morphological investigation of synthesized nanostructured ridges from electrospun Polyvinyl Alcohol – Egg Albumin blend using Atomic Force Microscopy

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Synthesized electrospun Polyvinyl Alcohol – Egg Albumin (PVA-EA) blend has been characterized as what we call "nanoridges", long narrow elevation from the flat substrate –distinct from other morphologies developed through electrospinning. Prior studies on electrospun PVA-EA blends claim to produce nanofiber morphology; we hypothesize that it is the solvent changes on the solution that developed such morphology on this study [1]. Formation of nanoridges has been hypothesized to develop due to high electric field polarization and migration of EA proteins to the apex of the material. On the characterization of general surface topology, formations of valleys are predominant as all skewness values are positive and most of the profiles are largely sharp with excess kurtosis values k>0, with ridge heights ranging from 31.27 nm to 88.59 nm. The surface has non-Gaussian distribution and is similar with the typical kurtosis and skewness envelope values of materials that had undergone turning, shaping, or electrodischarge machining processes at average roughness values of 14.29 nm to 47.56 nm. We also analyzed the effect of solution and processing parameters on the surface characteristics and the ridge curvature using Taguchi method. Processing parameter flow rate predominantly affected ridge height and root mean square (RMS) roughness, and tip-to-collector distance greatly influenced the curvature and RMS roughness of the material; solution parameter PVA-EA ratio affected the ridge height of the material. Evaluation of surface and morphological response to its solution and processing parameters can provide insight on the control of production, in which the novel morphology of electrospun PVA-EA blend could be used in vast areas of applications as scaffolds for tissue engineering.

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Poster Code: WS3-P12

Polarization-resolved multi-photon microscope supporting live cell imaging

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Lately, minimally-invasive nonlinear optical measurements used in conjunction with microscopy have created new opportunities in improving the spatial resolution and image contrast and in achieving a better characterization of biological specimens both *in-vitro* and *in-vivo*. Second-order nonlinear processes such as second-harmonic generation (SHG) or third-order processes such as third-harmonic generation (THG), and two-photon excited fluorescence (TPEF) have been used for the imaging and the understanding of biological systems and processes[1], as well as their interactions with nanomaterials.

Traditionally, analysis of non-linear biological imaging has been achieved by evaluating the strength of each of the above signals, used for contrast. There remains a clear need for quantitative, optical microscopy approaches that eliminate the artifacts inherent in the interpretation of signal intensities.

Towards that goal, we utilized polarization analysis of the non-linear signals to probe the orientational information of the implicating assemblies. In particular, we upgraded a regular Zeiss fluorescence microscope into a fully-motorized polarization-resolved multi-photon microscope, using an Yb:KGW femtosecond laser (1030nm, 70-90fs, 80MHz, 1,2W), galvanometric mirrors and photomultiplier tubes, as well as retardation plates, analyzers, appropriate electronics, optics and filters[2] (Fig.1). The non-linear imaging workstation further utilizes an incubator at the microscope sample plane, which provides the appropriate conditions for culturing cells, thus allowing live monitoring of cellular activities for long periods of time.

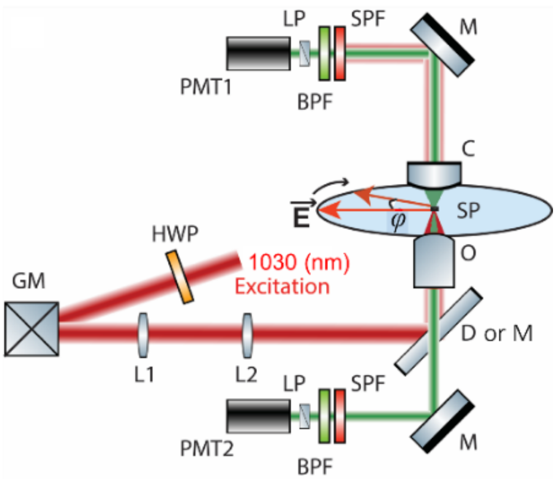

Figure 1: HWP: zero-order Half- waveplate; GM: silver coated Galvanometric mirrors; L1,2: achromatic Lenses; D or M: Dichroic or silver Mirror, both at 45°, O: Objective 40x, 1.3NA or 20x, 0.8NA; SP: Sample Plane; C: Condenser, 1.4NA; M: silver Mirror; SPF: Short Pass Filter; BPF: Band-pass Filter; LP: Linear Polarizer; PMT1,2: Photomultiplier Tubes. The setup further supports live cell imaging, using an incubator at the sample plane.

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Poster Code: WS3-P13

Applications of non-linear imaging microscopy in biology

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Non-linear microscopy techniques are at the forefront of biomedical research over the last decade. These non destructive modalities offer improved resolution, high contrast images with increased penetration depth and complementary information while minimizing phototoxicity and photodamage effects on the biological samples. These properties characterize them as perfect imaging tools for revealing valuable and unique information of the specimen under investigation. In addition, these techniques are not limited at visualization since they also permit precise quantitative analysis and testing of specific mechanisms and biological processes. The imaging modalities of Multiphoton Excitation Fluorescence (MPEF), Second Harmonic Generation (SHG) and Third Harmonic Generation (THG) have been successfully employed for the *in vivo* sub-cellular investigation of complex biological activities and the extraction of structural and morphological information from various samples (cancer cell lines [1], mouse embryos [2,3], *Caenorhabditis elegans* [4,5], and BV-2 microglia cells [6]). The discrimination between human breast malignant and non-malignant tissues, by utilizing non-linear microscopy modalities (SHG, THG) as diagnostic tools, comprises the target of our present study. Specifically, human breast tissues of different tumor grades are examined and attempt to correlate THG measurements with FTIR spectra to obtain additionally chemical information. Moreover, mitogen or antigen-stimulated T-lymphocytes (T-cells) are subjected to THG imaging microscopy to monitor the activation state of T-cells. Qualitative and quantitative analysis of resting and activated T-cells is performed. The detection of T-cells activation is a very important issue in cancer immunotherapy as it allows easy following–up of immune response development.

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Poster Code: WS3-P14

Electrospun Fibrous Matrices for the Treatment of Orthopedic Diseases

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There is, as a matter of fact, an ever increasing number of patients requiring total hip replacement. Implant-associated infections that are created after an invasive orthopaedic surgery is one of the major causes of implant failure, among others such as instability, aseptic loosening, metallosis, and fracture. In this work, a combined dual drug delivery nanoplatform system consisted of polymeric Polycaprolactone (PCL) scaffolds loaded with vancomycin drug and Cellulose acetate (CA) scaffolds loaded with dexamethasone was fabricated via a novel method of dual syringe Electrospinning system. Also, there was a comparison between the combined scaffold and the two drug delivery nanoplatforms separately. Scanning Electron Microscopy (SEM) was used to point out the successful fabrication of all those structures. Cytotoxicity studies were performed by MTT assay and methylene blue staining and showed very good cell adhesion and proliferation, indicating the cytocompatibility of these fibrous scaffolds. Drug release kinetics of all scaffolds was executed for the evaluation of a controllable and sustained release of antibiotic and anti-inflammatory drugs onto the engineered implants and degradation studies were applied in order to assess the mass loss of polymers. This combined drug delivery nanoplatform as coating onto Titanium implant, may be a promising approach not only to prevent but also to alleviate orthopedic implant-associated infections along with the simultaneously release of the two drugs in a controllable way.

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Poster Code: WS3-P15

Drug-loaded Nanoparticles for the Therapy of Orthopedic Implant Infections

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The replacing of a damaged joint by an artificial hip replacement is one of the most important achievements of the orthopedic science because it enables the person suffering from osteoarthritis to regain a normal life. However, infections that can be created after an implantation are one of the major complications that can lead to implant failure. Therefore, a preliminary study of vancomycin drug loaded Polycaprolactone (PCL) nano/microparticles were created via Electrospraying Process, making it a promising nanovehicle to prevent and treat orthopedic implant-associated infections. Scanning Electron Microscopy (SEM) measurements confirmed the successful fabrication of these structures. Finally, drug release kinetics was determined to observe the sustained release of the drug and degradation studies were performed in order to evaluate the mass loss of polymers.

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Poster Code: WS3-P16

Composite hydrogel based biomaterials functionalized with calcium carbonate for biomedical application

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Design of new tools for tissue engineering especially for bone implants is important to step to personalised medicine. We focused our work on the development of a multifunctional system based on alginate gels with surface mineralisation that could be used as bone implants. Realization of tissue engineering conception demands of three components: titanium-alginate scaffold in combination with osteoblastic cells mineral content and suitable biochemical factors (for example alkaline phosphatase) to improve their biological functions. There are few challenges for such system developments: it is the maximisation of the mineral content, and protein payload and optimises gel for interaction with mammalian cells [1].

For solving this problem, we developed a novel method of in situ mineralisation with calcium carbonate crystal in vaterite phase, which provides high loading capacity of target molecules. [2]. Such surface modification of the alginate gels with vaterite provides an opportunity for sorption cells adhesive protein and continues to release therapeutic molecules. Formed CaCO3 microparticles in vaterite phase on the Ti surface was confirmed via scanning electron microscopy, infrared spectroscopy (FTIR) and x-ray diffraction analyses. The homogeneous samples distribution with an average size of vaterite particles equal to 1,6 microns were demonstrated. Intense absorption band FTIR spectra at 877 cm-1, which arose from out-of-plane deformation mode of CO32-, chemically confirmed the presence of CaCO3 on the gel surface. Due to the use of atomic-force microscopy method, we measured Young's modulus of gels estimated via atomic force microscopy were in the range from 10^5-10^6 Pa for defence on gel concentration. The nontoxic behaviour of the Ti-alginate construction w demonstrated with LDH-test and proliferation were explored with Alamar Blue test in MC3T3-E1 cells.

The composite materials with an active surface and a high mineral content developed in this work solves the problem of cell adsorption and represent an attractive biointerface applicable in tissue engineering and biomaterial science.

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Poster Code: WS3-P17

BIOCOMPATIBILITY AND ANTIMICROBIAL ACTIVITY OF THYMOL-FUNCTIONALIZED 3D SCAFFOLDS

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The Direct Laset Writing (DLW) technique is based on the localized polymerization/cross-linking of photosensitive materials, induced by femtosecond laser pulses [2], and has attracted great interest for the fabrication of 3D scaffolds. for use in the fields of tissue engineeering and regenerative medicine [1]. In this work, we present the development of a photosensitive, hybrid, organic-inorganic, material which combines cell biocompatibility and antibacterial properties based on a thymol methacrylate derivative as a natural antimicrobial agent [3]. The functional material was polymerized by DLW, via a two-photon polymerization (2PP) process, to fabricate complex 3D structures with good resolution. The cell viability and proliferation on photopolymerized thin films as well as 3D scaffolds, fabricated by 2PP, was examined by human dental pulp stem cell cultures. Cells adhered strongly onto the material surfaces, similarly to the tissue culture treated polystyrene control. On days 2, 4 and 7 post-seeding, cell viability and proliferation increased. Cell adhesion on 3D scaffolds was visualized by imunocytochemical staining of actin cytoskeleton and cell nuclei. Moreover, the antimicrobial activity of the material was evaluated against *Bacillus cereus* and *Escherichia coli*, chosen as representative Gram-positive and Gram-negative bacteria, respectively.

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Poster Code: WS3-P18

HIGHLY EFFICIENT AND BIOCOMPATIBLE PHOTOINITIATORS FOR MULTI-PHOTON POLYMERIZATION

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Direct Laset Writing (DLW) is a powerful technique for the fabrication of 3D structures, via a computer-aided design (CAD), for use in optics, metamaterials as well as in the field of biomedical applications [1]. The DLW technique is based on the localized polymerization/cross-linking of photosensitive materials induced by femtosecond laser pulses. An essential component of the photosensitive system is the photoinitiator (PI), required to initiate the polymerization/cross-linking process by multi-photon adsorption [2]. Whereas, a large number of organic molecules, possessing high multi-photon absorption cross-sections (σ_2), have been employed as PIs, the vast majority of them suffer from poor solubility in the solvent medium combined with a low yield of radical generation. Furthermore, many of the PIs are toxic and highly fluorescent, which limit their use in biomedical applications. To overcome these challenges, highly soluble, biocompatible and non-fluorescent molecules are essential for use as PIs in this field [3]. In the present study, we report the use of novel PI molecules, for multi-photon polymerization. The photophysical properties of the PIs were investigated by UV−Vis absorption and emission spectroscopy as well as z-scan measurements. In addition, 3D structures were fabricated at different laser intensities and writing velocities. Finally, the biocompatibility of the PIs was studied by investigating the adhesion, viability, and proliferation of human dental pulp stem cells on photopolymerized thin films, containing 1 mol% PI, indicating a good cell adhesion and an increase of the cell proliferation after 7 days in culture.

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Poster Code: WS3-P19

Influence of micro/nano-patterned surfaces on neuronal cell response

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Novel micro- and nano-fabrication techniques can create local cellular microenvironment to closely mimic the physiological and pathological environment within tissues and organs. These technologies can help the generation of well-controlled three-dimensional structures which are valuable tools as model scaffolds in tissue engineering and regenerative medicine approaches. Although a growing body of literature support the hypothesis that the substrate nanoscale topography influences the cell proliferation and differentiation, the underlying molecular mechanisms are, at present, poorly understood.

Our research focuses on micro/nano texturing on silicon (Si) via ultrashort-pulsed laser irradiation. We have demonstrated that microconical Si substrates of different roughness may influence the properties of multiple neuronal cells as well as direct the alignment of the neuronal network [1,2]. In particular, it has been shown that the geometrical characteristics of the microcones alone inhibit neuronal differentiation in the PC12 (NGF-induced) and the Neuro-2a (retinoic acid-induced) cells. Furthermore, areas with microconical structures promoted the SW10 adhesion and orientation, while those with nano-ripples inhibited it. When cultured in a single-cell culture, the N2a cells adhered similarly to all the underlying topographies. However, when the N2a cells were co-cultured with SW10 they followed the selective adhesion of the SW10 [3]. In addition, the roughness of the microconical substrates appears to affect the growth and the proliferation of Neural Stem cells (NSCs) and concurrently delay the maturation of the derived neurons once differentiation is induced.

In order to answer the question of how the topography affect cellular responses at the molecular level, we investigated the activation state of major component of two intracellular signaling pathways in PC12 cells. Our results showed that microconical Si substrates of increased roughness may inhibit neuronal cell differentiation by downregulating the aforementioned pathways. These results made a significant contribution to the understanding of cell-nanostructured surface interaction and to the general understanding of the nano-bio interface.

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Poster Code: WS3-P20

Biocompatibility and potential cytotoxicity of silicalite-1 and nanodiamond-BMP-7 coatings for orthopedic implants

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Currently used load-bearing orthopedic implants are mainly fabricated from metallic alloys. When exposed to load and corrosive biological environments, these materials release metallic ions, which cause allergic reactions, inflammation, pain and bone resorption. In order to minimize the release of metallic ions and wear particles as well as to enhance the osseointegration and durability of the implant, various functional coatings are investigated.

Two types of hard coatings have been evaluated in the present study. Silicalite-1 film (zeolite, i.e. crystalline oxide with regular pore structure) and nanodiamonds functionalized with bone morphogenetic protein 7 (BMP-7). The numerous publications showed good biocompatibility and improved mechanical hardness as well as anti-corrosive properties of the materials coated with silicalite-1 or nanodiamond coating. Various studies reported enhanced adhesion, proliferation and osteogenic differentiation of the cells cultivated on these films. Moreover, the engagement of BMP-7 is expected to promote even stronger osteogenic differentiation than nanodiamond itself, and thus to enhance the osseointegration of the coated implant.

However, another study reported that non-toxic zeolite nanoparticles were able to generate harmful reactive oxygen species (ROS). We have, therefore, concentrated not only on the positive behavior of cells, such as adhesion, proliferation and viability, but also on potential cytotoxicity of silicalite-1 coating. This cytotoxicity was estimated by intracellular ROS generation and potential DNA damage response of the cells. In addition, osteogenic markers (such as ALP activity and extracellular matrix mineralization) of human osteoblasts cultured on nanodiamond-BMP-7 coating have been evaluated.

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Poster Code: WS3-P20

Biocompatibility of artificial rod and cone photoreceptors with human-like spectral sensitivities

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Abstract:

Photosensitive materials contain biologically engineered elements and are constructed using delicate techniques, with special attention devoted to efficiency, stability, and biocompatibility. In the previous study, artificial nanovesicle-based photosensitive materials were observed to possess the characteristics of photoreceptors similar to the human eye.[1] Four photoreceptors originating from the human eye with color distinguishability are produced in human embryonic kidney (HEK)-293 cells and partially purified in the form of nanovesicles. Four nanovesicles with different photoreceptors, namely, rhodopsin (Rho), short-, medium-, and longwave sensitive opsin 1 (1SW, 1MW, 1LW), showed remarkable color-dependent characteristics, consistent with those of natural human retina. In this study, we investigated biocompatibility of these photoreceptors in rat retinas. After intravitreal injection of plasmids of the photoreceptor, in vivo electroporation was carried out. Retinas were flat-mounted and stained with immunofluorescence. Various settings of electric field strength and pulse duration were tested. Immunofluorescence staining showed that photoreceptor proteins were expressed in retinal ganglion cells in vivo. Optimal electroporation condition (6V, 100ms interval) was found. This study demonstrates the potential applications of light-activated platforms in biological optoelectronic fields.

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	WORKSHOP 4 **GRAPHENE & RELATED 2D MATERIALS**
WS4-P1	**Reduced Graphene Oxide Ink/Conductive Polymeric Composites for Enhanced Field Emission Devices** Minas Stylianakis[1]*, George Viskadouros[1,2], Christos Polyzoidis[1], George Veisakis[1], Konstantinos Petridis[1,3] and Emmanuel Kymakis[1] [1]Center of Materials Technology and Photonics & Electrical Engineering Department, Technological Educational Institute (TEI) of Crete, Heraklion 71004 Crete, Greece [2]Department of Mineral Resources Engineering, Technical University of Crete, Chania, 73100, Crete, Greece [3]Department of Electronic Engineering Technological Educational Institute (TEI) of Crete, Chania 73132 Crete, Greece
WS4-P2	**Single-step Green synthesis of Biocompatible Graphene Quantum Dots and their Cell Uptake Studies** Arnab Halder*, Maria Godoy-Gallardo, Jon Ashley, Xiaotong Feng, Tongchang Zhou, Leticia Hosta-Rigau and Yi Sun Department of Micro- and Nanotechnology, Technical University of Denmark, DK-2800 Kgs Lyngby, Denmark
WS4-P3	**Optically induced absorption modulation in a graphene-based metasurface** Anna C. Tasolamprou[1]*, Charalampros Mavidis[1,2], Anastasios D. Koulouklidis[1], Cristina Daskalaki[1], George Kenanakis[1], George Deligeorgis[1], Zacharias Viskadourakis[1], Polina Kuzhir[3], Stelios Tzortzakis[1,4], Maria Kafesaki[1,2], Eleftherios N. Economou[1,4] and Costas M. Soukoulis[1,5] [1]Institute of Electronic Structure and Laser, FORTH, 71110, Heraklion, Crete, Greece; [2]Department of Materials Science and Technology, University of Crete, 71003, Heraklion, Crete, Greece; [3]Institute for Nuclear Problems, Belarus State University, Bobruiskaya 11,220030 Minsk, Belarus; [4]Department of Physics, University of Crete, University of Crete, 71003, Heraklion, Crete, Greece; [5]Ames Laboratory and Department of Physics and Astronomy, Iowa State University, Ames, Iowa 50011, United States
WS4-P4	**Separation and recovery of heavy metal ions by graphene acid.** Jan Kolarik*, Aristides Bakandritsos and Radek Zboril Regional Centre of Advanced Technologies and Materials, Departments of Physical Chemistry and Experimental Physics, Faculty of Science, Palacký University, 17. Listopadu 1192/12, 771 46 Olomouc, Czech Republic
WS4-P5	**Spatially Selective Reversible Charge Carrier Density Tuning in WS2 Monolayers via Photochlorination** I. Demeridou[1,2]*, I. Paradisanos[1,2], Yuanyue Liu[3,6], N. Pliatsikas[4], P. Patsalas[4], S. Germanis[1], N. Pelekanos[1,5], W. A. Goddard III[3], G. Kioseoglou[1,5], E. Stratakis1,2 [1] Institute of Electronic Structure and Laser, Foundation for Research and Technology - Hellas, Heraklion, Crete, Greece; [2] Department of Physics, University of Crete, Heraklion, Crete, Greece; [3] Materials and Process Simulation Center and The Resnick Sustainability Institute, California Institute of Technology, Pasadena, California, United States; [4] Physics Department, Aristotle University of Thessaloniki, Thessaloniki, Greece; [5] Department of Materials Science and Technology, University of Crete, Heraklion, Crete, Greece; [6] Department of Mechanical Engineering and Texas Materials Institute, University of Texas at Austin, Austin, Texas, United States
WS4-P6	**Theoretical investigation of water-soluble polyethylene glycol treated phosphorene system** Anikó Lábas* and Tibor Höltzl Furukawa Electric Institute of Technology, Budapest, Hungary

WS4-P7	**Laser fabrication of Transition-Metal Dichalcogenide Nanostructures based materials** Kyriaki Savva[1, 2]*, Bojana Višić[3], Ronit Popovitz-Biro[3], Athanasia Kostopoulou[1], Christina Lanara[1], Antonia Loufardaki[1], Emmanuel Stratakis[1] and Reshef Tenne[3] [1]Institute of Electronic Structure and Laser, Foundation for Research and Technology Hellas, 71110 Heraklion; [2]Physics Department, University of Crete, Heraklion, 71004 Crete, Greece; [3]Weizmann Institute of Science, 7610001 Rehovot, Israel
WS4-P8	**Characterization & Non-Linear Optical Imaging of 2D Transition Metal Dichalcogenides** I. Demeridou[1,2]*, I. Paradisanos[1,2], A. Papadopoulos[1,3], G. Kourmoulaki[s1,3], L. Mouchliadis[1], S. Psilodimitrakopoulos[1], G. Kioseoglou[1,3], E. Stratakis[1,2] [1]Foundation for Research and Technology – Hellas (F.O.R.T.H.), Institute of Electronic Structure and Laser (I.E.S.L.), Heraklion, Crete, Greece [2]Department of Physics, University of Crete, Heraklion, Crete, Greece [3]Department of Materials Science and Technology, University of Crete, Heraklion, Crete, Greece
WS4-P9	**A novel electrochemiluminescence glucose biosensor based on polypyrrole/polyluminol/ C3N4-Ni(OH)2/glucose oxidase modified graphite electrode** Lida Fotouhi[1],*,Morteza Hosseini[2],*,Maryam Hamtak[1] [1]Department of Chemistry, Alzahra university, Tehran, Iran [2] Center of Excellence in Electrochemistry, Faculty of Chemistry, University of Tehran, Tehran
WS4-p10	**Electronic properties of low dimensional transition metal dichalcogenide structures** D. Davelou[1,2]*, A.E. Maniadaki[1,2], M. Minotakis[1,2], K.Stavroulakis[1,2], I.N. Remediakis[1,2] and G. Kopidakis[1,2] [1]Department of Materials Science and Technology, University of Crete, GR-71003 Heraklion, Crete, Greece [2]Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology Hellas (FORTH), GR71110 Heraklion, Crete, Greece

Poster Code: WS4-P1

Reduced Graphene Oxide Ink/Conductive Polymeric Composites for Enhanced Field Emission Devices

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Hydroiodic acid (HI) treated - reduced graphene oxide (rGO) ink/conductive polymeric composites are considered as promising cold cathodes in terms of high geometrical aspect ratio and low field emission (FE) threshold devices [1-4]. In this study, four simple, cost-effective, solution-processed approaches for rGO-based field effect emitters were developed, optimized and compared; rGO layers were coated on a) n+ doped Si substrate, b) n+-Si/P3HT:rGO, c) n+-Si/PCDTBT:rGO and d) n+-Si/PCDTBT:PC71BM:rGO composites, respectively. The fabricated emitters were optimized by tailoring the concentration ratios of their preparation and field emission characteristics. In a critical ratio, FE performance of the composite materials was remarkably improved compared to the pristine Si, as well as n+-Si/rGO field emitter. In this context, the impact of various materials, such as polymers, fullerene derivatives, as well as different solvents on rGO function reinforcement and consequently on FE performance, upon rGO-based composites preparation, was investigated. The field emitter consisted of n+-Si/PCDTBT:PC71BM(80%):rGO(20%)/rGO displayed a field enhancement factor of ~2850, with remarkable stability over 20 h and low turn-on field in 0.6V/μm. High-efficiency graphene-based FE devices realization paves the way towards low-cost, large-scale electron sources development. Finally, the contribution of this hierarchical, composite film morphology was evaluated and discussed.

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[2] G. Viskadouros, et al. *ACS applied materials & interfaces* 6, 388-393 (2013)
[3] L. Sygellou, et al. *RSC Advances* 5, 53604-53610 (2015)
[4] G. Viskadouros, et al. *RSC Advances* 6, 2768-2773 (2016)

Poster Code: WS4-P2

Single-step Green synthesis of Biocompatible Graphene Quantum Dots and their Cell Uptake Studies

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Graphene-based quantum dots (GQDs) are stable, biocompatible and highly fluorescent materials offering huge potential for cellular bio imaging, LED diodes and diverse optoelectronic applications. However, the lack of straightforward, efficient and environmental-friendly synthesis methods often limits their applications. In this work, we demonstrate a novel one-pot, fast and green synthesis approach for the synthesis of fluorescent GQDs without involving any harsh chemicals. Graphene oxide is chosen as a precursor and a two-hour hydrothermal reaction is carried out with assistance of low concentration of hydrogen peroxide, and no further post-purification steps are involved. The effects of reaction conditions on the GQDs characteristics are comprehensively studied. The as-synthesized GQDs show high photo stability and excellent biocompatibility as displayed by cell viability assays for three different cell lines, namely macrophages, endothelial cells and a model cancer cell line. The extensive investigations of cellular uptake mechanisms reveal that the for all the three cell lines, the major internalization route for GQDs is caveolae-mediated endocytosis followed by clathrin-mediated endocytosis at a less extent. The key findings of our work demonstrate the huge potential of the as-synthetized GQDs as fluorescent nanoprobes. The study also provides unique and detailed insight into the cell-GQDs interactions, which is highly important for bio-imaging and other related applications such as biomedical diagnostics and drug delivery.

[1] Arnab Halder et al. *ACS Applied Bio Materials 2018* (under minor revision)

Poster Code: WS4-P3

Optically induced absorption modulation in a graphene-based metasurface

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Since its experimental realization in 2004 [1], graphene, a two-dimensional material made of carbon atoms arranged in a honeycomb lattice, has attracted enormous attention as a research topic as well as a material for commercial technological applications. A pronounced application, suitable for graphene exploitations, is that of thin film absorbers that are structures capable of absorbing all power of incident electromagnetic waves. Absorbers are used as non-reflective covering layers for shielding against electromagnetic radiation and minimization of backscattering form electromagnetic large structures. Recently, it has been demonstrated experimentally, that electrostatic gate-tunable perfect absorption in a simple structure consisting of an extended area of graphene placed over a grounded dielectric is possible in the THz regime [2]. In this work we demonstrate experimentally the ultrafast optically induced modulation of the THz absorption in this simple structure (graphene over a grounded dielectric).

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Poster Code: WS4-P4

Separation and recovery of heavy metal ions by graphene acid.

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Heavy metal water pollution has become a severe environmental issue with the development of metallurgical and chemical manufacturing and batteries. Heavy metals have high toxicity and biological accumulation. The conventional methods often suffer from limited efficiency at low metal concentrations, fouling by organic matter and low regeneration rates. Due to this reason is necessary to develop new methods to recovery heavy metal ions from wastewater.[1]

Graphene nanostructures have attracted increasing interest in recent years due their unique electronic and magnetic properties. Its potential range of applications can be extended by functionalization because introducing functional groups onto the graphene surface enables modulation of its properties. Growing attention has been given to graphene acid and in recent years also to fluorographene, cyanographene and graphene acid.[2]

Here, we present the removal and recovery of heavy metals (Co, Cu, Cd) from contaminated water by using graphene acid (GA).[3] The adsorbed metal ions on the GA can be recovered via acid pH adjustment allowing GA to be recycled and reused for further decontamination processes. Simultaneously, metal ions dissolved in acid can be recycled. This cyclic process decreased amount of sorbents and return expensive metals to next production.

Acknowledgements:
Authors gratefully acknowledge the support by Internal Student Grant (IGA) of the UP in Olomouc, Czech Republic (IGA_PrF_2018_015) and by Ministry of the Interior of the Czech Republic (Project No. VI20162019017).

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Poster Code: WS4-P5

SAME AS WS4-P8

Poster Code: WS4-P6

Theoretical investigation of water-soluble polyethylene glycol treated phosphorene system

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Phosphorene (PHO) is monolayer or few-layer black phosphorus (BP), sticked together by weak van der Waals forces between layers, which is similar to the behavior of other layered materials. Compared with other two-dimensional (2D) layered nanomaterials such as graphene nanoscale phosphorene distinguishes itself from them by its binary structure: lattice structure in the armchair direction and bilayer configuration along the zigzag direction (**Figure 1**). This structural anisotropy leads to its unique properties and great potential in various fields. Previous experiments demonstrated exfoliated BP nanosheets to be photosensitizers suitable for the generation of singlet oxygen for photodynamic therapy[1] and applicable for photothermal therapy of cancer[2]. Polyethylene glycol (PEG) treated phosphorene allows better dissolution in water which leads improved usability in biological systems.[2] The aim of this study is the investigation of PEGylated phosphorene bilayer in aqueous solution in order to identify the main factors influence the interactions between molecules. For this, molecular dynamics simulations were carried out. Our results give fundamental description from this system in the atomic level, which leads better understanding and new design strategy of novel PHO-based nanostructures.

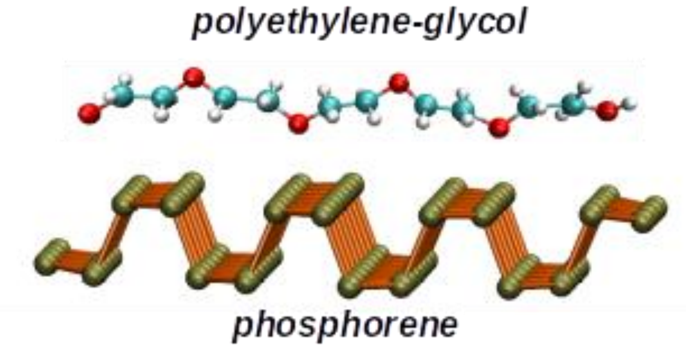

Figure 1. Phosphorene and polyethylene-glycol.

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Poster Code: WS4-P7

Laser fabrication of Transition-Metal Dichalcogenide Nanostructures based materials

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The study of inorganic nanometer-scale materials with hollow closed-cage structures, such as inorganic fullerene-like nanostructures (IF) and nanotubes (INT), is a rapidly growing field. To date, numerous kinds of IF and INTs TMDs were synthesized for various applications, particularly for lubrication. In this work we demonstrate new simple, room temperature and environmentally friendly approaches for the synthesis of IF and INTs via a) ultrashort pulse laser ablation of TMDs in bulk form in ambient air as well as b) via pulsed laser deposition (PLD) of bulk TMD targets. In the first part is presented the synthesis of IF and INTs via ultrashort pulse laser ablation of a mixture of transition-metal dichalcogenides in bulk form mixed with Pb/PbO, in ambient air. The method can be considered as a synergy of photothermally and photochemically induced chemical transformations. The ultrafast laser induced excitation of the material, complemented with the formation of extended hot annealing regions in the presence of the metal catalyst, facilitates the formation of different nanostructures [1]. In the second section is presented the application of the pulsed laser deposition technique (PLD) for the growth of hierarchical TMD structures, specifically the formation of WS2 nanostructures onto microstructures [2]. These techniques can be further developed for the formation of nanostructures at any preselected location, such as microsized asperities, which are destined to numerous applications, including for electron emission cathodes and scanning probe microscopy field emitters.

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Poster Code: WS4-P8

Characterization & Non-Linear Optical Imaging of 2D Transition Metal Dichalcogenides

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The interest in two-dimensional (2D) materials has been steadily increasing since the discovery of graphene, a material with fascinating properties and great potential for various applications. Transition metal dichalcogenides (TMDs) with the form MX_2 exhibit a structure very similar to that of graphene and have attracted significant attention of the scientific community due to their extraordinary physical properties. Chlorine-doped tungsten disulfide monolayer (1L-WS_2) with tunable charge carrier concentration has been realized by pulsed laser irradiation of the atomically thin lattice in a precursor gas atmosphere. This process can sufficiently control the carrier density and consequently the PL emission of WS_2 single layers, also it gives rise to a systematic shift of the neutral exciton peak towards lower energies, indicating reduction of the crystal's electron density. The capability to progressively tune the carrier density upon variation of the exposure time is demonstrated; this implicates that the Fermi level shift is directly correlated to the respective electron density modulation due to the chlorine species. Notably, this electron withdrawing process enabled the determination of the trion binding energy of the intrinsic crystal. It is found that the effect can be reversed upon continuous wave laser scanning of the monolayer in air. Density functional theory calculations, reveal that chlorine physisorption is responsible for the carrier density modulation induced by the pulsed laser photochemical reaction process.

Furthermore, we use nonlinear laser-scanning optical microscopy in atomically thin TMDs to reveal, with high-resolution, information about the orientational distribution of armchair directions and their degree of organization in the 2D crystal lattice. In particular, polarization resolved second harmonic generation (PSHG) imaging in monolayer WS_2 reveals with high-precision the orientation of the main crystallographic axis (armchair). By performing a pixel-by-pixel mapping of the armchair orientations of WS_2 triangular islands on a large CVD-grown sample area, we are able to distinguish between different domains, locate their boundaries and reveal their detailed structure. To do that, we fit experimental PSHG images of sub-micron resolution into a generalized theoretical model and we acquire the armchair orientation for every pixel of the material. This allows us to measure the mean orientational average of armchair angle distributions from specific regions of interest and consequently to define the standard deviation of these distributions as a crystal quality factor.

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Poster Code: WS4-P9

A novel electrochemiluminescence glucose biosensor based on polypyrrole/polyluminol/ C_3N_4-$Ni(OH)_2$/glucose oxidase modified graphite electrode

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A novel electrochemiluminescence glucose biosensor based on polypyrrole/polyluminol/C_3N_4-$Ni(OH)_2$/glucose oxidase was synthesized by electro-oxidizing the monomers of pyrrole and luminal to glucose detection in the H_2SO_4 acidic medium. An average diameter of nano particles is about 43-48 nm were decorated on the surface of layer by layer polymers. The glucose oxidase can be fixed firmly in the polymer film and $Ni(OH)_2$-functionalized g-C_3N_4 nanosheets to form hybrids. It offers excellent electrocatalytic activity toward oxidation of glucose, which liberated hydrogen peroxide (H_2O_2) in enzymatic reaction, that react with luminal radicals, so enhanced the luminol ECL and enable sensitive determination of glucose. Under the optimized conditions, the linear region of ECL intensity to glucose concentration was valid in the range from 0.5 to 500 $\mu molL^{-1}$(R^2= 0.98) with a detection limit (S/N=3) of 0.06 $\mu molL^{-1}$. In order to verify the reliability, the fabricated biosensor was applied to determine the glucose concentration in saliva and human blood serum. The results indicated that the proposed biosensor presented good characteristics in terms of high sensitivity and good reproducibility for glucose determination, promising the applicability of this sensor in practical analysis.

Poster Code: WS4-P10

Electronic properties of low dimensional transition metal dichalcogenide structures

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The isolation of atomically thin sheets from layered materials has generated enormous interest in two-dimensional (2D) crystals. Single layers cleaved from materials such as graphite, boron nitride, and molybdenum disulfide (MoS2) have been studied extensively, both experimentally and theoretically. 2D MoS2 and other semiconducting Transition Metal Dichalgogenides (TMDs) exhibit novel optoelectronic properties, different from their bulk counterparts. Similar to graphite, TMDs layered 3D structure allows for the extraction of single or few layers but unlike gapless graphene, 2D TMDs possess a direct electronic energy bandgap. Their unique optoelectronic properties depend on composition, dimensionality, strain, defects, chemical modification and nanostructuring, so that they can be engineered for specific applications. When combined with graphene and/or other materials, TMDs offer new possibilities in nanotechnology. Transistors, solar cells, light-emitting devices, sensors, and inexpensive catalysts are some of the technological applications currently explored using these materials. We present theoretical results based on Density Functional Theory calculations for the modification of the electronic and dielectric properties of TMD monolayers under strain [1], for nanoribbons and nanoflakes with metallic edge states [2,3], for hybrid TMD/graphene nanostructures and the substrate induced changes of their optoelectronic and catalytic properties [4], and for TMD alloys in order to examine the possibility of continuously tuning the bandgap. Detailed understanding of the atomic structure, electronic properties and their manifestation in observable quantities, provides interpretation to experiments and predictions for the functionality of 2D materials and nanostructures. Finally, engineering the electronic properties of these materials may enable their widespread use in applications.

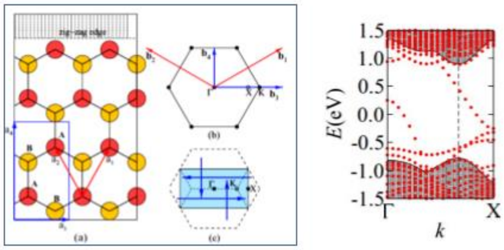

Figure 1: (left) Mapping of the original BZ of the 2D TMD to the new BZ of the TMD nanoribbon. (right) Band structure of quasi 1D MoS2 nanoribbon with two S adatoms (red dots) compared to band structure of MoS2 monolayer (shaded area)[3].

Figure 1: (left) Mapping of the original BZ of the 2D TMD to the new BZ of the TMD nanoribbon. (right) Band structure of quasi 1D MoS2 nanoribbon with two S adatoms (red dots) compared to band structure of MoS2 monolayer (shaded area)[3].

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	WORKSHOP 5 NANOELECTRONICS & BIOELECTRONICS
WS5-P1	**Substrate-dependent triboelectric charging of graphene surface for enhanced electric potential generation by motion of ionic liquid droplets** Junghyo Nah*, Pangun Park, Daehoon Lee Chungnam National University, Daejeon, Korea
WS5-P2	**Top down InAs nanowire field-effect transistors on a SiO2/Si via soft lithographic method** Junghyo Nah[1]*, Pangun Park[1], Min Hyung Lee[2] [1]Chungnam National University, Daejeon, Korea [2]Kyung Hee University, Yongin, Korea
WS5-P3	**High-Performance Piezoelectric Nanogenerators Based on Chemically-Reinforced Composites** Youngmin Choi Korea Research Institute of Chemical Technology (KRICT), Daejeon, Republic of Korea.
WS5-P4	**Molecularly imprinted chiroptical sensor for detection of glucose** M. F. Frasco*[1], R. Pereira-Cameselle[2], S. Chiussi[3], J. L. Alonso-Gómez[2] and M. G. F. Sales[1] [1]BioMark-CEB/ISEP, School of Engineering, Polytechnic Institute of Porto, Porto, Portugal [2]Organic Chemistry Department, University of Vigo, Vigo, Spain [3]New Materials Group, Applied Physics Department, University of Vigo, Vigo, Spain
WS5-P5	**Utilizing PLL-g-PEG substrates to detect DNA in complex samples: a combined Quartz Crystal Microbalance/Spectroscopic Ellipsometry study** Dimitra Chronaki[1,2]*, George Papadakis[1], Pasquale Palladino[1], Achilleas Tsortos[1] and Electra Gizeli[1,2] [1]Institute of Molecular Biology and Biotechnology-FORTH, Heraklion, Greece [2]Department of Biology, University of Crete, Heraklion, Greece
WS5-P6	**Salmonella detection in whole blood using an acoustic wave device combined with signal-monitoring smartphone** Gesthimani-Ioanna Theodosi[1,2]*, Konstantinos Parasyris,[2] George Papadakis[1,] Electra Gizeli[1,2] [1]Institute of Molecular Biology and Biotechnology-FORTH, Heraklion, Greece [2]Department of Biology, University of Crete, Heraklion, Greece
WS5-P7	**Organic Based Transistors as biosensors for inflammatory biomarkers** Chiara Diacci[1,2], Marcello Berto[2], Carlo A. Bortolotti[2], Daniel T. Simon[1] [1] Division of Physics and Electronics, University of Linköping, Sweden; [2] Scienze della vita, University of Modena and Reggio Emilia, Italy
WS5-P8	**Epitaxial Vanadium Dioxide Films with Sharp Electrical and Optical Switch Properties** Olga Boytsova[1,2]*, Fariya Akbar[2], Dmitrii Sharovarov[2], Artem Makarevich[1,2] and Andrey Kaul[2] [1]Kurnakov Institute of General and Inorganic Chemistry, Moscow, Russia [2]Lomonosov Moscow State University, Moscow, Russia
WS5-P9	**Bioresorbable wireless electrical stimulator for nerve regeneration** Sung-Geun Choi[1], Gun-Hee Lee[1], Jae-Young Bae[1], Jae-Hwan Lee[1], and Seung-Kyun Kang[1,2],* [1] Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology, Daejeon 34141, Republic of Korea [2] KI for Health Science and Technology (KIHST), Korea Advanced Institute of Science and Technology, Daejeon 34141, Republic of Korea
WS5-P10	**Fluorescent polymer-based nanocomposite electrospun fibers as optical sensors for ammonia and pH** Xenofon Karagiorgis[1]*, A. Petropoulou[2], I. Savva[1], C. Riziotis[2], S. Kralj[3,4] and T. Krasia-Christoforou[1] [1]Department of Mechanical and Manufacturing Engineering, University of Cyprus, 75, Kallipoleos

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WS5-P11	**Au-Ag star shaped nanoparticles as highly efficient SERS nanoresonators.** Jan Krajczewski, Andrzej Kudelski Laboratory of Molecular Interaction, Faculty of Chemistry, University of Warsaw, Warsaw, Poland
WS5-P12	**The new type of bipyramidal-Au@SiO2 nanoparticles – synthesis and Raman application**. Karol Kołątaj, Andrzej Kudelski University of Warsaw, Department of Chemistry, Warsaw, Poland
WS5-P13	**New type of highly efficient optical nanoresonators for SHINERS measurements.** Karol Kołątaj, Andrzej Kudelski Department of Chemistry, University of Warsaw, Ludwika Pasteura 1, Warsaw, Poland,
WS5-P14	**A study of spectroscopic properties and morphological behavior of ZnO nanoparticles and globular protein bovine serum albumin in solution and in a layer-by-layer self-assembled film** Utsav Chakraborty*, Pabitra paul Dept of Physics, Jadvpur University, Kolkata, West Bengal, India – 700032
WS5-P15	**Carbon quantum dots as active layer for hybrid light emitting diode (HyLEDs)** Sofia Paulo,[1,2]* Eugenia Martinez-Ferrero [2], Emilio Palomares[1,3] [1]Institute of Chemical Research of Catalonia (ICIQ). The Barcelona Institute of Science and Technology (BIST), Tarragona, Spain; [2]Fundació Eurecat, Mataró, Spain; [3]Catalan Institution for Research and Advanced Studies (ICREA), Barcelona Spain
WS5-P16	**Laser-based multi-functional biomimetic surfaces** Skoulas E.[1,2]*, Mimidis A. [1,2], Papadopoulos A. [1,2], Livakas N. [1,2], Petrakakis E. [1,2], Tsibidis G.D. [1], and Stratakis E [1,2] [1]ULMNP, Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology (FORTH), N. Plastira 100, Vassilika Vouton, 70013, Heraklion, Crete, Greece; [2] Materials Science and Technology Department, University of Crete, 71003 Heraklion, Greece
WS5-P17	**Highly selective and sensitive DNA detection on nanoscale interdigitated electrodes using gold nanoparticle amplification** Dilu G. Mathew[1]*, A. Marti[2], J. Huskens[2], S.G. Lemay[3] and W. G. van der Wiel[1] [1]NanoElectronics group; [2]MolecularNanofabrication group; [3]BioElectronics group; MESA+ Institute of Nanotechnology, University of Twente, The Netherlands

Poster Code: WS5-P1

Substrate-dependent triboelectric charging of graphene surface for enhanced electric potential generation by motion of ionic liquid droplets

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Triboelectric potential generation at the solid-liquid interface has been demonstrated as a potential route to harvest energy from liquid motions. Graphene has gained attention as a promising platform for liquid-based triboelectric energy harvesting as well as for different sensor applications. When graphene is transferred on the substrate, it exhibits many ripples because of inhomogeneous interactions with the substrate, creating different triboelectric charges in the form of ripples. Therefore, depending on the surface properties of handling substrate that graphene is transferred, different surface charges can be created by interaction between graphene and the substrate, differentiating triboelectric power generation behavior. However, most of reports to date have focused on interaction between liquid and graphene layer rather than the graphene and the substrate.

In this work, we investigated the roles of the substrate, where graphene layer is transferred, on triboelectric output performance. By using graphene layers transferred on different substrates with dissimilar triboelectric properties, we investigated the triboelectric output by flowing liquid over graphene layer. The results demonstrated distinct output performance depending on the substrate property. In addition, we adopted simple surface functionalization method to render its surface to be more favorable for triboelectric power generation, such that the potential generated from liquid-graphene interaction can be further increased. The work introduced here can provide useful insight on monolayer graphene and substrate interaction and can be adopted to develop liquid-based energy harvesting device.

Acknowledgement: This subject is supported by Korea Electric Power Cooperation as Basic Research Program for Power Industry.

Poster Code: WS5-P2

Top down InAs nanowire field-effect transistors on a SiO2/Si via soft lithographic method

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The epitaxial layer transfer process was introduced to integrate high-quality and ultrathin III-V compound semiconductor layers on any substrate. However, this technique has been limited to fabricate sub-micron nanoribbons due to the diffraction limit of photolithography. In order to overcome this limitation and scale down its width to sub-50nm, we need either costly short wavelength lithography system or non-optical patterning method. In this work, high-quality III-V compound semiconductor nanowires were fabricated and integrate on a Si/SiO2 substrate by a soft-lithography top-down approach and an epitaxial layer transfer process, using MBE-grown ultrathin InAs as a source wafer. The width of the InAs nanowires is controlled by using solvent-assisted nanoscale embossing (SANE), descumming, and etching processes. By optimizing these processes, the NWs with their width below 50 nm were readily obtained. The InAs NWFETs prepared by our method demonstrate peak electron mobility of ~1600 cm2/Vs, indicating negligible material degradation during SANE process.

Acknowledgement: This subject is supported by Korea Electric Power Cooperation as Basic Research Program for Power Industry and by Korean National Research Foundation as Basic Research Laboratory program(NRF-2017R1A4A1015744).

Poster Code: WS5-P3

High-Performance Piezoelectric Nanogenerators Based on Chemically-Reinforced Composites

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High-performance flexible piezoelectric nanogenerators (PNGs) based on composite thin films comprising amine-functionalized lead zirconate titanate (PZT) nanoparticles (PZT-NH2 NPs) and a thermoplastic triblock copolymer grafted with maleic anhydride are fabricated. The chemically reinforced composite contains a stable dispersion of PZT NPs within the polymer matrix with enhanced stress applied to the PZT NPs. Without additional dispersants, the uniform distribution of PZT-NH2 NPs in the polymer composite improves the piezoelectric power generation compared to that of a PNG device using pristine PZT NPs. This unique composite behavior allows the PZT-NH2 NP-based flexible PNG to exhibit a high output voltage of 65 V and current of 1.6 μA without time-dependent degradation. This alternating energy from the PNG can be used to charge a capacitor and operate light-emitting diodes through a full bridge rectifier. Furthermore, the proposed PNG is demonstrated as a promising energy harvester for potential applications in self-powered systems.

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Poster Code: WS5-P4

Molecularly imprinted chiroptical sensor for detection of glucose

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As populations age, the growing prevalence of age-related chronic diseases is expected to greatly increase the burden to healthcare systems. The versatility of biosensor approaches can answer the demand for ever more accurate and personalized portable devices. Namely, glycemic control for improved management of diabetes with its associated risk factor for cardiovascular diseases calls for new diagnostic/monitoring tools [1].

Herein, a novel strategy for the chiroptical sensing of glucose is presented based on molecularly imprinted polymers incorporating tailored chiral fragments. It is essential to develop functional materials with intense chiroptical responses in order to expand their use in sensing devices [2]. Concerning the detection of biomarkers in complex biological samples like body fluids containing interfering molecules, the development of chiroptical sensors may prove their potential by providing high sensitivity and specificity of detection.

Molecular imprinting is a cost-effective technique for the production of specific binding sites in polymeric matrices enabling the selective recognition of the target analyte [3]. Herein, the imprinted polymer is obtained by deposition of a polymer film on an electrode substrate with suitable conductivity and optical properties. The polymer film is formed by electropolymerization of a monomer mixture that includes axially chiral fragments. This straightforward approach aims the detection of glucose and envisions a rapid development of chiroptical sensors.

Acknowledgements: The authors gratefully acknowledge the financial support from IBEROS project (INTERREG POCTEP/0245_IBEROS_1_E).

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Poster Code: WS5-P5

Utilizing PLL-*g*-PEG substrates to detect DNA in complex samples: a combined Quartz Crystal Microbalance/Spectroscopic Ellipsometry study

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An acoustic biosensor, the quartz crystal microbalance with dissipation monitoring (QCM-D) combined with a spectroscopic ellipsometer were employed for **real-time** monitoring the adsorption of the graft copolymer poly(L-lysine)-*g*-poly(ethylene glycol) (PLL-*g*-PEG) on a gold surface and the subsequent binding of DNA molecules[1]. In order to obtain information regarding the structural features of the copolymer and explain its specificity against DNA, we characterized the film properties such as thickness, “dry” (polymer) mass, “wet” (polymer + water) mass and water content. This copolymer is known to attract DNA molecules through its positively charged PLL backbone and at the same time repel protein molecules through the grafted PEG units[2,3] (Fig. 1). This remarkable property enabled the **label-free** acoustic detection of DNA amplicons that were produced from whole *Salmonella* Thyphimurium cells. Our results suggest that the architecture of the copolymer PLL-*g*-PEG leads to the selective detection of DNA molecules; this can be applied to real-life complex samples such as milk. Future screening assays could use PLL-*g*-PEG as a surface coating to detect foodborne pathogens or diagnose infectious diseases.

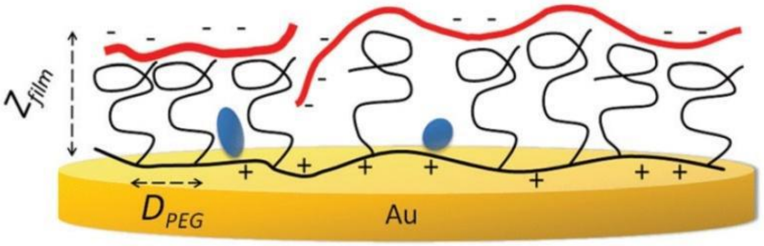

Figure 1. A suggested structure of the adsorbed PLL-*g*-PEG (black) on the Au sensor surface (gold). Adsorbed dsDNA (red) is shown in a rather flat conformation.

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Poster Code: WS5-P6

Salmonella detection in whole blood using an acoustic wave device combined with signal-monitoring smartphone

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Bacteria of genus *Salmonella* and particularly non-typhoidal *Salmonellae* (NTS) are major food-borne pathogens that have considerable effects on public health globally, since they have been associated with severe symptoms[1,2]. Although, generally bloodstream infection is rarely caused, it is very common in Africa where its case fatality rate is estimated to be 20-25%[1]. Therefore, the design of fast, convenient, and labour-saving diagnostic tools that could be implemented in this region is necessary to improve the efforts of controlling the transmission risk and combatting such infectious pathogens. In the current work, we are introducing a new approach where a portable system employing an acoustic biosensor is combined with an isothermal amplification method for the development of a new assay for *Salmonella enterica* serovar Typhimurium detection in whole blood (Fig. 1). More specifically, our system utilizes an acoustic wave sensor (either a Quartz Crystal Microbalance (QCM) or a Surface Acoustic Wave (SAW)) combined with the loop-mediated isothermal amplification (LAMP) method which is performed at 63°C for 20 min directly in blood without an extraction step. Our acoustic results revealed that with this methodology a detection limit of as low as 10 bacteria can be achieved in a crude sample and within 30 min of total analysis time. The assay's rapidity, simplicity, reduced power consumption, portability and cost-effectiveness could contribute to the development of point-of-care (POC) diagnostic tools that will accelerate the access to advanced medical services in low-income countries. Finally, the use of a smartphone for signal detection is considered another assay of the new methodology, especially for POC applications.

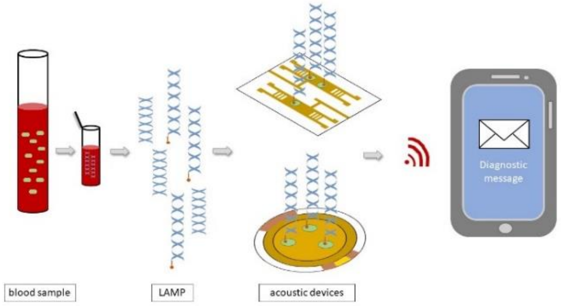

Figure 1: Schematic representation of work concept

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Poster Code: WS5-P7

Organic Based Transistors as biosensors for inflammatory biomarkers

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Cytokines are small soluble proteins, secreted by different types of cells, they act as intracellular signalling molecules: in fact they regulate the immune system, the inflammatory response, and many other physiological processes. Cytokine detection and quantification is essential to monitor inflammation or disease progression. The most common methods for cytokine quantification are based on antibody-antigen binding, as ELISA assays. However, ELISA can detect only one analyte at time, increasing the reagents cost; moreover, it requires large sample volumes and long preparation time. Organic electronic devices, in particular Organic Field-Effect Transistors (OFETs), can be a novel platforms for label-free protein detection, exploiting as sensing unit surface-immobilized antibodies or other proteins. The technology in antibody production is well known and made them easily available for diagnostic assays, such as ELISA. However, antibodies may lead to some problems. To overcome these problems, there has been an increasing interest in the engineering of proteins to be used as recognition elements alternative to Abs. The scaffolds for non-antibody proteins are borrowed from human proteins, or designed from scratch using de novo design.

Here we report two Electrolyte-Gated OFETs biosensors for IL-6 detection, featuring monoclonal antibodies and peptide aptamers adsorbed at the gate. Both strategies yield biosensors that can work on a wide range of IL-6 concentrations and exhibit a remarkable Limit of Detection of 1pM. Eventually, EGOFETs responses have been used to extract and compare the binding thermodynamics between the sensing moiety, immobilized at the gate electrode, and IL-6.

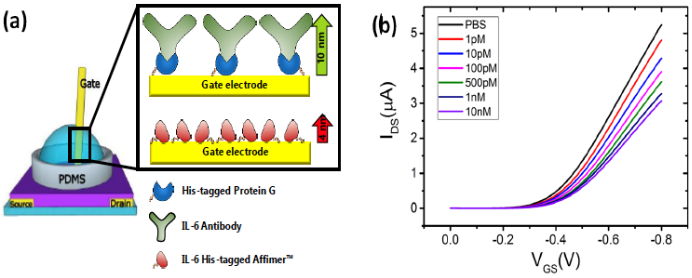

Figure 1: a) Schematic representation of gold electrode functionalization. Antibody functionalization required the presence of his-tag protein G, to achieve the right orientation. Affimer, presenting a his-tag tail, required only one step of functionalization .b) Transfer characteristics of antibody-based EGOFET sensor upon exposure to IL-6solutions in PBSbuffer. The corresponding IL-6 concentrations are reported in the legend.

Poster Code: WS5-P8

Epitaxial Vanadium Dioxide Films with Sharp Electrical and Optical Switch Properties

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New effects in the couple of titanium dioxide-vanadium dioxide discovered about 5 years ago have fueled interest in materials based on vanadium dioxide (VO_2) [1]. VO_2 undergoes a first-order phase transition from a monoclinic structure (phase M) with a dielectric conductivity to a tetragonal (phase R) with metallic conductivity at a temperature of 67°C. The dielectric-metal transition (DM) occurs almost instantaneously (<1 ps) and is accompanied by a change in the resistance up to 105 times. The electronic transition to VO_2 is accompanied by a sharp change in the optical transparency in the IR and THz bands. The combination of these unique qualities makes VO_2 a promising key component of a number of optoelectronic devices-switches, modulators, sensors. Obviously high-quality films (with a sharp DM transition) on substrates up to 3 inches in size are interesting for expansion of areas, conversion of thermal and solar energy, for nanophotonics, terahertz optics and medicine. The development of the processes for obtaining such films is the goal of this work.

Most of the known methods for the production of VO_2-based films require precise control of the partial pressure of oxygen, since vanadium is capable of exhibiting various degrees of oxidation. We proposed a method for the production of VO_2 films based on the reaction of vanadyl volatile complexes with water vapor. Earlier, we showed [2] that the precursor $VO(hfa)_2$ makes it possible to obtain films with an acute DM transition, however when switching to larger samples, it was found that such films are highly inhomogeneous. Therefore, other compounds of vanadyl - $VO(acac)_2$ and $VO(thd)_2$ have been tested. It was demonstrated a decrease in the concentration of grain boundaries after recrystallization annealing at 600°C leads to an increase in the amplitude of the DM transition. In the course of the work, uniform single-phase films of vanadium dioxide were obtained on single-crystal R-Al_2O_3 substrates with a diameter of 3 inches.

We acknowledge the RSF (№18-73-10112). Aspects of this research was performed using equipment of the JRC PMR IGIC RAS.

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Poster Code: WS5-P9

Bioresorbable wireless electrical stimulator for nerve regeneration

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Peripheral nerve injury, a common traumatic injury, can have long-term sequelae and lead to permanent impairment, depending on the degree of damage, and thus the development of therapeutic techniques is highly beneficial to society. Promoting rapid nerve regeneration is a major issue since treatment efficacy depends strongly on regeneration speed. Electrical stimulation is an effective way to accelerate nerve regeneration. In this study we developed an implantable wireless electric stimulator, all of whose components are bioresorbable, to provide continuous and repetitive stimulation. Because all materials absorb in the body after use, there is no need for a separate removal operation, which can cause the secondary nerve damage and infection problems. This device was applied to a rodent model with sciatic nerve damage to verify the therapeutic functionality of electrical stimulation from one to six days. Accelerated regeneration of the injured nerve was demonstrated by assessing loss of muscle mass, muscle force, and electromyography for 8 weeks.

Poster Code: WS5-P10

Fluorescent polymer-based nanocomposite electrospun fibers as optical sensors for ammonia and pH

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The design and development of polymer-based fluorescent nano- and microfibers by electrospinning has attracted considerable attention during the last years since such materials may be exploited as fluorescent sensors [1-3]. In the present study, electrospun cellulose acetate fibers have been functionalized with Fe_3O_4/SiO_2 core-shell nanoparticles bearing fluorescent functionalities (either fluorescein-FL or rhodamine B-RhB) on their surfaces. These materials were characterized in regards to their morphology by Scanning Electron Microscopy (SEM), whereas their fluorescence efficiency was evaluated by fluorescence microscopy and fluorescence spectroscopy. Most importantly, the Fe_3O_4/SiO_2/RhB-functionalized CA fibers exhibiting the highest stability, were further evaluated as gas (ammonia) and pH sensors. Regarding the former, it was demonstrated that these materials can act as “turn-off” sensors in the presence of ammonia vapour whereas these systems responded optically (i.e. via decreasing or increasing their fluorescence efficiency) upon pH alteration.

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Poster Code: WS5-P11

Au-Ag star shaped nanoparticles as highly efficient SERS nanoresonators.

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Nanoparticles formed from group 11 elements, especially from gold and silver exhibit very interesting optical properties. Visible light with a suitably adjusted frequency could induce a collective oscillation of electron plasma from conductivity band of these plasmonic nanoparticles. Electron oscillation lead to a local significant increase in the intensity of the electromagnetic field. Therefore, such nanoparticles can be used as optical nanoresonators for example in surface-enhanced Raman scattering (SERS) measurements. Theoretical calculations showed that the highest enhancement of electromagnetic fields occurs on tops and edges of anisotropic nanostructures. Unfortunately, in some cases the contact of analyte molecules with the metal surface may lead to their denaturation. Therefore, deposition of thin transparent layer of inert oxide could be used to covering surfaces of nanoparticles what prevents direct contact.

In this work we present easy, fast and repeatable method for synthesis of Au-Ag star shaped nanoparticles. Their optical and structural properties were examined using TEM microscope and UV-Vis spectrophotometer. Influence of the amount of various chemical compounds on the efficiency of the SERS enhancement and on final geometry of obtained nanostructures were studied. Two different methods were used for deposition of nanometric silica layer on the surface of Au-Ag stars. Silica layer prevents direct contact of the analyte molecules with the metallic surface. Obtained nanoparticles were tested as optical nanoresonators for SERS and SHINERS measurements. SERS and SHINERS measurements were carried out on monolayers of p-MBA formed on flat platinum surfaces. We found that Au-Ag star-shaped nanoparticles exhibit almost 5 times higher activity in SERS spectroscopy than standard spherical nanoparticles.

Poster Code: WS5-P12

The new type of bipyramidal-Au@SiO_2 nanoparticles – synthesis and Raman application.

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SHINERS measurements were introduced by Tian et al. in 2010 as the new approach to analyze various surfaces [1]. In this method Raman spectrum is measured from an investigated substrate covered with gold nanoparticles protected by a thin layer of silica or alumina. In this work, we present the synthesis of bipiramidal Au@SiO_2 core shell nanoparticles as the new type of SHINERS nanoresonators.

The synthesis of bipiramidal Au@SiO_2 nanoparticles, we firstly obtained bipiramidal gold nanoparticles according to a modified method developed by Weizmann [2]. Deposition of thin silica layer on obtained bipiramidal nanoparticles was carried out by the hydrolysis of tetraethoxysilane catalyzed by ammonium solution [3]. Synthesized bipiramidal Au@SiO_2 nanoparticles were presented in Figure 1.

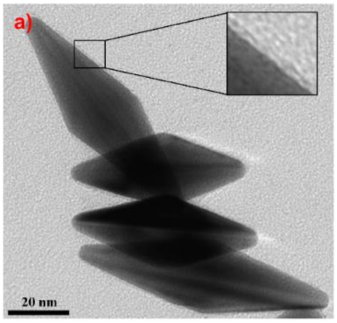

Fig. 1. TEM micrograph of synthesized bipiramidal *Au@SiO_2 nanoparticles.*

Obtained Au@SiO_2 nanoparticles were afterwards successfully used as nanoresonators in Raman measurements of 4-mercaptobenzoic acid and 2-mercaptoethanesulfonate. Synthesized anisotropic nanoparticles were approximately 10 times more efficient raman nanoresonators than typical spherical ones. Obtained bipyramidal Au@SiO_2 were also used for detection of Thiram pesticide deposited on tomato fruit. Limit of detection of Thiram were estimated to be 1.2 ng/cm^2.

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Poster Code: WS5-P13

New type of highly efficient optical nanoresonators for SHINERS measurements.

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In 2010 Tian reported a new analytical method of chemical analysis of surfaces named SHINERS (shell-isolated nanoparticle-enhanced Raman spectroscopy) 1. In this approach the analyzed surface was covered with the layer of gold nanoparticles protected by a thin layer of silica or alumina, and then the Raman spectrum of the investigated sample was recorded. Gold nanoparticles act as electromagnetic resonators, significantly enhancing the electric field of the incident electromagnetic radiation, and hence leading to very large increase of the Raman signal from the surface on which nanoparticles have been spread. The protecting coating separates metal cores from direct contact with the probed material and keeps them from agglomerating. Therefore, metal nanoparticles covered with protecting layer might be used for broader range of systems, also for living cells. In this contribution we report the synthesis of new type of SHINERS nanoparticles with the decahedral silver core and show their application for Raman studies of some molecules and yeast cells.

Decahedral silver nanoparticles were obtained by photochemical method developed by Kitaev [2]. Briefly, sodium borohydride were added to the aquous solution of $AgNO_3$, sodium citrate, PVP and L-arginine, and then resulting silver colloid were irradiated by blue light for 5 hours under stirring. For silica deposition we used method developed by Mirkin group [3].

Obtained decahedral silver nanoparticles were used afterwards as nanoresonators in SHINERS measurements of monolayer of PMBA deposited on Pt plate and in measurements of yeast cells. Figure 1 shows Raman spectra of Saccharomyces boulardii (yeast) cells before and after deposition of decahedral-$Ag@SiO_2$ nanoparticles. As can be seen in this Figure, in the Raman spectrum recorded with the decahedral-$Ag@SiO_2$ nanoparticles many Raman bands (e.g., at 1135, 1315, 1346, 1456, 1611, 1665 cm^{-1}) can be clearly identified, whereas in a case of the Raman spectrum recorded without nanoresonators it is very hard to distinguish these bands from the noise.

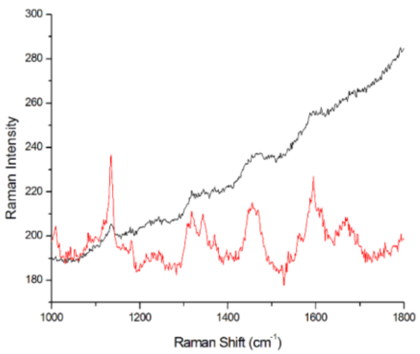

Fig. 1. Raman spectra of *Saccharomyces boulardii* cells without nanoparticles (black curve) and after addition of decahedral-Ag@SiO2 nanoparticles (red curve).

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Poster Code: WS5-P14

A study of spectroscopic properties and morphological behavior of ZnO nanoparticles and globular protein bovine serum albumin in solution and in a layer-by-layer self-assembled film

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In this study, we investigated the spectroscopic properties of the water-soluble globular protein bovine serumalbumin (BSA) while interacting with zinc oxide (ZnO) semiconductor nanoparticles (NPs) in aqueous medium and in a ZnO/BSA layer-by-layer (LbL) self-ssembled film fabricated on poly (acrylic acid) (PAA)-coated quartzor a Si substrate via electrostatic interactions. BSA formed a ground state complex due to its interaction with ZnO NPs, which was confirmed by ultraviolet–visible absorption, and steady state and time-resolved fluorescenceemission spectroscopic techniques. However, due to its interaction with ZnO, the photophysical properties ofBSA depend significantly on the concentration of ZnO NPs in the mixed solution. The quenching of the fluorescenceintensity of BSA in the presence of ZnO NPs was due to the interaction between ZnO and BSA, and theformation of their stable ground state complex, as well as energy transfer from the excited BSA to ZnO NPs in the complex nano-bioconjugated species. Multilayer growth of the ZnO/BSA LbL self-assembled film on the quartzsubstrate was confirmed by monitoring the characteristic absorption band of BSA (280 nm), where the nature ofthe film growth depends on the number of bilayers deposited on the quartz substrate. BSA formed a well-orderedmolecular network-type morphology due to its adsorption onto the surface of the ZnO nanostructure in thebackbone of the PAA-coated Si substrate in the LbL film according to atomic force microscopic study. The synthesized ZnO NPs were characterized by field emission scanning electron microscopy, X-ray powder diffraction, and dynamic light scattering techniques.

Keywords: Adsorption, Bovine serum albumin, Electrostatic, Layer-by-layer, Photophysical, ZnO nanoparticle.

Poster Code: WS5-P15

Carbon quantum dots as active layer for hybrid light emitting diode (HyLEDs).

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Under scale up point of view, the most widely used hole transport materials (HTMs) PEDOT:PSS and molybdenum oxide inks present some issues when they are deposited by roll-to-roll or inject printing. PEDOT:PSS present poor charges injection carriers and PSS has to be added in order to improve their solubility. The high annealing temperature needed to deposit molybdenum oxide limits its applicability on flexible and textiles substrates [1].

A new family of carbon based quantum dots (CQDs) were synthetized. The low temperature annealing as well as the good solubility in non-chlorinated solvents make CQDs as an excellent alternative to replace the above HTMs mentioned. In addition, we used different organic capping ligands to study how the ligand length influences in the hole injection and the stability of the HyLEDs.

In addition, we tested CQDs as an emissive layer [2], which present an emission broad band that allow to obtain white light without the need to mix green, blue and red quantum dots.

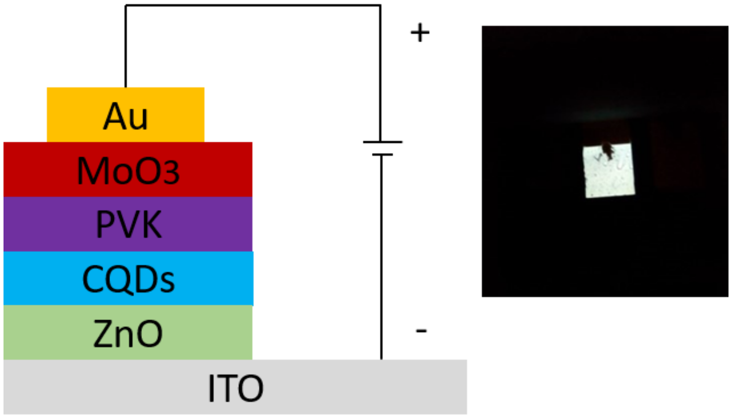

Figure 3. White light emitting diode applying a voltage.

[1] C. Girotto,et al. *ACS Applied Materials & Interfaces 3*, 3244-3247, (2011).

[2] F. Wang, et al. *Chemistry of Materials*, *22*, 4528-4530, (2010).

Poster Code: WS5-P16

Laser-based multi-functional biomimetic surfaces

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Nature has always provided a plethora of functional surfaces exhibiting unique, complex hierarchical morphologies with dimensions of features ranging from the macroscale to the nanoscale. Such morphologies are always behind the superior properties exhibited by the natural surfaces, including extreme wetting, antireflection, floatation, adhesion, friction and mechanical strength. In principle, femtosecond laser induced surface structuring has been demonstrated to produce numerous biomimetic structures for a range of applications, including microfluidics, tribology, tissue engineering and advanced optics.

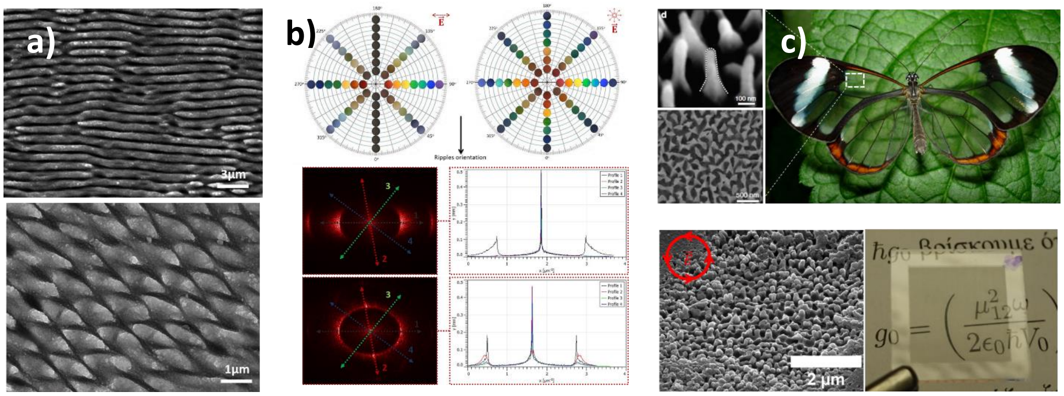

Fig.1: Periodic structures on the surface of (a) shark skin (drag reduction), (b) peacock spiders (angle free diffraction), (c) Glass wing butterflies and Cicada (anti-reflectivity)

In this poster, we present a summary of the research activities by the ULMNP group towards producing biomimetic self-assembled structures of variable shape and periodicity on various types of materials (metals, semiconductors, dielectrics). The primary objective of the research work aims to allow a systematic investigation of the laser conditions that lead to structures with application-based properties (Fig.1). The fabrication of a plethora of complex structures by varying the laser beam parameters brings about a new concept in laser structuring and it can be considered as an emerging laser based fabrication technique.

Acknowledgements
The work has been supported from the projects *Mouldtex* (funded by EU's H2020 framework programme for research and innovation under Grant agreement No 768705) and *Nanoscience Foundries and Fine Analysis (NFFA)*–Europe H2020-INFRAIA-2014-2015 (under Grant agreement No 654360) and *Laserlab IV*.

Poster Code: WS5-P17

Highly selective and sensitive DNA detection on nanoscale interdigitated electrodes using gold nanoparticle amplification

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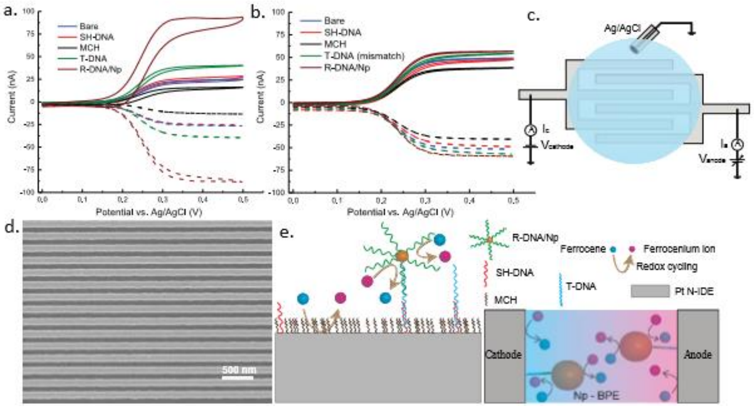
Electrochemical (EC) sensors are popular for their portability, low cost and fast operation. However, most of the EC nucleic acid detection methods are based on coulometric sensing of electrostatically bound cathodic EC species onto the DNA molecules making them unstable, irreproducible and unsuitable for point-of-care applications.[1] Here, we report a novel non-coulometric EC DNA detection method using gold nanoparticles (NPs) for amplification on nanoscale interdigitated electrodes (IDEs) with a neutral EC mediator, Ferrocenedimethanol. This DNA sensor uses a "sandwich" detection strategy. It involves the capture probe DNA (SH-DNA) immobilized on the Pt IDEs, the reporter probe DNA with NPs (R-DNA/NP) and the target DNA (T-DNA) which is complementary to both the other probes . When the R-DNA/NP binds to the T-DNA, it also immobilizes the NP making it a floating metallic object between anodic and cathodic electrodes of IDEs. This makes the NP a bipolar electrode (BPE) facilitating both oxidation and reduction reactions on it (shown in figure e).[2] Consequently, in addition to the redox cycling at the IDE, NP BPE also provides amplification (~4 fold) for low DNA concentration (1 nM) through redox cycling between IDEs and the NP. The cyclic voltammograms in figure a and b shows the NP amplification and its absence (mismatch T-DNA) respectively. This method can be used for highly sensitive and selective DNA detection.



Cyclic voltammograms (a) fully complementary and (b) mismatch T-DNA; (c) Schematic of measurement setup (d) SEM image of IDEs (e) Schematic of DNA functionalization

[1] T. G. Drummond et al. *Nature Biotechnology* 21 (10), 1192 -1199 (2003)
[2] G. Loget et al. *Analytical Bioanalytical Chemistry* 400, 1691-1704 (2011)

END OF POSTER PRESENTATION PROGRAM

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Deadline for manuscript submissions: 20 December 2018

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This Special Issue is expected to select excellent papers presented at Nanobio Conference 2018 regarding the design and development of advanced materials and nanotechnologies in relation to the field of energy and health applications. Particularly, on the development of novel nanomaterials, bionanosystems for tissue engineering and healthcare, innovative solar cells, nanophotonics, nanomedicine, bioelectronics and lab-on-chip systems. We invite investigators interested in nanotechnologies and bionanosciences to contribute their original research articles to this Special Issue. Potential topics include, but are not limited to:

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Michael Graetzel, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Antonios G. Mikos, Rice University, Houston, Texas, USA
Paul S. Weiss, UCLA, Los Angeles, USA

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