SMART NANO-MATERIALS and SYSTEMS STRATEGY from NATURE

The online Virtual Forum Invited Presenters
Mon. 9.00 -18.00 h., 31st May, 2021

The E-MRS Invited Organizers/Chairs

Professors Dr. Emmanuel STRATAKIS and Insung S. CHOI

With supporting this event as Guest Editors in the Special Issues of

International Journal of Molecular Sciences entitled
"Natural and Biomimetic Functional Materials" (Prof. Dr. Emm. Stratakis's project)

International Journal of Nanomedicine entitled
"Frontier Research in Biomaterials and Nanomedicine" (Prof. Dr. Insung S.Choi's project)

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1. Emmanuel Stratakis

9.00 h. (O.1.1)- CONTROL ID number BPF7K

Emmanuel Stratakis

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Dr. Emmanuel Stratakis research interests are in the fields of ultrafast laser interactions with materials for (a) biomimetic micro- and nano- structuring (b) nanomaterials synthesis, modification and functionalization for organic electronics and (c) biomaterials processing for tissue engineering. He has delivered more than 60 invited and keynote lectures and has been organizer and chair in major international scientific conferences. He has over 230 publications including 7 cover pages, in refereed scientific journals and he has received ~ 9000 total citations (h-index 52). Dr. Stratakis is the Greece representative for the Horizon 2020 committee configurations on: Nanotechnologies, Advanced materials, Biotechnology, Advanced Manufacturing and Processing.
In the Ultrafast Laser Micro- and Nano- processing group (ULMNP) of IESL, research is focused on the development of novel ultrafast pulsed laser processing schemes for controlled structuring at micro- and nano- scales of a variety of materials, including biopolymers. By applying ultrafast UV and IR laser pulses novel surface structures with sub-micron sized features are produced while the physical properties of semiconductor, dielectric and metallic surfaces are significantly modified. Developed methods include laser micro/nano surface structuring performed in different media, laser-induced forward transfer deposition and combination of those. Further control over the surface topology is achieved by proper functionalization of the 3D structures obtained with well-defined nanostructures. In particular, the artificial surfaces developed by processing under gaseous environments exhibit controlled dual-scale roughness, that mimics the hierarchical morphology of natural surfaces with exciting properties (i.e. the Lotus leaf), comprising micro-conical structures decorated with nanometre sized protrusions. The biomimetic morphology attained gives rise to notable multifunctional properties when combined with methods of tailoring the surface chemistry. Research shows that appropriate combination of topography and chemistry can lead to artificial surfaces that are: (a) of extremely low surface energy, thus water repellent and self-cleaned (b) smart, i.e show the ability to change their surface properties in response to different external stimuli and (c) functional in the sense that exhibit remarkable physical properties compared to the bulk. The ability to tailor the morphology and chemistry is an important advantage for the use of such structures as models to study the dependence of growth, division and differentiation of cells on the surface energy of the culture substrate and as scaffolds for tissue regeneration. At the same time, ULMNP focuses on the ultrafast laser syntheses of various types of nanomaterials including nanolayers. In particular, laser processing in liquid media results in the formation of self-organized surface nanostructures and colloids of surfactant-free nanoparticles used for photovoltaic applications. Additionally, the exploitation of ultrafast laser processing schemes for the synthesis and functionalization of graphene derivatives and other 2D materials for organic electronic applications is investigated.
Editor of the '*Materials Today Bio'* journal. **Guest Editor** of Special Issue 'Biomimetic and Functional Materials', *International Journal of Molecular Sciences*.

The Nano-Bio Conference activity: 2018 Heraklion, Crete, Principal Organizer 1st International conference on Nanotechnologies and Bionanoscience.

Invited Presenter for The E-MRS Symposia "Bioinspired and Biointegrated Materialas as New Frontiers Nanomaterials I and II th Editions and Co- Organizer next Symposia III-IV and Principal Organizer for VI th Edition, Co-Organizer for Symposia IX, Xth editions.

KEY PRESENTATION

Ultrafast laser biomimetic fabrication and diagnostics for neural tissue engineering applications

Professor, PhD in Physics **Emmanuel Stratakis**

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The surface topography of biomaterials can have an important impact on the cellular adhesion, growth and proliferation. Apart from the overall roughness, the detailed morphological features at all length scales, significantly affect the cell-biomaterial interactions in a plethora of applications including structural implants, tissue engineering scaffolds and biosensors. We present simple, one-step direct femtosecond (fs) laser processing patterning techniques to fabricate various types of micro/nano structured biomaterials platforms. Variation of the laser fluence, alters the surface morphology of solid materials, leading to a rippled-type, at lower laser fluences, or a conical spiked-type morphology, as the laser fluence increases. Hierarchically-structured cell culture platforms incorporating gold nanoparticles functionalized with specific bio-functional moieties have been additionally developed. Cells with nerve cell phenotype were cultured on the substrates. More specifically, PC12 cells cultured on the developed substrates and treated with nerve growth factor showed a differentiation response that was highly dependent on the surface topography. While, experiments with DRG/SCG nerve cells showed a differential orientation of the cells, depending of the underlying geometry of the laser engineered surface structures. Depending on the laser processing conditions, distinct SW10 cell-philic or cell-repellent patterned areas can be attained with a desired motif, enabling spatial patterning of cells in a controllable manner. Furthermore, we report on the fs laser microfabrication of porous collagen scaffolds, providing implants that via precise micron-sized features held the promise to control neuron cell phenotypes. Finally, the fs laser fabrication of a novel microfluidic platform for the study of the combined effect of fluid shear forces and culture substrate morphology on neuron cell proliferation and directionality will be demonstrated. Our work provides a versatile laser-based biofabrication approach to tune neuron cell responses by proper selection of the surface free energy of the substrate and may be promising for the design of cell culture biomaterial platforms for neural tissue engineering applications.

2. ELEFTHERIA BABALIARI

9.20h (O.1.2) - CONTROL ID number 6DEB0

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Ms. Eleftheria Babaliari is a Ph.D. candidate at the Department of Materials Science and Technology at the University of Crete, Greece. She has received three PhD scholarships under the framework of IKY (2016-2019), ELIDEK (2017) and Onassis Foundation (2016). She received a Bachelor's and a Master's Degree in Materials Science and Technology from the University of Crete, Greece in 2012 and 2015, respectively. During the undergraduate program, she joined the Polymer Group of the Institute of Electronic Structure and Laser (IESL), FORTH where she worked on the rheology of hard spheres colloidal suspensions and binary mixtures. In the graduate program, she joined the Biomaterials Lab of the Department of Materials Science and Technology in Crete where she studied the effect of microfluidics in biomaterials for bone tissue engineering applications. In 2015, she joined the Ultrafast Laser Micro and Nano Processing Group of the IESL, FORTH. Her current research interests include the development of laser-microstructured scaffolds for tissue engineering using Ultrafast Laser Processing and the study of the combined effect of shear stress and topography on tissue growth.

Study of the combined effect of shear stress and topography on Schwann cells behavior

Eleftheria Babaliari, Paraskevi Kavatzikidou, Anna Mitraki, Yannis Papaharilaou, Anthi Ranella, Emmanuel Stratakis

leftheria Babaliari 1,2; Paraskevi Kavatzikidou 1; Anna Mitraki 1,2; Yannis Papaharilaou 3; Anthi Ranella 1; Emmanuel Stratakis 1,4 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 Foundation for Research and Technology Hellas (F.O.R.T.H.), Institute of Applied and Computational Mathematics (I.A.C.M.), Heraklion, Crete, Greece 4 Department of Physics, University of Crete, Heraklion, Crete, Greece

Although the peripheral nervous system exhibits a higher rate of regeneration than that of the central nervous system through a spontaneous regeneration after injury, the functional recovery is fairly infrequent and misdirected. Therefore, the development of successful methods to guide neuronal outgrowth in a controllable manner, in vitro, is of great importance [1]. The present work aims to present a first study of the combined effect of shear stress and topography on Schwann (SW10) cells? behavior under dynamic culture conditions attained via continuous flow. For this purpose, a precise flow controlled microfluidic system with custom-designed chambers incorporating laser-microstructured polyethylene terephthalate (PET) culture substrates comprising microgrooves [2] was developed [3]. The microgrooves were positioned either parallel or perpendicular to the direction of the flow inside the chambers and the response of SW10 cells was evaluated in terms of growth, orientation, and elongation. In addition to this, the cell culture results were combined with computational flow simulations to precisely calculate the shear stress values. Our results demonstrated that wall shear stress gradients may be acting either synergistic or antagonistic to substrate groove orientation in promoting guided morphologic cell response when microgrooves are placed parallel or perpendicular to the mean flow direction respectively [3]. The ability to guide the outgrowth of SW10 cells, in vitro, via flow-induced shear stress and surface topography, could be potentially useful in the fields of neural tissue engineering with the creation of autologous graft substitutes for nerve tissue regeneration. REFERENCES [1] Kim, In Ae, et al. "Effects of mechanical stimuli and microfiber-based substrate on neurite outgrowth and guidance." Journal of bioscience and bioengineering 101.2 (2006): 120-126. [2] Babaliari, Eleftheria, et al. "Engineering cell adhesion and orientation via ultrafast laser fabricated microstructured substrates." International journal of molecular sciences 19.7 (2018): 2053. [3] Babaliari, Eleftheria, et al. "Combined effect of shear stress and laser-patterned topography on Schwann cell outgrowth: synergistic or antagonistic." Biomaterials Science (2021). ACKNOWLEDGEMENTS We acknowledge support of this work by the project Advanced Research Activities in Biomedical and Agro alimentary Technologies? (MIS 5002469), which is implemented under the Action for the Strategic Development on the Research and Technological Sector, funded by the Operational Program Competitiveness, Entrepreneurship, and Innovation? (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund); 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.

3. PARASKEVI KAVATZIKIDOU

MARIA ELENI TSOUTSA

9.30 h (O.1.3) - CONTROL ID number 2WCVA

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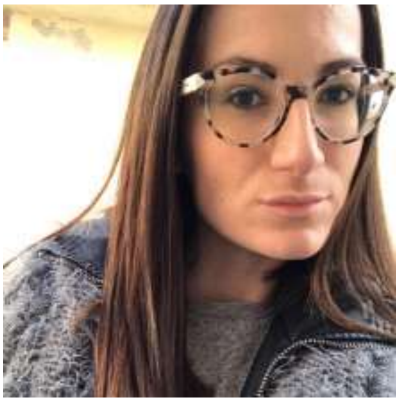

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P. Kavatzikidou is a Postdoctoral Researcher at The Stratakis Lab, Ultrafast Laser Micro and Nano Processing Laboratory in the Institute of Electronic Structure & Laser (IESL) – Foundation for Research and Technology Hellas (FORTH), Heraklion, Crete, Greece. She received her PhD in Clinical Engineering, BBSRC Case Studentship, Faculty of Medicine, University of Liverpool, UK in collaboration with an SME, Giltech Ltd and an Orthopaedic company, Stryker in 2008. She has joined the ULMNP group in the summer of 2014 and her main research interests focus on development of polymeric scaffolds via soft lithography, correlation of physicochemical, topographical, degradation properties of the scaffolds with the cytotoxicity, cytocompability (adhesion, proliferation and differentiation) of various cell types.

M. Tsoutsa is a MSc student at the Chemistry Department of the University of Crete, Greece. She received her BSc from the Department of Chemistry of the same University in 2019.

Biodegradable micropatterned polymeric replicas to control mouse stem cell focal adhesion, mechanotransduction and differentiation

M. Tsoutsa1,2, P. Kavatzikidou1, D. Angelaki1,3, A. Karagiannaki1, E. Petraki1,4, E. Babaliari1, P. Mangana1, L. Papadimitriou1, Manousaki1, A. Ranella1, E. Stratakis 1,3

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Engineered microenvironments are offering mechanistic insights into how the extracellular matrix (ECM) and physical forces regulate stem cells, revealing how these control self-renewal, adhesion, proliferation and differentiation potentials. The cells sense ECM mechanics (mechanotransduction) and spread via Hippo pathway effectors Yes-associated protein (YAP) and WW domain-containing transcription regulator protein 1 (WWTR1 or TAZ). YAP/TAZ are considered as nuclear relays of mechanical signals exerted by ECM rigidity and cell shape and as master regulator of cell?ECM interaction. Ultrafast pulsed laser irradiation is considered as a simple microfabrication method to produce structures controlling the structure geometry and pattern regularity1. Such structures with an anisotropy discontinuous topographical nature could enhance cellular growth and alignment (eg neuronal 2,3). Soft lithography has been successfully used to transfer well-defined micro-sized patterns from silicon to polymeric surfaces allowing the in-depth study on cell behavior4. In this study, a series of micro-patterned silicon (Si) structures were fabricated by using the ultrashort laser irradiation at a range of fluences, resulting in different anisotropic discontinuous patterns at micro-nano scale. Positive replicas of biodegradable polymers (PLGA and PCL) have been successfully reproduced from the Si structures via soft lithography. The morphological characterization of the polymeric replicas was performed by Scanning Electron Microscopy (SEM) and their wetting profile was determined by contact angle. The degradation rate of the micropatterned replicas was studied via SEM images and their weight loss. The cytocompatibility of replicas with a mouse Mesenchymal Stem Cells C57BL/6 was evaluated. Cell mechanotransduction was analyzed via the focal adhesion activity, cytoskeleton organization (shape) and cell nuclear profile on the replicas. The effect of the micropatterned surfaces on MSC cell fate and differentiation was also studied. All the topographies supported cells? adhesion and proliferation. The surface roughness had an effect on the MSCs mechanotransduction and differentiation. The chemical composition and degradation rate influenced cell morphology and cell nuclear mechanics. The ability of our technique to control the cellular behavior and create cell patterns could be potentially useful in understanding disease pathogenesis and for the development of patient-specific applications. This research has been co?financed by the European Union and Greek national funds such as ?OF (GSRT, ?1EDK-02024, MIS:5030238); NFFA (EU H2020 and GA654360) and Neurostimspinal (EU H2020 and GA829060). [1] Ranella A. et al. Acta Biomaterialia. 2010; 6: 2711; [2] Simitzi C. et al. Biomaterials. 2015; 67:115-128; [3] D Angelaki D. et al., Mater. Sci. Eng. C, 2020; 115:111144; [4] Babaliari E. et al. Int. J. Mol. Sci. 2018; 19(7):2053

4. PHANEE MANGANAS

9.40 h (O.1.4)- CONTROL ID number BJSCY

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Phanee Manganas is a post-doctoral researcher at IESL-FORTH. She received her BSc in Biology (Specialisation in Biomolecular Sciences and Biotechnology) and MSc in Molecular Biology and Biomedicine from the University of Crete. She then continued her studies at the University of Glasgow (UK), from where she obtained a PhD in Biochemistry and Molecular Biology, while working on oxidative regulation mechanisms in the mitochondrial intermembrane space. Since joining the team of the Ultrafast Laser Micro- and Nano-Processing (ULMNP) group, she has been interested in interpreting the effect of 3D architecture on various cellular processes – including growth, survival, adhesion and differentiation – from a molecular and biochemical viewpoint, in order to understand the ways in which cells interact with the fabricated environment.

Cytotoxicity assessment of reduced graphene oxide and laser micropatterned structures for ocular drug delivery applications

Phanee Manganas [1], Paraskevi Kavatzikidou [1], Evangelos Skoulas [1], Stella Maragkaki [1], Katerina Anagnostou [2], Emmanuel Kymakis [2], Anthi Ranella [1], Emmanuel Stratakis [1,3]
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Glaucoma is the second most common cause of blindness worldwide [1]. It is estimated that in 2020, 80 million people worldwide had some form of glaucoma. Glaucoma is a group of ophthalmic diseases that lead to progressive damage of the optical nerve responsible for the transfer of information in the brain. With the appropriate treatment, glaucoma can be cured. The reduction of intraocular pressure (IOP) is associated with slowing down the risk of disease progression to a great extent. Nowadays, the majority of people with glaucoma use eye drops to tackle the problem. The biggest hurdle arising from their continued use is that many patients do not comply with their treatment. In attempting to address the above problem, various drug delivery systems have been developed to ensure consistent administration of the appropriate drugs [2], but have failed to overcome significant limitations, such as the delivery of hydrophobic drugs and their high cost. Therefore, it is necessary to develop new and innovative systems, including features such as: i) the use of biocompatible materials (graphene oxide and biodegradable polymers) with the appropriate biological, electrical and mechanical properties; ii) the appropriate glaucoma drugs; iii) a controlled pharmacokinetic mechanism based on the use of ultrafast lasers for micro-nano patterning of the ocular devices; and iv) the inter-relation of the intraocular pressure and controlled drug release rate by the ocular patch. Ultrafast pulsed laser irradiation is considered a simple and effective microfabrication method to produce structures controlling the structure geometry and pattern regularity [3]. Such structures have been shown to enhance cellular growth and alignment (eg in neuronal cells [4,5]). Additionally, due to their biocompatibility, graphene and its derivatives have been used in a number of different biomedical applications, such as biosensors, tissue engineering and drug delivery systems. In this study, graphene oxide and a series of reduced graphene oxide preparations, prepared using green reducing agents, were tested for cytotoxicity, as well as better drug deposition and release. The structures were characterised in terms of their homogeneity, morphology and optical properties. The cytotoxicity of the functionalised structures with a fibroblast cell line and with corneal cells is further investigated. This research has been co?financed by the European Union and Greek national funds under the calls RESEARCH CREATE INNOVATE (project code: ?1EDK-02024, MIS:5030238), NFFA (EU H2020 framework program) and H2020 FET-open (project name: Biocombs4NanoFibers, Grant Agreement No. 862016). [1] Blomdahl S. et al., Acta Ophthalmol Scand 1997; 75 (5): 589?591. [2] Knight, O.J. & Lawrence, S.D., Curr Opin Ophthalmol. 2014; 25(2):112-7. [3] Ranella A. et al., Acta Biomaterialia 2010; 6: 2711. [4] Simitzi C. et al. Biomaterials. 2015; 67:115-128. [5] Angelaki D. et al., Mater. Sci. Eng. C, 2020; 115:111144

5. KARSTEN HAUPT –

9.50 h (O.1.5)- CONTROL ID number 1TBV6

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Karsten Haupt studied Biochemistry at the University of Leipzig, Germany. In 1994 he obtained his PhD in Bioengineering from the Université de Technologie de Compiègne, France. He then spent several years as a research fellow at Lund University, Sweden, where he worked on molecular imprinting with Klaus Mosbach. Back in France he was a researcher at INSERM, Paris and worked on erythrocyte membrane proteins (blood group antigens), before joining the University of Paris 12 as an associate professor. In 2003 he was appointed full professor of Nanobiotechnology at Université de Technologie de Compiègne, France, where he is now the Head of the CNRS Institute for Enzyme and Cell Engineering. Karsten Haupt is also holding positions as an Adjunct Professor at the University of Sonora, Hermosillo, Mexico, at the University of Arizona Tucson, USA, and at Jiangsu University, China. In 2018 he has become a senior member of the Institut Universitaire de France. He is one of the founders of the start up company Polyintell (now Affinisep). His present research interests include affinity technology, chemical and biosensors, molecularly imprinted polymers and synthetic receptors, biomimetic polymers and nanomaterials for biomedical applications.
For publication list and impact see: https://scholar.google.fr/citations?user=d_suiyQAAAAJ&hl=fr&oi=ao

Full Professor **Karsten Haupt – Invited Presenter at The Symposia – I, III - VIII th Editions and Keynote Presenter, Round Table's Speaker at The Symposia – IXth Edition due to The Symposia Sci Comm Board decision. Principal Organizer for The Symposium Vth Edition - The E-MRS Spring Meeting 2015 Lille. The Symposia IV-X th Editions Scientific Committee Member.**

Molecularly imprinted polymers nanoparticles as synthetic antibody mimics for diagnostics and antibody therapy

Full Professor Dr. **Karsten Haupt,** PhD student **Alejandra Mier Gonzalez,**
Dr. **Bernadete Tse Sum Bui**, Dr. **Valentina Montagna**

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Molecularly imprinted polymers (MIPs) are synthetic antibody mimics that specifically recognize molecular targets. They are highly cross-linked polymers synthesized in the presence of the target molecule ore an epitope thereof, acting as a molecular template. This templating induces three-dimensional binding sites in the polymer that are complementary to the template in size, shape and chemical functionality. The synthetic antibody can recognize and bind its target with an affinity and selectivity similar to a biological antibody Herein, we demonstrate the potential of MIPs for antibody therapy on the example of cell surface biomarker targets, including a cell-cell adhesion protein, and of soluble protein biomarkers. In addition, their applications in diagnostics will be discussed.

6. Aida Naghilou

10.05 (O.1.6) - CONTROL ID number L61G7

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Correlating the secondary protein structure of natural spider silk with its guiding properties for nerve regeneration

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Spider silk has been established as one of nature?s most fascinating materials and has attracted vivid attention due to its unique strength, toughness, and elasticity [1]. The application of the dragline silk of spider genus Nephila as a filament for nerve guidance conduits has led to promising results in nerve regeneration [2]. However, the use of spider silk has been phenomenological so far and the reasons for its success are still not identified. This renders a targeted production of synthetic fibrous luminal fillings such as recombinant silk out of reach. In this work dragline and cocoon silk of Nephila edulis, as well as the connecting and attaching silk of Avicularia avicularia were investigated [3]. Scanning electron microscopy was employed to study the size and morphology of the fibers, while Raman spectroscopy in native state and aqueous environment revealed the secondary protein structures. The results indicate that the difference in the diameter of the silk fibers does not impact the adhesion of cells. However, the attaching silk shows a lower ?-sheets content, crucial for the stiffness of the silk. Therefore, the flexible attaching silk fibers adhere to each other when placed in liquid, leading to the generation of cell agglomerations. This direct comparison demonstrated the crucial role of ?-sheets conformation for the guidance properties of natural spider silk, providing essential insights into the necessary material properties for the integration of fibrous luminal fillings in nerve guidance conduits. [1] L. Römer, et al., The elaborate structure of spider silk, Prion, 2 (2008) 154-161. [2] C. Radtke, Natural Occurring Silks and Their Analogues as Materials for Nerve Conduits, Int J Mol Sci, 17 (2016) 1754. [3] A. Naghilou, et al., Correlating the secondary protein structure of natural spider silk with its guiding properties for Schwann cells, Materials Science and Engineering: C, 116 (2020) 111219.

7. Gianni Ciofani

10.30 (O.1.7) - CONTROL ID number UQJP9

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Gianni Ciofani (born in La Spezia, Italy, on August 14th, 1982) is Senior Researcher Tenured at the *Istituto Italiano di Tecnologia* (Italian Institute of Technology, IIT), where he is Principal Investigator of the Smart Bio-Interfaces Research Line and Coordinator of the Center for Materials Interfaces (Pontedera, Italy).
He received his Master Degree in Biomedical Engineering (with honors) from the University of Pisa, Italy, in July 2006, and, in the same year, his Diploma in Engineering (with honors) from the *Scuola Superiore Sant'Anna* of Pisa, Italy. In January 2010, he obtained his Ph.D. in Innovative Technologies (with honors) from the *Scuola Superiore Sant'Anna*. From January 2010 to August 2013 he was Post-Doc at the IIT, Center for Micro-BioRobotics, where, from September 2013 to October 2015, he was Researcher in the framework of the Smart Materials Platform. From October 2015 to October 2019 he was Associate Professor at the Polytechnic University of Torino (Italy), maintaining at the same time his research activity in IIT, where he is Senior Research Tenured since November 2019.
His main research interests are in the field of smart nanomaterials for nanomedicine, bio/non-bio interactions, and biology in altered gravity conditions. He is coordinator or unit leader of many grants/projects, and in 2016 he was awarded a European Research Council (ERC) Starting Grant. Gianni Ciofani is author of more than 140 papers on international journals (*H*-index 34, excluding self-citations), 3 edited books, and 16 book chapters. He delivered more than 40 invited talks/lectures in international contexts and, for his research activity, he was awarded several national and international prizes. He serves as Reviewer for more than 180 international journals, and as Editorial Board Member of *Nanomedicine UK*, *Scientific Reports*, *International Journal of Nanomedicine*, *Journal of Physics: Materials*, *Bioactive Materials*, and *Advances in Nano Research*; he is Specialty Chief Editor (Nanobiotechnology) for *Frontiers in Bioengineering and Biotechnology*.

Innovative nanotechnological approaches for the treatment of glioblastoma multiforme

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Central nervous system tumors are an important cause of morbidity and mortality worldwide. Among them, glioblastoma multiforme is the most aggressive and lethal, characterized by extensive infiltration into the brain parenchyma [1]. In our research we propose nanotechnology-based approaches able to improve both the drug anti-cancer efficacy and its delivery efficiency across the blood-brain barrier. To achieve these aims, we exploit hybrid nanovectors composed by lipids and superparamagnetic iron oxide nanoparticles [2]. The fabricated nanovectors demonstrate an enhanced release after exposure in an alternating magnetic field, and a complete release of the encapsulated drug after the synergic effect of low pH, increased concentration of hydrogen peroxide, and increased temperature due to the applied hyperthermia. The optimal anticancer effects result from the synergic combination of hyperthermal chronic stimulation with the controlled drug release, highlighting therefore the potential of the proposed drug-loaded lipid magnetic nanovectors for the treatment of glioblastoma multiforme. An in-depth proteomic analysis corroborated the findings obtained on a complex multi-cellular in vitro model [3]; finally, we showed as nanovector-mediated hyperthermia induces a lysosomal membrane permeabilization that not only initiates a caspase-dependent apoptotic pathway, but also enhances the anticancer efficacy of the drug [4]. Acknowledgments This project has received funding from the European Research Council (ERC) under the European Union?s Horizon 2020 research and innovation program (grant agreement N°709613, SLaMM). References [1] Kim S.S., [?], Chang E.H. Biochem. Biophys. Res. Commun. 468: 485-489 (2015) [2] Tapeinos C., [?], Ciofani G. Nanoscale 11: 72-88 (2019) [3] Marino A., [?], Ciofani G. Nanoscale 11: 21227-21248 (2019) [4] Pucci C., [?], Ciofani G. ACS Appl. Mater. Interfaces 12: 29037-29055 (2020)

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10.50 (O.1.8) - CONTROL ID number 27PBW

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Combined plasmonic-magnetic nanostructures for label free direct ex vivo diagnosis through surface enhanced Raman spectroscopy

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Localisation of light at the subwavelength limit would yield in a strong enhancement of electromagnetic fields in spin-plasmonic nanostructures. This work opens a study of surface enhanced Raman scattering using combined plasmonic-magnetic nanostructures for label free direct ex vivo diagnosis. The reactivity of magnetic nanoparticles increases with decreasing size and thus surface effects are more intense than in bulk [1]. Drawbacks on using them in active sensing parts are the low conductivity, poor optical properties and the tendency to form aggregates when dispersed in particular solvents. [2]. Therefore, we propose nanostructured magnetic surfaces and plasmon generating coatings (Au) in a bilayer sequence to produce substrates suitable for surface enhanced Raman spectroscopy. The materials of choice are iron oxides (Fe_2O_3 and Fe_3O_4). The Fe_3O_4 nanocompound was prepared via green synthesis. The precursors for Fe(II) and Fe(III) were dispersed in an aqueous solution and were reduced with a phyto-extract. High dispersion of magnetic particles in water and EtOH has been noticed. The solution containing nanoparticles of Fe_3O_4 was spin coated onto a stainless-steel substrate and dried (60-200°C). A solution of 7.14% Au nanoparticles in lavender oil has been deposited onto the magnetic nanostructured surfaces and let dry for 2 days prior to the thermal treatment. Magnetite and Au coated magnetite samples have been investigated by several techniques for morphology, structure and optical properties, e.g. scanning electron microscopy, energy dispersive X-ray analysis, atomic force microscopy, dynamic light scattering and Raman spectroscopy. The coatings have been tested in real conditions showing that label free SERS with 632nm Raman excitation can provide fluorescence-free spectra of fresh samples. The resulting enhancement factor has been 3 times the one resulted from SERS experiments on twin samples laid on Au nanostructured surfaces. Screening of body fluids in general and with SERS in particular may represent a strategic target for direct ex-vivo diagnostics.

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9. Insung S. Choi

11. 05 (O.1.9) - CONTROL ID number E3TSQ

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Dr. **Insung S. Choi** is Professor of Chemistry and of Bio and Brain Engineering at KAIST, Korea, and the Director of the Center for Cell-Encapsulation Research (Creative Research Initiative; 2012-). He obtained his BS and MS degrees in Chemistry at Seoul National University in 1991 and 1993, and did his PhD degree in Chemistry at Harvard University in 2000 under the supervision of George M. Whitesides. After postdoctoral work with Robert Langer at the

Department of Chemical Engineering of MIT, he joined the faculty at KAIST in 2002. He was awarded KCSWily Young Chemist Award (2003), Thieme Journal Award (2003), Presidential Young Scientist Award (2004; KAST), and JANG SEHEE Research Achievement Award (2013; KCS). His research interests include biomimetic chemistry, cell-material interfaces, and biosurface organic chemistry. He has published over 240 peer-reviewed papers (>10000 citations, h-index = 48). He is the editorial board member of Chemistry-An Asian Journal (Wiley-VCH), ChemNanoMat (Wiley-VCH), Scientific Reports (NPG), and Polymers (MDPI), and the editorial advisory board member of Advanced Healthcare Materials (Wiley-VCH).

Professor **Insung S. Choi Honorary Invited and Key Presenter for The Symposia "Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials from 2014 to 2020. Invited with PhD students presenter for Young Investigators Forum from 2017 to 2020. The Member of The Symposia Scientific Committee Board.**
The Member of The E-MRS –Korea Working Committee.
The Principal Organizer for this Symposium Xth Edition – The E-MRS Spring Meeting VIRTUAL CONFERENCE.

KEY PRESENTATION

Single-Cell Nanoencapsulation: Past, Present, and Future

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Single-cell nanoencapsulation is defined as the cytocompatible chemical strategy to physically confine individual living cells with ultrathin (preferably, < 100 nm), tough shells in the three-dimensional space. The cellular hybrid structures generated by single-cell nanoencapsulation have been called various names, such as cell-in-shell structures, artificial spores, micrometric Iron Men, cyborg cells, or SupraCells. Since concept development in 2013, the field has rapidly grown and recently entered the second stage of development, where the artificial shells are actively and intimately involved in the cellular metabolism and activities, not just protecting the cells from harmful aggressors. The past, present, and future of single-cell nanoencapsulation are discussed concisely.

10. Christian Goldhahn

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Christian Goldhahn a scientist with the urge to contribute to the sustainable transformation of our society | Polymer-Chemist by education with a PhD in bio-based material development | Postdoc at ETH Zurich and Empa Dübendorf, developing new sustainable materials and processes for a circular economy | Co-founder and member of the board of directors of Swiss Wood Solutions, a startup with the mission to replace tropical woods and synthetic plastics with sustainable materials from domestic wood

Wood-Enzyme Hybrids for Contious-Flow Biocatalysis

Christian Goldhahn, Mark Schubert, Ingo Burgert, Munish Chanana

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Continuous-flow biocatalysis has big potential as an efficient green alternative to established catalytic processes. It offers a wide variety of possible chemical transformation at moderate reaction conditions. However, most of these processes rely on the immobilization of enzymes on synthetic polymeric beads or membranes. These materials are unsustainable, as they are oil-based and cannot be recycled. Hence, the investigation of greener alternatives is demanded. Wood is a natural material with a complex anisotropic structure, which is dominated by micrometer-sized pores that are aligned along the tree?s growth direction. These pores, which are naturally designed for directed transport of liquids, make wood an interesting membrane material. Hence, we here present a wood-based biocatalytic flow-through reactor. Enzymes were immobilized inside the wood-structure by a two-step process, which relies on nanoparticle-mediated adsorption. The process is easy to execute, versatile, and completely water-based. The resulting wood-metal-enzyme hybrids offer excellent reusability and can be applied as biocatalytic flow-through reactors. Moreover, a two-step reaction cascade was executed in continuous flow. These bio-based biocatalytic membrane reactors can be a promising material for green processes.

11. Guido Panzarasa

11. 40 (O.1.11) - CONTROL ID number QPO4O

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Guido Panzarasa joined in 2018 ETHZ in the Laboratory of Soft and Living Materials led by Prof. Eric R. Dufresne, where he developed a completely new line of research on time-domain self-assembly of materials based on a molecular systems engineering (systems chemistry) approach. In June 2020 he was promoted Group Leader in the Wood Materials Science Laboratory led by Prof. Dr. Ingo Burgert. His **Active and Adaptive Wood Materials** group focuses on enabling wood with novel functionalities (including time-programmability), promoting their use for future sustainable smart buildings. Guido Panzarasa is an active member of many European scientific societies, including the *Royal Society of Chemistry* (*RSC*, UK). In September 2019 he was elected President of the *Swiss Young Chemists' Association* (*SYCA*, Switzerland), which he joined in 2018 as board member and ETHZ representative. Guido Panzarasa is author and co-author of more than 40 scientific publications in peer-reviewed international journals

Programming Self-Assembly in Time with Chemical Clocks

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Living systems can grow a huge variety of materials with the highest degree of sophistication, and an overall efficiency that remains largely unparalleled by artificial fabrication techniques. Moreover, living materials are adaptive i.e. they exist and perform autonomously under dissipative conditions. These features are made possible by the ability to control complex reactions networks, carefully organized in spatiotemporal sequences. Developing autonomous chemical systems that could imitate the properties of living matter is a challenge at the meeting point of materials science and systems chemistry. Chemical clocks are versatile tools to program in time the autonomous and transient self-assembly of organic as well as inorganic building blocks. I will show how to clock molecules, polymers and metal cations into different structures, from nanoparticles to gels, without the need for external control, and demonstrate how this approach paves the way to the development of (almost) living artificial materials.

12. Jinho Hyun

11. 55 (O.1.12) - CONTROL ID number L6YQ2

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Cell culture platform of cellulose nanofiber hydrogels

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Carboxymethylated hydrophilic CNF (Hphil-CNF) was modified with methyltrimethoxysilane into hydrophobic CNF (Hphob-CNF) and used as a printing matrix. The Hphil-CNF hydrogel was printed at the surface of the Hphob-CNF hydrogel, forming an immiscible, distinct 3D structure. Petroleum-jelly-printed CNF hydrogels were dehydrated at 40 °C to form a film structure with microfluidic designs. After dehydration for 24 h, the petroleum jelly patterns were removed by applying compressed air at 70 °C to form a channel structure. The channels formed in the CNF film was treated with 1 % calcium ion solution to prevent further deformation. Due to the high transparency of the platform, it is possible to observe the cell morphology and response to external stimuli as well as chemical flow in the channel. The applicability of the open cell culture platform was investigated with A549 lung cancer cells by injecting cisplatin, a model drug into the channel.

13. Stefan Guldin

12. 10 (O.1.13) - CONTROL ID number 7020S

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Research Interests:Adaptive & Responsive Nanomaterials; Molecular Self-Assembly; Chemo- & Biosensors; Molecular self-assembly is a common principle of structure formation in natural and synthetic materials. The cooperative assembly of molecular building blocks into ordered super-structures is generally driven by weak, non-covalent intermolecular forces. In our group, we study these formation principles and build functional nanoarchitectures for a variety of fields ranging from chemical sensing and biomedical diagnostics to photovoltaics and optical coatings.

Evaluating the Interaction of Nanoparticles with Chemical and Biological Targets

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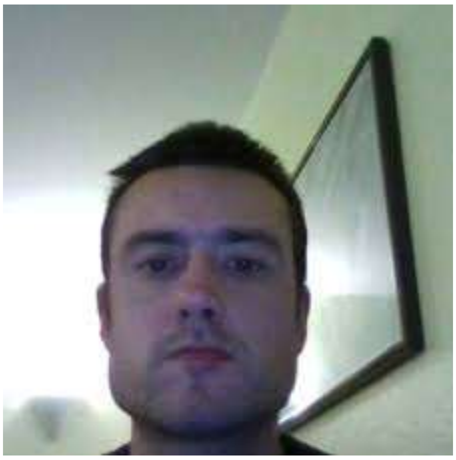
While accurate information of individual building blocks and their spatial arrangement is important,[1-3] my group is particularly interested in the interaction of nanoparticles with their environment. In analogy to biomolecular recognition prevalent in many biological processes, gold nanoparticles (AuNPs) have been developed as nanocarriers and artificial molecular machines. For any of the above mentioned applications, the screening of affinity and selectivity of specifically designed AuNP ligand shells towards molecular targets is essential. We have recently developed an approach, based on quartz crystal microbalance with dissipation monitoring (QCM-d), for the stepwise in situ quantification of AuNPs immobilisation and subsequent uptake and release of binding partners.[4] Crucially, the frequency shift patterns offered by QCM-d enabled us to model the binding kinetics and calculate binding parameters, such as the association and dissociation rate constants (kon and koff) and apparent binding constant Ka. We have recently extended this platform to the acoustic immunosensing of exosomes, which are endocytic lipid-membrane bound bodies, with the potential to be used as biomarkers in cancer and neurodegenerative disease.[5] In combination with a recently developed synthetic protocol for decoupled control of size and surface composition,[6] this analytical toolbox provides a powerful platform for systematic studies on colloidal behaviour, ligand-shell mediated nanoparticle-stimuli interactions and rational optimisation of material design for environmental and biomedical applications. References: [1] Comparative characterisation of non-monodisperse gold nanoparticle populations by Xray scattering and electron microscopy - Y. Yang, S. Liao, Z. Luo, R. Qi, N. MacFhionnlaoich, F. Stellacci, S. Guldin, Nanoscale, vol. 12, pp. 12007 - 12013, 2020. [2] Information entropy as a reliable measure of nanoparticle dispersity - N. MacFhionnlaoich, S. Guldin, Chemistry of Materials, vol. 32, pp. 3701 - 3706, 2020. [3] Application of the Spatial Distribution Function to colloidal ordering - N. MacFhionnlaoich, R. Qi, S. Guldin, Langmuir, vol. 35, pp. 16605 - 16611, 2019. [4] Probing nanoparticle-analyte interaction in real time via quartz crystal microbalance with dissipation monitoring - Y. Yang, G. Poss, N. Nianias, Y. Weng, R. Qi, H. Zheng, E. Kay, S. Guldin, Nanoscale, vol. 11, pp. 11107 - 11113, 2019. [5] Acoustic immunosensing of exosomes using a quartz crystal microbalance with dissipation monitoring - J. Suthar, E. Parsons, B. Hoogenboom, G. Williams, S. Guldin, Analytical Chemistry, vol. 92, pp. 4082 - 4093, 2020. [6] A versatile AuNP synthetic platform for decoupled control of size and surface composition - Y. Yang, L.A. Serrano, S. Guldin, Langmuir, vol. 24, pp. 6820 - 6826, 2018.

14. Erik Laurini



12. 25 (O.1.14) - CONTROL ID number CBJI0

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Erik Laurini graduated in in Medicinal Chemistry (2006). He got the PhD in Chemical and Pharmaceutical Sciences and Technologies at the University of Trieste in 2010. From 2010 to 2015 he was Post-doc Researcher at the Department of Engineering and Architecture at the University of Trieste in collaboration with the Oncology Institute of Italian Switzerland (IOSI) and Otsuka Pharmaceuticals. From 2015 he is Assistant Professor at the Department of Engineering and Architecture of University of Trieste. The main research activities of Erik Laurini are focused in project in the area of computer-aided molecular simulation of biological systems related to drugs, drug resistance in cancer treatment and study of nanocarriers for gene therapy and drug delivery. Moreover, he is also involved in multiscale molecular modeling of nanostructured and nanomaterials for material science. With an h index of 22 (Scopus, October 2019), he is the author of about 150 scientific publications on international journals and conference proceedings in the field of multiscale molecular modeling of complex systems.

Self-Assembling Nanotechnology for Cancer Theranostics: From Computer-Assisted Design to In Vivo Applications

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Theranostics is a new field of medicine which combines specific targeted therapies based on specific targeted diagnostic tests. The theranostic paradigm in cancer involves nanoscience to unite diagnostic and therapeutic applications to form agents for diagnosis, drug/gene delivery and treatment response monitoring. In this respect, our team as a part of a pan-European task force in the field has developed a series of innovative theranostic systems which proven to be excellent agents in cancer imaging and therapeutics in vivo. Nanotechnology-based imaging in cancer diagnosis plays a prominent role in both improving imaging sensitivity and specificity and reducing toxicity. Quite recently, based on the previous experience with Amphiphilic Dendrimers (AD) and further studies on AD modifications, we developed innovative nanosystems for positron emission tomography (PET) and single photon emission computed tomography (SPECT) imaging again exploiting AD-based self-assembly in which the surface of the amphiphile was decorated with different radionuclide (Gallium, Gadolinium and Indium) complexed within different macrocyclic chelator. The key findings of these efforts can be summarized as follows: the nanovectors were characterized by effective accumulation in tumors, exceeding sensitivity and specific imaging of various tumours, and was especially efficacious for tumors otherwise undetectable using the clinical gold reference. In addition, this nanovectors were endowed with an excellent safety profile and favorable pharmacokinetics. This study also demonstrated that nanotechnology based on self-assembling dendrimers can a fresh perspective for biomedical imaging and cancer diagnosis, i.e., cancer theranostics.

15. Valerio Voliani

12. 40 (O.1.15) - CONTROL ID number 1I8H3

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Valerio Voliani is a researcher at Center for Nanotechnology Innovation, Istituto Italiano di Tecnologia. He has obtained his MSc in Chemistry and PhD in Molecular Biophysics from Scuola Normale Superiore (Pisa, Italy). His efforts are devoted to the translation of noble metal nanomaterials to clinical practice by addressing the issue of metal persistence, in order to promote innovative and non-invasive treatments for neoplasms and infectious diseases. His main interests are related to photothermal conversion, drug delivery, and photoacoustic/ultrasound imaging. He is also actively engaged in scientific disseminations to students and community.

Publications impact: More than 35 peer-reviewed papers, 7 books/chapters, >700 citations, 30 invited, 3 international patents, H-index=18 (from G. Scholar)

Dr. **Valerio Voliani – Key Presenter and Invited with Special Speech on Frontier Research at this Symposium Xth edition, due to The Symposium Scientific Committee Board decision.**

Ultrasmall-in-nano noble metals biokinetics

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Keywords: cancer, theranostics, nanoparticles, ultrasmall, photothermal

Plasmonic noble metal nanoparticles (NPs) have attracted increasing interest for their potentiality to revolutionize diagnosis and treatment of many diseases, especially neoplasms.[1,2] Nonetheless, there are still no clinically approved NPs for cancer therapy/diagnostic and very few candidates are in clinical trials. The clinical translation of NPs is mainly prevented by their persistence in organism after the medical action. Such persistence increases the likelihood of toxicity and the interference with common medical diagnoses. Sizereduction to ultrasmall nanoparticles (USNPs) is a suitable approach to promote metal excretion by the renal pathway, however altering most of the behaviors of NPs.[1]

A groundbreaking advance to jointly combine the appealing features of NPs with metal excretion relies on the ultrasmall-in-nano approach.[1] Within this approach, we have designed inorganic all-in-one biodegradable nanoplatforms comprising plasmonic USNPs: the nature-inspired passion fruit-like nano-architectures (NAs).[3,4] The versatility of NAs production will be presented, together with the significant metal-excretion trend from murine models and preliminary applications, in particular for photothermal treatments.[5–8] Furthermore, the last achievements from this novel approach will be discussed and the next exciting perspectives provided. Such nano-architectures might bring again noble metal nanomaterials to the forefront of cancer theranostics, in order to treat carcinomas in a less invasive and more efficient manner. The research leading to these results has received funding from AIRC under MFAG 2017 – ID 19852 project – P.I. Voliani Valerio.

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17. 20 (O.1.29) - CONTROL ID number UT1D3

Noble metals in medicine: where are we?

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Inorganic nanomaterials hold the promise to shift the current medical paradigms for the treatment and diagnosis of several diseases, among which neoplasms and infections. This is due to their peculiar chemical, physical and physiological behaviors. Despite the massive efforts, treatments based on inorganic nanomaterials are mainly at the preclinical stage, due to the body persistence issue. Indeed, non-biodegradable materials usually result in long-term persistence within excretion system organs, increasing their likelihood of toxicity. In this round table, the next strategies to support the translation of inorganic nanomaterials to the clinical settings will be discussed.
The research leading to these results has received funding from AIRC under MFAG 2017 " ID 19852 project" P.I.VolianiValerio.

16. Hemi Rotenberg

14. 00 (O.1.16) - CONTROL ID number 146Y4

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key presentation

Non-Genetic "Optogenetics": Silicon Based Bio-Interfaces for Multi-scale Optical Modulation

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Traditional methodologies for bio-electrical interrogation are associated with leads and substrate-bound electrodes, which are invasive and lack intra-volumetric access. Optogenetics, however, requires genetic modification, which limits its translational applications. Here we describe optically responsive silicone-based materials to perform leadless, minimally invasive non-genetic photo-electrical modulation from the sub-cellular to tissue and whole organ level. We used ultrathin (~2µm) single crystalline p-type silicon membranes, in which the silicon-biofluid interface resulted in a bandgap bending and thus photoelectrical capabilities. Nanoporous surface was induced by high concentration hydrofluoric acid etching. This surface was oxygen plasma treated, which enhanced the generated photocurrent in more than 2 orders of magnitude. These ultrathin and flexible membranes were wrapped around tissues and established a tight electrical coupling allowing for leadless optical light modulation. As a proof of concept, we interfaced the flexible silicon device with an ex vivo isolated heart, and with the sciatic nerve in situ. We then performed optical biomodulation of the heart and the sciatic nerve using optical powers that were lower than 1 sunlight illumination. We optically paced the heart from both ventricles, demonstrating its feasibility for cardiac resynchronization therapy applications. The sciatic nerve was stimulated while being exposed, and in situ in the sutured rat using implanted optical fiber. For subcellular modulation, we hybridized myofibroblasts and oligodendrocytes with label-free silicon nanowires by spontaneous internalization. Then, local stimulation with subcellular resolution was achieved by stimulating internalized nanowires. Consequently, transient calcium fluxes originating at the stimulation location demonstrated our subcellular interrogation capabilities. These cell-silicon hybrids performed electrical coupling in nitro, as optical stimulation of the hybridized cells resulted in heterocellular calcium propagation from myofibroblasts to cardiomyocytes and from oligodendrocytes to neurons. Thereafter, we used these cell-silicon hybrids to address the long-standing debate of whether myofibroblasts electrically couple with cardiomyocytes in vivo. When hybrids were injected into the left ventricular wall, they establish a seamless integration with the native heart in vivo, as opposed to bare silicon nanowires that resulted in a severe immune-response, and fibrotic encapsulation. We then applied local cell-specific photo-stimulation of a pre-hybridized cell within the 3D tissue ex vivo. We found that heterocellular electrical coupling did not occur, as no calcium propagation to the native tissue was observed. We conclude that silicon-based nanomaterials can be utilized for high spatial resolution optical modulation of cells for basic research investigations. Moreover, translational applications are also possible using flexible ultrathin silicon devices that can be employed to electrogenic tissues in vivo.

17. Bo ZHU

14. 20 (O.1.17) - CONTROL ID number 61W70

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Prof. Dr. Bo Zhu received his Ph.D. from Tokyo Institute of Technology in 2004. He continued his research as a postdoctoral researcher from 2004 to 2006, and as a JSPS Postdoctoral Fellow from 2006 to 2008 at Tokyo Institute of Technology. He moved to RIKEN since 2008, and received a SPDR Fellowship to start his independent research from 2010, and became a research scientist in 2013. Since late 2013, he joined Donghua University as a full professor. From 2017, he moved to Shanghai University, and has been promoted as Deputy Dean of School of Materials Science and Technology since 2018. He works on the functional conducting polymers, electro-responsive polymers, flexible bioelectronics, wearable and wireless sensors. He has given more than 20 invited talks in international conferences, co-authored 2 book chapters, more than 80 peer reviewed papers.

The activity in the E-MRS: **Professor Dr. Bo Zhu is The E-MRS Member 2013-2019 with a special invited Presentations/Lectures and with a special invited presentations his Grad Students/Postdoctoral researchers for The Symposia "Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials III-IX". Professor Dr. Bo Zhu has success working, as The Symposia Sci Comm Member, Organizer/Chair for a special ONE Day SESSION with invited Professors/Dr Lecturers and Presenters from China (2017, E-MRS Spring Meeting Strasbourg).**

Professor Dr. Bo Zhu – Invited by The Symposium O 2021 Scientific Committee Board for KEY PRESENTATION on Frontier Research in Smart BIO-Interface Systems.

key presentation

Bio-mimicking Polymers and Electronics toward Selective Electro-Coupling with Cells

Bo ZHU
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Bioelectronic implants, electrically coupled with nerve tissues, can help to resolve the sensory, motor, and cognitive deficits of the treated patients. These devices can serve as neural prostheses, brain-machine interfaces, nerve regeneration scaffolds, and bio-integrated devices for biological signal detection and recording. The long-term electrocoupling of the devices with nerve tissues are being challenged, however, by the immune system?s severe reaction to foreign bodies and the emigration of neuron cells. An ideal bioelectronic implant should combine flexibility, protein-resistance and cell-targeted electro-coupling to ensure the required biocompatibility and efficient electrical trade-offs for interfacing with cells/tissues. Being driven by this aim, we have adopted a biomimicking molecule design for both the polymer of electrodes and that of electric insulating packages. During the past several years, we synthesized a series of bio-mimicking conducting PEDOTs with either static, dynamic or 3D cell interaction of high selectivity and low impedance. All these conductive polymers have demonstrated an intimate, stable and efficient electrical electro-coupling with targeted cells by integrating nonspecific-binding resistance, specific interaction and low-impedance. As the insulating surface is the major part of the device surface, we also synthesized a protein resistant parylene polymer for further ensuring the biocompatibility of electronic implants. Most recently, we utilized the cellselective EDOT polymer and the cell-resistant parylene polymer to construct a fully bio-mimicking OECT array device, which presents a spatially resolved and selective electro-coupling to targeted cells.

18. Dimitrios Koutsouras

14. 50 (O.1.18) - CONTROL ID number X4Y03

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Dimitrios A. Koutsouras received a B.Sc. in Physics and a second B.Sc. in Pharmacy from the Aristotle University of Thessaloniki (Greece). After his M.Sc in Materials Physics and Technology from the same educational institution, he received a Ph.D. in Microelectronics (speciality Bioelectronics) from the École des Mines de Saint-Étienne (France), under the supervision of Prof. George Malliaras. He is currently a postdoc at the Max Planck Institute for Polymer Research in Mainz. His research is focused on the realization of organic electronic devices with applications in bioelectronics and neuromorphics.

Probing the Impedance of a Biological Tissue with PEDOT: PSS-Coated Metal Electrodes: Effect of Electrode Size on Sensing Efficiency

Dimitrios A. Koutsouras, Leona V. Lingstedt, Katharina Lieberth, Jonas Reinholz,
Volker Mailänder, Paul W. M. Blom, Paschalis Gkoupidenis.
Max Planck Institute for Polymer Research

PEDOT:PSS (Poly(3,4-ethylenedioxythiophene):polystyrene sulfonate)-coated electrodes have been widely used to evaluate the integrity of cellular barriers. Nevertheless, an experimental and systematic study of the correlation between tissue integrity and impedance of the sensing device has not yet been conducted. In this work, with the use of impedance spectroscopy, we investigate the way that the impedance ratio of the biological tissue to the recording device affects the recording ability of the latter. Various sized PEDOT:PSS-coated electrodes are employed and the effect of their dimensions to their sensing ability is determined. A simple equivalent circuit is proposed to model the biotic/abiotic ensemble and an analytical expression of the total impedance as a function of frequency is extracted. The study results in a critical impedance ratio of the biological tissue to the sensor, which allows for efficient sensing of the tissue integrity. This work opens new pathways for the realization of improved impedance-based biosensors with optimized sensitivity.

19. Gabriel Gaal

15. 05 (O.1.19) - CONTROL ID number B68PB

Gabriel Gaal
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Currently I am working with deposition and characterization of conductive self-healing thin films via self-assembly Layer-by-Layer deposition technique. Characterization includes electrical transport properties obtained with different doppants, and mechanical properties of the thin films.

Smart materials for flexible, self-healing and conductive interfaces

1 Antonio Riul Jr., 2 Anerise de Barros, 1 Gabriel Gaal, 1 Mawin J. M. Martinez, 2 Carlos A. Avendano, 3 Monica J. Andrade, 2 Manuel Quevedo-Lopez, 1 Fernando Alvarez, 3 Ray H. Baughman

1 University of Campinas, Department of Applied Physics, Institute of Physics Gleb Wataghin, Campinas, SP, BR;
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Self-healing materials inspire the next generation of multifunctional wearables and IoT appliances. Nonetheless, it is crucial to fabricate thin films enabling seamless and conformational coverage irrespective of the complexity of shape and geometry of the surface for electronic skins, smart textiles monitoring body signals, soft robotics, and wearable devices storing energy. Within this context, the layer-by-layer (LbL) technique is a versatile approach for homogeneously dispersing materials into various matrices. Moreover, it provides molecular level thickness control and conformational configuration on virtually any surface. Poly(ethyleneimine) (PEI) and poly(acrylic acid) (PAA) are materials primarily employed in LbL structures due to their intrinsic ability to form restorative composite coatings at room temperature. However, it is still challenging to achieve thin films having high conductivity, good healing strength, and controlled mechanical properties at ambient conditions. Here, PEI and PAA were mixed with conductive materials such as gold nanorods, poly(3,4-ethylene dioxythiophene) polystyrene sulfonate (PEDOT: PSS), reduced graphene oxide and multi-walled carbon nanotubes in distinct LbL film architectures. Electrical (AC and DC), optical (Raman spectroscopy), and mechanical (nano-indentation) measurements were performed to evaluate changes occurring in multilayered structures. Self-healing tests in some composites indicated multiple healings at the same damaged area, without changes in the electrical properties. The results are promising for the manufacture of self-healing conductors by design, as the mechanical properties were balanced with the healing and electrical efficiencies. The formed nanostructures have the potential for creating smart surface layers having unique features that solve technical challenges.

20. Pengcheng Gao

15. 25 (O.1.20) - CONTROL ID number NI7S9

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Dr. Pengcheng Gao is a Dean and Professor Faculty of Materials Science and Chemistry, China University of Geosciences, China. His scientific interest is focused on biomimetic nanopores and nanochannels, Wettability of bionic interfaces, as the first author and corresponding author, has published 10 papers.

Distinct functional elements for outer-surface anti-interference and inner-wall ion gating of nanochannels

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During the decades, widespread advances have been achieved on nanochannels correspondingly, including nanochannel based DNA sequencing, single-molecular detections, smart sensors, energy transfer/storage and so on. However, researchers focus all interests on the contribution from the functional elements (FEs) at the inner wall (IW) of nanochannels, little attention has been paid on the contribution from the FEs at the outer surface (OS) of nanochannels. Herein, we achieve explicit partition of FEOS and FEIW based on accurate regional-modification of OS and IW. Furthermore, the FEIW are served for ionic gating, and the chosen FEOS (hydrophobic or charged) are served for blocking interference molecules into the nanochannels, decreasing the false signals for the ionic gating in complex environments. Furthermore, we also define a composite factor, areas of a radar map, to evaluate the FEOS performance for blocking interference molecules.

21. Mor Maayan

16. 00 (O.1.21) - CONTROL ID number 2DCBM

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I am a Postdoctoral Researcher in the Institutions and Political Economy Research Group at the University of Barcelona. Broadly, my research explores how identity motivates the behavior of voters and legislators. My research interests also include political parties, institutions, democratization, and European and Israeli politics. You can read more about my research here. I received my PhD in Political Science from the University of Wisconsin—Madison in 2019. Before coming to Madison, I received a BA in International Relations and a MA in Political Science from the Hebrew University of Jerusalem, Israel. My dissertation won the Ernst B. Haas Award for the best dissertation on European Politics from the European Politics and Society section of APSA. My previous work on ethnicity and violence appeared in the American Journal of Political Science and won the 2014 AJPS Best Article Award.

Development of antibiofilm surfaces' coating -Pickering Emulsion based

Mor Maayan, Karthik Ananth Mani, Micahl Natan, Ehud Banin, Guy Mechrez
Agricultural Research Organization, Volcani Center and The Hebrew University of Jerusalem.

This research presents bio-friendly and cost-effective antibiofilm coating formulations based on Pickering emulsion templating. The coating does not contain any active material, where its antibiofilm function is based on passive mechanisms, laying solely on the superhydrophobic nature of the coating, and thus highly suitable for food and medical applications. The coating formulation is based on water in toluene or xylene emulsions that are stabilized by commercial hydrophobic silica, with Polydimethylsiloxane (PDMS) that is dissolved in the organic phase. The stability of the emulsions and their structure were studied by confocal microscopy. The most stable emulsions were applied on polypropylene surfaces and dried in an oven to form PDMS/silica rough coatings. The surface morphology of the coatings shows a honeycomb-like structure that exhibits a combination of micron-scale and nano-scale roughness resulting in a superhydrophobic property. The superhydrophobicity of the resulting coatings has been tuned to meet the demands of highly efficient antibiofilm passive activity. The obtained coatings have shown a decrease of one order of magnitude in the E-coli accumulation on the surface, that is a significant value for coating with a passive based antibiofilm coating.

22. Paula E. Colavita

16. 15 (O.1.22) - CONTROL ID number T1K85

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Dr. **Eoin M. Scanlan** is a graduate of the National University of Ireland, Galway. He completed his PhD in synthetic organic chemistry at the University of St. Andrews in 2004. Following postdoctoral work with Prof. Philippe Renaud at the University of Bern, Switzerland and Prof. Benjamin Davis at the University of Oxford, UK, he started his independent academic career in Trinity College Dublin in 2008. He is currently Associate Professor of Organic and Medicinal Chemistry and a PI in the Trinity Biomedical Sciences Institute. He was elected Fellow of Trinity College Dublin in 2016 and was an SFI Career Development Award (CDA) recipient in 2016. He leads an international research team in Trinity College with a focus on the discovery of novel methods for biomolecular synthesis, including peptides, proteins and glycoconjugates and the development of novel therapeutics, diagnostics and biomaterials. He is author of 52 publications and is co-inventor of three patents. He is co-founder and CSO of Glycome Biopharma, a biotech start-up company based in Trinity College.

Dr. **Paula E. Colavita** joined the School of Chemistry at Trinity College Dublin in 2008 and in 2014 was elected College Fellow and promoted to Associate Professor. Her work focuses on understanding chemical reactions and achieving control of interfacial chemical processes at non-crystalline materials, particularly carbons and nanocarbons. Her group has used materials design in order to investigate fundamental processes such as charge transfer and photochemical surface transformations. In turn, molecular level understanding of surface reactivity can be leveraged to create smart interfaces with enhanced functionality. Fundamental understanding of interfacial transformations at carbons is relevant for important applications that are currently under investigation in her group: the development of antifouling coatings, the development of thin-film electrodes for the fundamental study of carbon electrocatalysis for energy conversion, and the rational design of metal/carbon composite materials. Prof. Colavita is the recipient of research funding from Science Foundation Ireland (SFI), the Environmental Protection Agency Ireland (EPA), Irish Research Council (IRC), Enterprise Ireland (EI) and EU FP7 Access funding from Rutherford Appleton Laboratories (UK). She has been a National Science Foundation (NSF) Postgraduate Research Fellow and a visiting researcher at Livermore National Laboratories (USA). She is the author of 77 publications and is co-inventor of three patents. She is co-founder of Glycome Biopharma, a biotech start-up company based in Trinity College.

The activity of **Dr. Eoin M. Scalan and Dr., Associate Professor Paula E.Colavita at The E-MRS Symposia "Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials" IX and Xth Editions – Key Presenters**

Harnessing recognition and lack thereof using functional saccharide layers at electrode surfaces

Alessandro Iannaci, Adam Myles, James A. Behan, Thomas Flinois, Eoin M. Scanlan, Frédéric Barrière and Paula E. Colavita

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Surface-bound glycans hold potential as versatile tools for tailoring the interactions of biomolecules, cells and organisms with solid surfaces via regulation of either specific or non-specific interactions. We have recently focused on the development of precursors and surface modification protocols for the immobilization of carbohydrates based on the chemistry of aryldiazonium cations, with the objective of offering a scalable onestep route to their covalent immobilization onto carbon, metals and polymers. In this work we will discuss applications of functional saccharide thin layers in which we leverage both the ability to regulate non-specific adsorption and the ability to promote affinity binding via bio-recognition of selected glycans. First, we show that, in the absence of specific recognition, we can achieve fouling mitigation in complex biomass matrices. This is of vital importance for instance in electroanalysis and we demonstrate applications of such layers to voltammetric detection at carbon electrodes. Second, we show that use of glycans that are specifically recognised by lectins can be leveraged to promote bacterial recruitment and colonization of surfaces. We demonstrate applications of this approach to electrocatalysis at bioanodes in bioelectrochemical systems such as microbial fuel cells. A selected glycan layer was found to accelerate electrode colonization and fuel cell start-up times. The scalability of aryldiazonium reactions further supports the possibility of extending this strategy to devices with larger total power outputs based on processing of wastewater or other biomass side streams.

23. Yutaka WAKAYAMA

16. 30 (O.1.23) - CONTROL ID number AMO3K

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Prof. Dr. **Yutaka Wakayama** from 2018- Present Deputy Director of MANA, NIMS; 2016 – Present Group Leader, Quantum Device Engineering Group, MANA, NIMS; 2014 - Present Professor, Kyushu UniversityNIMS Graduate Program

Research Interests
Fundamental studies on molecular assemblies in various dimensions and their application to optoelectronic devices: crystalline and electronic structure of molecular superlattice, carrier transport through directed- and self-assembled molecular wires, STM study on two-dimensional supermolecules and molecular quantum dot for single-electron devices.

Professor Dr. **Yutaka Wakayama – Key Presenter at The Symposium O "Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials"**..

KEY PRESENTATION

Functionalized lipid membrane on organic field-effect transistor for ion sensor

Yutaka Wakayama
International Center for Materials Nanoarchitectonics (WPI-MANA), National Institute for Materials Science (NIMS)

A main purpose of this study is to develop a new ultra-highly sensitive sensor in particular for the detection of Cs ions in natural water. The long-time effect of radioactivity of Cs is known to be responsible for dramatic health condition of humans, as well as aquatic plants and animals. Therefore, the detection and monitoring of Cs ions in natural water are necessary. Our sensor is based on an organic field-effect transistor (OFET) structure, which is composed of three main components: (1) organic semiconducting channel with high stability in working with natural water, (2) monolayer lipid membrane working as ultra-thin dielectric layer to allow low operating voltage and high sensitivity, and (3) novel calixarene-crown ether probe for high selectivity to Cs, which is grafted with the lipid layer. In comparison with other conventional methods like ICP-MS, our sensor has many advantages: portability for on-site monitoring, high sensitivity on the femtomolar (pg/l) level of Cs ion and a high selectivity against competing ions, such as K, Na and Cl.

24. Joerg LINDNER

16. 45 (O.1.24) - CONTROL ID number N9E5X

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After a PhD in Physics at Dortmund University in 1989 he joined the University of Augsburg to establish a research team for ion beam physics, electron microscopy and nanomaterials. After "habilitation" in 2000 he became academic director and was appointed professor in Augsburg in 2008.The radiation damage of semiconductors, the formation of buried elemental and compound layers by ion beam synthesis and radiation effects in nanostructures were among the research topics at that time. With his research team and partners from industries he developed patents on the formation and processing of SiC layers. Extended research stays lead him to Hong Kong, Nagasaki and Madrid.
In 2009 he became professor at Paderborn University, where he is heading a group for Nanopatterning, Nanoanalysis and Photonic Materials. He is, in parallel, guest professor at the Ruhr-University in Bochum (Germany), on the board of directors of the Centre of Optoelectronics and Photonics Paderborn CeOPP, founding member and CEO of the Institute of Ultra-Light Weight Construction with Hybrid Systems ILH in Paderborn, and he is serving the European Materials Research Society EMRS (since 1999), where he is heading the European Materials Research Education working group. For EMRS, MRS (USA) and other organizations he (co-) organized more than 12 international conferences and symposia. The present research focus is on selfassembly techniques for the large-area nanopatterning of solid surfaces. Since 2017 he is establishing a regional user center (OWL-AC) for state-of-the-art transmission electron microscopy.
The activity at the E-MRS: The E-MRS Exclusive Committee Member.

Publications- go view, please https://physik.uni-paderbom.de/

KEY PRESENTATION

State-of-the-art analytical (S)TEM investigations of block-copolymer nanopatterned surfaces

Jörg K. N. Lindner
Department of Physics, Paderborn University, Germany; Institute for Lightweight Design with Hybrid Systems ILH, Paderborn; Centre for Optoelectronics and Photonics Paderborn CeOPP, Paderborn.

More than twenty years ago, the mutual investigation of objects on the nanoscale was predicted to lead to the convergence of sciences like biology, chemistry and physics with fruitful applications in various technologies. A blazing example of such objects are regular nanopatterns on solid surfaces which can be easily created on large areas by exploiting the self-assembly of block-copolymers (BCPs). Various patterns with sub-ten to fewten nanometer feature size can be fabricated, depending on the application in mind: While lamellar nanopatterns are candidates for next generation ultra-large-scale integrated electronics, ordered arrays of cylindrical dots or nanocylinders hold promise of enabling the controlled placement of quantum dots, catalysts, and biological entities such as drugs and proteins. Macroscopic surface properties such as optical reflectivities and wettabilities can be precisely tuned by controlling the nanopatterns, allowing to exploit patterned surfaces e.g. in the biomed area. At the same time, all these applications require a detailed knowledge of the morphological and chemical characteristics of nanopatterns. This can be achieved using advanced (scanning) transmission electron microscopy ((S)TEM) in combination with other techniques. The presentation will shed light on recent progress in the characterization of BCP thin films ordered on the nanoscale and their applications in the fields mentioned above.

25. Mariana Tasso

17. 00 (O.1.25) - CONTROL ID number BG2ZN

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Mariana studied Physics (UBA) and Materials Sciences (CNEA-UNSAM), she pursued a specialization in Processing Techniques of Plastic Materials (INTI-UNSAM) and then she worked as a R&D Scientist at TENARIS Siderca prior embarking in a master in Bioengineering at the Politecnico di Milano (Italy). In November 2009, Mariana obtained a Ph.D. in Chemistry (Leibniz IPF; cell-material interactions, biofouling) granted by the TU Dresden (Germany) after which she worked briefly at the Laboratory of Biopolymers (Brandenburgischer TU, Germany) developing a paper-based sensor. Two postdocs followed: one at the Microfluidics Lab (Northeastern University, USA) and another one at the LPEM (ESPCI, France); the first dedicated to the design of microchips for proteomics and for rare cell separation and the second one aiming at developing biofunctional quantum dot nanoparticles for biomedical applications.
Mariana also has four-year teaching experience as a university TA in Mathematics II and Applied Chemistry at the UTN Delta, to which practical scanning electron microscopy courses are added (ESPCI). Mariana has contributed to the scientific training and education of grad and undergrad students in various countries. She has also participated in dissemination and outreach activities organized by the European Union and in a series of talks addressed to college students.

NanoPaint: A Tool for Rapid and Dynamic Imaging of Membrane Structural Plasticity at the Nanoscale

Mariana Tasso, Thomas Pons, Nicolas Lequeux, Julie Nguyen, Zsolt Lenkei, Diana Zala
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Single-particle tracking with quantum dots (QDs) constitutes a powerful tool to track the nanoscopic dynamics of individual cell membrane components unveiling their membrane diffusion characteristics. Here, the nano-resolved population dynamics of QDs is exploited to reconstruct the topography and structural changes of the cell membrane surface with high temporal and spatial resolution. For this proof-of-concept study, bright, small, and stable biofunctional QD nanoconstructs are utilized recognizing the endogenous neuronal cannabinoid receptor 1, a highly expressed and fast-diffusing membrane protein, together with a commercial point-localization microscope. Rapid QD diffusion on the axonal plasma membrane of cultured hippocampal neurons allows precise reconstruction of the membrane surface in less than 1 min with a spatial resolution of tens of nanometers. Access of the QD nanoconstructs to the synaptic cleft enables rapid 3D topological reconstruction of the entire presynaptic component. Successful reconstruction of membrane nano-topology and deformation at the second time-scale is also demonstrated for HEK293 cell filopodia and axons. Named ?nanoPaint,? this superresolution imaging technique amenable to any endogenous transmembrane target represents a versatile platform to rapidly and accurately reconstruct the cell membrane nano-topography, thereby enabling the study of the rapid dynamic phenomena involved in neuronal membrane plasticity.

26. Hoik Lee

17. 15 (O.1.26) - CONTROL ID number ODJFO

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Effective surface functionalization of cellulose nanofiber membranes for the reduction of heavy metal ions in water

Hoik Lee
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We reports thiol-based functionalization chemistry which allows easy and readily scalable modification of cellulose with a variety of complex molecules and polymers under mild conditions, i.e. in any reaction medium, at room temperature, and under ambient atmosphere. In detail, (i) various reactive amines (primary amine and quaternary amine) functionalized cellulose nanofibers by thiol-acrylate and thiol-methacrylate Michael addition, and (ii) copolymer-functionalized cellulose nanofibers by radical based thiol-ene reaction are demonstrated. In addition, i report the demonstration of metal ion adsorption membrane made from electrospun cellulose nanofibers with well-defined surface thiol group. Although some functionalities such as primary amine or carboxylic acid on cellulose nanofibers have been utilized to adsorb various metal ions, one of the most metal-interactive functional group, thiol, has not been extensively investigated as a surface functionality for metal ion removal in cellulose nanofiber membrane. Surface thiol functionality defined on cellulose nanofiber via post-electrospinning modification effectively adsorbed Cu(II), Cd(II), and Pb(II). The adsorption mechanism was investigated thoroughly by kinetic studies: (i) the adsorption isotherm follows Langmuir model where monolayer of the adsorbate was formed with evenly distributed adsorption energy, and (ii) time-dependent adsorption capacities suggest that the chemisorption of each doubly charged metal ion occurs with two thiol groups on the cellulose nanofiber.

27. Oleksandr Ivanyuta

17. 20 (O.1.27) - CONTROL ID number 5YBE6

Oleksandr Ivanyuta
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Dr. **Oleksandr Ivanyuta** completed his studies in Radiophysics and Electronics at the Taras Shevchenko National University of Kyiv, Ukraine in 1993 and afterwards he performed at this University in the laboratory of solid physics his research work to receive the Master of Science Degree (1995) and the Ph.D – Candidate of Physical and Mathematical sciences (2003).
He worked as academic researcher at this Faculty (2001-2004). From September 2004 to March 2011 Dr. O. Ivanyuta has worked as academic researcher, and performed his Habilitation at this Faculty. After the successful Habilitation defense (March 2011) Dr. O. Ivanyuta became Private Docent at the Taras Shevchenko National University of Kyiv. He has profound experience in spectrometry and electro--physic methods as well as in the field of hybrid organometallic physic investigations. He is author /co-author more than twenty articles at refereed journals and co-author two invited chapters at special books (Publ. World Scientific).

Dr. **O. Ivanyuta is The E-MRS Member during 2016 -2019 and worked as Invited Organizer/Chair for Special Sessions on Nanocarbon materials at The E-MRS Symposia 'Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials: VI 2016, VII 2017, VIII 2018 and IX 2019.**
Now, **for this Symposium 2021, Dr. O. Ivanyuta has working Invited Chief of the Working Team.**

Invited Presentation

Supramolecular ds DNA self –assembling: models and electrical characterization

Dr., Docent **Oleksandr Ivanyuta**
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The ds-DNA supramolecules encodes the architecture and function of cells in all living organisms. A theoretical model for the temperature dependence of the electrical conductivity of DNA is presented, based on microscopic models and percolation theoretical arguments. The theoretical results, excluding or including correlation effects, are applied to recent experimental findings for DNA, considering it as a one-dimensional molecular wire. Two strands may come together through hydrogen bonding of the bases A with T (A T) and G with C (GC). The obtained current-voltage curves were compared with the approximated ones for semiconductor, dielectric, and conductor. Its resistance was greater than 10^{14} Ohm in the region of low bias. The enlightenment of this issue could improve long range chemistry of oxidative DNA damage and repair processes, monitoring protein-DNA interactions and possible applications in nano-electronic circuit technology. A smaller current gap was found showing that the electrical conductivity can be somewhat controlled by silver and gold deposition. The ds-DNA template is flexible enough that it can be shaped in many different way's geometrical structures of DNA. Periodic arrays are being examined as the main components in nanoscale memory devices and other electronic applications. The approach to build functional devices has relied on the modification of semiconductor surfaces with DNA. These modified surfaces can then be used to fabricate nanoscale electronic devices on a silicon with carbon monolayer to attach double-stranded DNA. The study of electrical conductivity has crucial importance in the development of biosensors.

28. Monica Marini

17. 20 (O.1.28) - CONTROL ID number WEZRW

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Dr. Monica Marini is a Senior Postdoc at the Department of Applied Science and Technology (DISAT) of the Polytechnic of Turin in Italy. Her research focuses on the mechanical and structural study of nucleic acids and their interactions with other biomolecules (e.g., Rad51 repair protein) and ligands such as chemotherapeutic compounds (Cisplatin), bisintercalants (YOYO-1) and heavy metals (e.g. Nickel) to reveal their connection to diagnosis and disease. To reach this goal, conventional bio -molecular, -chemical and -physical tools are combined with microfabrication, high-resolution TEM imaging and diffraction, Raman spectroscopy, and Laser Doppler Vibrometer.

Selected publications:

[1] S. Stassi*; **M. Marini***; M. Allione; S. Lopatin; D. Marson; E. Laurini; S. Pricl; C.F. Pirri; C. Ricciardi; E. Di Fabrizio, *Nat. Commun.* **2019**, 10, 1690.
[2] **M. Marini**; M. Allione; S. Lopatin; M. Moretti; A. Giugni; B. Torre; E. di Fabrizio, *Microelectron. Eng.* **2018**, 187–188, 39–42.
[3] **M. Marini***; T. Limongi*; A. Falqui; A. Genovese; M. Allione; M. Moretti; S. Lopatin; L. Tirinato; G. Das; B. Torre; A. Giugni; F. Cesca; F. Benfenati; E. Di Fabrizio, *Nanoscale*. **2017**,
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INVITED PRESENTATION

DNA/ligands and superhydrophobic devices: structural studies

Monica Marini1, S. Stassi,1 M. Allione,2 B. Torre,2 A. Giugni,2
M. Moretti,2 C.F. Pirri,1 C. Ricciardi,1 E. Di Fabrizio1
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Super-hydrophobic surfaces (SHS) with regular patterns of micropillars were used to suspend DNA molecules and DNA after its interaction with other compounds such as protein, intercalants, and chemotherapeutic drugs. Briefly, a 5?l droplet of a physiological-compatible solution containing nucleic acids and ligands is pipetted on the SHS. At temperature and humidity-controlled conditions the solution evaporates, and the droplet reduces the volume retracting from one pillar to the following one. The DNA helices follow this movement and the molecules linked to the top of one pillar are pulled to the next in line. With this technique we obtained free-standing self-assembled back ground-free DNA bundles, analysed by several techniques such as Raman Spectroscopy, high-resolution transmission electron microscopy (HRTEM), and Laser Doppler Vibrometer. The strategy shown allows studying the native characteristics of DNA helices and their alterations to the pristine conditions, showing a great potential in medical-oriented research.

29. Thomas J. WEBSTER

8.45 h Key Introduction Control ID number FQJCV

Thomas J. WEBSTER

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Prof. Dr. **Thomas J. Webster**, Editor of Nanomedicine J. (5 year IF= 5.038)
https://www.dovepress.com/journal-editor-international-journal-of-nanomedicine-eic5

Thomas J Webster is the Zafiropoulo chair and professor, chemical engineering at Northeastern University and the Center of Excellence for Advanced Materials Research, King Abdulaziz University, Jeddah 21589, Saudi Arabia. Previously he was associate professor for the Division of Engineering at Brown University and the Division of Orthopedic Surgery at Brown University Medical School. He has degrees in chemical engineering from the University of Pittsburgh (BS, 1995) and in biomedical engineering from Rensselaer Polytechnic Institute (MS, 1997; PhD, 2000). Prof Webster's research addresses the design, synthesis, and evaluation of nanophase materials (that is, materials with fundamental length scales less than 100 nm) as more effective biomedical implants. Prof Webster is the current director of the Nanostructured Biomaterials Laboratory and has completed extensive studies on the use of nanophase materials as implanted materials. His lab group has produced four books, 15 book chapters, 62 invited presentations, 157 literature articles and conference proceedings, 245 conference presentations, and 15 provisional or full patents on the study of nanophase materials and implantable devices. Prof Webster's research on nanophase materials has received attention in numerous recent media publications such as MSNBC News, June 1, 2004; the *Economist*, June 5, 2004; and *Chemical and Engineering News*, Feb 28, pp. 39–42, 2000. He has organized more than 25 symposia at academic conferences highlighting the use of nanomaterials in biological applications. Other honors include: 2000, Karen and Lester Gerhardt Graduate Student Award in recognition of outstanding academic achievement and promise for a successful career, Rensselaer Polytechnic Institute; 2002, Biomedical Engineering Society Rita Schaffer Young Investigator Award; 2004, Purdue University Young Investigator Award from the Schools of Engineering; 2005, finalist for the Young Investigator Award for the American Society for Nanomedicine; and 2004, Early Career Award from the Coulter Foundation. He currently serves as the editor-in-chief of the *International Journal of Nanomedicine*and is on the editorial board of *Biomaterials, American Society for Artificial Internal Organs*, *International Journal of Nanomanufacturing*, and *Journal of Biomedical Nanotechnology*.

Focus of the research: The primary focus of the research is the design, synthesis, and evaluation of nanomaterials for various medical applications. This includes self-assembled chemistries, nanoparticles, nanotubes, and nanostructured surfaces. Medical applications include inhibiting bacteria growth, inflammation, and promoting tissue growth. Tissues of particular interest are bone, cartilage, skin, nervous system, bladder, cardiovascular, and vascular. There is also an interest in anti-cancer applications where nanomaterials can be used to decrease cancer cell functions without the use of pharmaceutical agents. There is also a large interest in developing in situ sensors which can sense biological responses to medical devices and respond in real time to ensure implant success. Lastly, there is an interest in understanding the environmental and human health toxicity of nanomaterials.

Research & Scholarship Interests: design, synthesis, and evaluation of nanomaterials for various medical applications, including self-assembled chemistries, nanoparticles, nanotubes, and nanostructured surfaces

Honors & Awards: American Institute for Medical and Biological Engineers; American Society for Nanomedicine; Biomaterials Science and Engineering; Biomedical Engineering Society; Ernst Strungmann Foundation; International College of Fellows - Biomaterials Science and Engineering

Professor **Thomas J Webster - Invited Presenter of The Symposia "Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials" The I-IX th Editions and Key Presenter, Co-Organizer for The Xth Edition of this Symposium.**

Goodbye Hospitals: Hello Implantable Nanosensors

Thomas J. Webster, Art Zafiropoulo Chair
Department of Chemical Engineering, Northeastern University, Boston, MA 02115, United States

There is an acute shortage of organs due to disease, trauma, congenital defects, and most importantly, age related maladies. While biotechnology (and nanotechnology) has made great strides towards improving tissue growth, infection control has been largely forgotten. Critically, as a consequence, the Centers for Disease Control have predicted more deaths from antibiotic-resistant bacteria than all cancers combined by 2050. Moreover, there has been a lack of biotechnology translation to real commercial products. This talk will summarize how nanotechnology with FDA approval can be used to increase tissue growth and decrease implant infection without using antibiotics. Studies will also be highlighted using nano sensors (while getting regulatory approval). Our group has shown that nanofeatures, nanomodifications, nanoparticles, and most importantly, nanosensors can reduce bacterial growth without using antibiotics. This talk will summarize biotechnology techniques and efforts to create nanosensors for a wide range of medical and tissue engineering applications, particularly those that have received FDA approval and are currently being implanted in humans.

The E-MRS Invited Organizer for FORUM on Tue, 2 June, 2021

NEW FRONTIERS in MULTI-DIMENSIONAL CARBONS :

Invited Chairs:
*Prof.Dr.**Peter SCHARFF**, (TU of llmenau, Germany),*
*Prof.Dr.**Uwe Ritter**, (TU of llmenau, Germany),*
*Dr. **Nikos G. TSIERKEZOS** (TU of llmenau, Germany),*
*Dr.Prof.**Maurizio Prato** (Università di Trieste, Italy)*
*Dr.**Alberto Bianco**. (University of Strasbourg, France)*

Peter Scharff,
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Peter Scharff graduated at TU Clausthal as a chemist. He holds a PhD (1987) and his habilitation followed in 1991 in the field of inorganic chemistry. He worked as a visiting professor at University of Torun, Poland and was appointed associate professor. In 1999 he went as a C4-Professor to TU Ilmenau in the subject of physics. In the time from 2000 till 2004 he was head of the department of chemistry in TU Ilmenau and was selected as rector of this university in 2004. In this position, he is until now.

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Heard for Institute of Chemistry and Biotechnology,
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Skills and Expertise: Nanomaterials, Composites, Fullerenes, CNT/MWCNT, Carbon Fibers, Graphene, Materials Chemistry, Analytical Chemistry, Catalysis, Cyclic Voltammetry, Electrochemical Analysis, Graphene, Electrodes, Carbon, Electrocatalysis, Electroanalytical Chemistry, Electrochemical Impedance Spectroscopy, Electrochemical Sensors. Institute of Chemistry and Biotechnology was established in February 2011 in Technical University of Ilmenau, Faculty of Mathematics and Natural Sciences.The Institute is headed by the chemist Prof. Dr.Uwe Ritter, who is an expert in the field of nano-carbon chemistry. The newly established Institute is specialized in the fields of "Chemistry", "Nanobiosystemtechnic" and "Physical chemistry / Micro reaction technology". Its research focuses on the production of new nanomaterials, particularly carbon nanomaterials and metal nanoparticles, and the use of microreactors in chemical synthesis, cell culture and biological screening. The aim of this research is to design nano-materials using environment friendly micro-methods and to study the effect of drugs, chemicals and pollutants on cells and tissues. In this way the institution is not only a contribution to scientific and technical progress, but it also helps to better control and reducing risks. http://www.welcome-ecolcap.put.poznan.pl/index.php?option=com_content&view=article&id=99&Itemid=93&lang=en

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Dr. **Nikos G. Tsierkezos** completed his studies in Chemistry at the National University of Athens in Greece in 1996 and afterwards he performed at the same University in the laboratory of Physical Chemistry his research work to receive the Master of Science Degree (1999) and the Ph.D. Degree (2002). He worked as a postdoc at the Technical University of Berlin (2002-2004) and as academic researcher at the Humboldt University of Berlin (2004-2007) in Germany as well as academic researcher at the Institute of Organic Chemistry and Biochemistry of Academy of Sciences of Czech Republic in Prague (2007-2008). During the period from September 2008 to December 2016
Dr. N.G. Tsierkezos worked as academic researcher, and at the same time, he performed his Habilitation at the Ilmenau University of Technology in Germany. After the successful Habilitation defense (December 2016) Dr. N.G. Tsierkezos became Privatdozent at the Ilmenau University of Technology.

Maurizio Prato
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Maurizio Prato graduated in Padova, where he was appointed Assistant Professor in 1983. He moved to Trieste in 1992, to become Professor in 2000. In 2015 he joined CICbiomaGUNE, Spain, as Ikerbasque Research Professor. He worked at Yale and University of California, Santa Barbara. He was the recipient of an ERC Advanced Research Grant in 2008 and became a Member of Accademia Nazionale dei Lincei in 2010. His research focuses on the synthesis of new functional materials, for applications in medicine and energy fields, in particular in spinal cord repair, splitting of water, reduction of carbon dioxide into useful chemicals.

The research of the Carbon Bionanotechnology laboratory focuses on the development of functional carbon-based interfaces with enhanced performance in the field of biosensing and diagnostics. Carbon nanotubes (CNTs) and graphene (G) are having a tremendous impact in biosensor design and preparation, in particular as electron transducers in electrochemical devices. In practice, CNT- or Gbased interfaces lead to electrodes with large surface areas, which enhance the surface loading of desired biomolecules and increase the sensitivity.

Prof. Maurizio Prato has made numerous significant scientific contributions to the field of Organic Chemistry applied to Nanosciences by enabling innovative, controlled and reproducible ways to make intractable materials, such as carbon nanotubes and graphene, useful materials for sensing, catalysis, drug delivery, as well as in neurosciences and energy-relevant technologies. In addition, the surfaces possess excellent conductivities with small band gaps, which are beneficial for transferring electrons between the biomolecules and the electrode surface. Besides, the possibility of covalent or non-covalent functionalization of these carbon forms allows for the fine-tuning of the materials intrinsic chemical and physical properties along with the attachment of different recognition motifs (e.g. antibodies or genetic material) or other functional materials. All these properties enhance exponentially the fields of action of the modified electrodes, ranging from the highly sensitive detection of cancer cells to the adsorption of enzymes for improved catalysis.

The group also carries out basic research, studying a wide variety of methodologies for functionalization of carbon-based materials (GBMs), such as supported unsupported graphene, reduced graphene oxide or CNTs, mainly based on new cycloaddition and radical reactions. Of interest is also the preparation of multifunctional GBMs for broader applications, such as the design and preparation of new molecular materials with useful optical, electronic and/or biomedical properties.

Has published more than 600 papers on international peer reviewed Journals, with a total of around 40,000 citations and an h-index of 97. Has been invited to more than 200 conferences and workshops in the last 10-15 years as a plenary or keynote speaker, and has given more than 50 invited talks in Universities or research centers all around the world.

PUBLICATIONS – view on
https://pubs.rsc.org/en/results?searchtext=Author%3aMaurizio+Prato&SortBy=Latest%20to%20oldest&PageSize=25&tab=all

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Editor, Journal Carbon in 2011
https://www.journals.elsevier.com/carbon/editorial-board/alberto-bianco

The research activity of Alberto Bianco is mainly focused on the development of novel vectors based on carbon nanomaterials (carbon nanotubes, graphene, and adamantane) for biomedical applications. We are exploring the multi-functionalization of carbon nanomaterials to link different types of molecules. Our objective is to create multimodal systems not only capable of delivering a therapeutic agent but that can also be tracked and are capable of reaching the desired organ or tissue once modified with a targeting ligand.

Alberto Bianco is also comprehensively studying the health impact and the toxicity effects of functionalized carbon nanomaterials and analyzing the mechanisms of cell penetration, organ biodistribution, routes of elimination, and biodegradability profile. We have recently proposed a new concept based on the functionalization of carbon nanomaterials with specific ligands to enhance their biodegradability. This will allow the design of safer conjugates. We believe that our findings support the development of functionalized carbon nanomaterials as a promising class of carriers in biomedicine.

1 Peter Scharff

09.45 (O.2.1) CONTROL ID number K8JO8

Peter Scharff,
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Peter Scharff graduated at TU Clausthal as a chemist. He holds a PhD (1987) and his habilitation followed in 1991 in the field of inorganic chemistry. He worked as a visiting professor at University of Torun, Poland and was appointed associate professor. In 1999 he went as a C4-Professor to TU Ilmenau in the subject of physics. In the time from 2000 till 2004 he was head of the department of chemistry in TU Ilmenau and was selected as rector of this university in 2004. In this position, he is until now.

Professor Peter Scharff selected for high functions in scientific committees and associations. For about ten years he is chairman of the local chapter Erfurt Ilmenau of the German Chemical Society. Further honorable calls followed with the election as president of the European Carbon Association as well as the senator of the academy of charitable sciences to Erfurt. For his work in the field of graphite and fullerene chemistry, Peter Scharff was honored in 1998 by the Sigri Great Lakes Carbon AG with the "SGL-CARBON-Award". https://www.sglgroup.com/ and https://idw-online.de/de/news?print=1&id=5716

Research activity: Professor Sharff is the author and co-author of more than 250 scientific publications (citations – 3500, h-index 36). He is presented 200 reports at International Conferences and Congresses, specially at The E-MRS Spring Meetings at Focused Sessions on Nanocarbons and Carbon based Biomaterials (31).

Professor **Peter Scharff – Founder The EMRS Symposium 'Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials I 2009 with active Organizer working during next Symposia II –Xth Editions.**

(project) **Carbon materials chemistry and processing for multi-functionality: from graphite to fullerenes-tubes-graphene**

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Graphite is composed of layers of linked carbon hexagons. Between the layers, base metals such as potassium and the like, but also metal compounds can be incorporated, forming new substances (GIV). In hightemperature electrolyses any GIV formed may destroy the carbon electrodes. In other processes, such as the production of graphite foils, a versatile material with outstanding chemical and physical properties, make GIV the crucial intermediate. The electrochemical behavior of GIV opened up the possibility of constructing new high-performance lithium-GIV battery systems. New carbon compounds are found and their reaction behaviour characterized [1]. In addition to graphite and diamond, the group of fullerenes is the third carbon form, which has been experimentally accessible by graphite evaporation in the carbon arc. In the case of graphite evaporation, in addition to the fullerenes, similarly constructed carbon tubes. Buckminsterfullerene is soluble in organic solvents and gives a brownish product in the solid state. Fullerenes with many inorganic and organic substances react to form derivatives that have interesting physical properties and potential applications in the field of superconductivity and nonlinear optics. Fullerene research is an area of research in chemistry, materials science, physics and medicine. [2]. Considering of CNTs, our research is focused on the study of CNT synthesis and growth mechanisms upon thermal chemical vapour deposition, and their electrochemical properties. The functionalization of CNTs, through a chemical attachment of either molecules or functional groups to their sidewalls, is an effective way to improve their solubility and to enhance their physical properties that make them of potentially useful for technological applications ranging from nanoelectronics, sensors and electrochemical devices to composite materials. Graphene is the carbon fourth form: the 2D material graphene, made of carbon atoms arranged in a honeycomb lattice, has its peculiar mechanical, electronic, optical, and transport properties. Many of these features result solely from the symmetry properties of the honeycomb lattice. The chemical modification can be achieved via either covalent or non-covalent interactions. Covalent modifications often destroy some of the graphene conjugation system, resulting in compromising some of its properties. [3].

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2 Uwe Ritter

10.15 (O.2.1) CONTROL ID number VFHMT

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Skills and Expertise: Nanomaterials, Composites, Fullerenes, CNT/MWCNT, Carbon Fibers, Graphene, Materials Chemistry, Analytical Chemistry, Catalysis, Cyclic Voltammetry, Electrochemical Analysis, Graphene, Electrodes, Carbon, Electrocatalysis, Electroanalytical Chemistry, Electrochemical Impedance Spectroscopy, Electrochemical Sensors. Institute of Chemistry and Biotechnology was established in February 2011 in Technical University of Ilmenau, Faculty of Mathematics and Natural Sciences.The Institute is headed by the chemist Prof. Dr.Uwe Ritter, who is an expert in the field of nano-carbon chemistry. The newly established Institute is specialized in the fields of "Chemistry", "Nanobiosystemtechnic" and "Physical chemistry / Micro reaction technology". Its research focuses on the production of new nanomaterials, particularly carbon nanomaterials and metal nanoparticles, and the use of microreactors in chemical synthesis, cell culture and biological screening. The aim of this research is to design nano-materials using environment friendly micro-methods and to study the effect of drugs, chemicals and pollutants on cells and tissues. In this way the institution is not only a contribution to scientific and technical progress, but it also helps to better control and reducing risks. http://www.welcome-ecolcap.put.poznan.pl/index.php?option=com_content&view=article&id=99&Itemid=93&lang=en

Research Activity:

- ***Fullerenes and carbon-nanotubes***
  Production of fullerenes and carbon nano tubes, studies on their formation
  Preparation of catalysts for production of aligned carbon nanotubes
  Exploration of colloidal fullerene solutions for medical applications
  Polymerisation of fullerenes for organic photovoltaics
- ***Electrochemistry***
  Preparation and analysis of fullerene derivatives
  Analysis of formation and degradation mechanisms of fullerene derivates
  Aligned carbon nanotubes as sensor materials
  Electrochemical impedance measurements for detection of biomolecules
  Gas sensors and gas analytics to characterise volatile organic compounds.

Carbon nanotubes (CNTs) are the interesting, new members of the carbon family, offering unique mechanical and electronic properties combined with chemical stability. Since their discovery, much experimental and theoretical research has been directed toward their production, purification, mechanical and electronic properties, and electrical conductivity. Considering the importance of CNTs in the fields of nanoscience and nanotechnology, our research interest is focused on the study of CNT synthesis and growth mechanisms upon thermal chemical vapour deposition, and their electrochemical properties. The functionalization of CNTs, through a chemical attachment of either molecules or functional groups to their sidewalls, is an effective way to improve their solubility and to enhance their physical properties that make them of potentially useful for technological applications ranging from nanoelectronics, sensors and electrochemical devices to composite materials. The group of chemistry, in collaboration with other academic and industrial partners, is involved in production of new carbon compounds and nanomaterials via functionalization of either CNTs (single- and multi-walled) or fullerenes and their potential application in different fields. The scientific goal, is to gain a better understanding of the dependence of the chemical properties of the carbon materials on the extent and the type of functionalization. Specifically, the purpose of our research work is to establish a controlled way for the modification of the electrochemical properties of CNT and fullerenes based on the type and the degree of their functionalization.
To accomplish the aim of the research work, carbon nanomaterials with better designed parameters are produced, functionalized and used further for the construction of new devices.

Services offered

- Production of carbon nano structures and derivatives
- Electrochemical explorations
- Chemical analytics by means of AAS, HPLC, GC/MS, MALDI-TOF, IR, Raman, NMR
- MALDI-TOF analysis of macromolecular substances
  (protein analysis) Synthesis chemistry

Special equipment

- Electrochemistry (cyclic voltammetry, electrochemical impedance spectroscopy)
- Fullerene and nano tube generators
- MALDI-TOF: Measurement of MALDI-TOF spectra of organic and inorganic substances
- AAS, HPLC, GC-MS (gas chromatograph mass spectrometer), IR, Raman, NMR

Professor Dr. Uwe Ritter is The Researchgate Member :212 research publications, 12041 Reads, 1913 Citations with h-index – top referenced researcher.

Prof. Uwe Ritter was The E-MRS Member during 2009 – 2011 having invited presentations for Special Sessions on Nanocarbon materials at The E-MRS Symposia 'Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials:I and II..

Now, for this Symposium 10th 2021, Prof. Uwe Ritter is invited by The Symposium Scientific Committee Board, as the symposium Scientific Committee Member, Invited presenter – Keynote Lecturer for: "New Frontiers in Multi-dimensional Carbons' Forum.

(Key Lecture project-an example) Frontiers in carbons nanomaterials chemistry and functionality: from immobilized MWCNT to nanofibres on substrate

Prof. Dr**. Uwe Ritter**,

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The presentation focuses on a characterization of the production and fundamental parameters of carbon nanomaterials based on nanocarbons from carbon nanotubes powders to multi-walled carbon nanotubes (MWCNTs) and nanofibres on oxidized silicon substrate by means of chemical vapor deposition technique using acetonitrile as carbon source and ferrocene as catalyst [1 -6].The aligned MWCNTs are well-ordered due to their structure, and have the so-called bamboo-like structure. Such bamboo-shaped nanotubes are known to contain nitrogen incorporated into their structure [2.3]. Surface chemistry of these carbon materials using special – COOH, - COO and other functional groups developed. Electrochemistry of nanocarbons is researched for the electrochemical response of MWCNTs-based films towards oxidation of various molecules with biological interest, such as glucose and cholesterol which was tested by means of standard electrochemical techniques. And anodic peak corresponding to oxidation of studied biomolecules was observed on MWCNTs-based electrode. The successful oxidation of investigated biomolecules on MWCNTs-based film in the absence of their enzymes at relative low oxidation potential reveals the great electrocatalytic activity of nitrogen-doped MWCNTs. The enhanced detection ability and sensitivity of fabricated MWCNTs-based film towards investigated biomolecules make them quite suitable for further applications in biosensing. Novel sensing principles on carbon surface have developing. Its determine hybrid nanomaterials nanocarbon surface covered by biomolecules engineering for biomedical nanomaterials.

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3 Nikos G. TSIERKEZOS

10.45 (O.2.3) CONTROL ID number H177F

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Dr. **Nikos G. Tsierkezos** completed his studies in Chemistry at the National University of Athens in Greece in 1996 and afterwards he performed at the same University in the laboratory of Physical Chemistry his research work to receive the Master of Science Degree (1999) and the Ph.D. Degree (2002). He worked as a postdoc at the Technical University of Berlin (2002-2004) and as academic researcher at the Humboldt University of Berlin (2004-2007) in Germany as well as academic researcher at the Institute of Organic Chemistry and Biochemistry of Academy of Sciences of Czech Republic in Prague (2007-2008). During the period from September 2008 to December 2016

Dr. N.G. Tsierkezos worked as academic researcher, and at the same time, he performed his Habilitation at the Ilmenau University of Technology in Germany. After the successful Habilitation defense (December 2016) Dr. N.G. Tsierkezos became Privatdozent at the Ilmenau University of Technology.

Research interests and activity Dr. N.G. Tsierkezos are focused on production and investigation of novel electrochemical sensors based on carbon nanomaterials, with particular emphasis their modification and application for analytical determination of biomolecules. In addition to his skills in applied electrochemistry, Dr. N.G. Tsierkezos has profound experience in mass spectrometry and physicochemical methods as well as in the field of preparative organometallic chemistry.

Research Publications - 113, Reads 4,327, Citations – 1,692, h-index 22 (The Researchgate Member)

Dr. N.G. Tsierkezos **is The E-MRS Member during 2013 -2017 having Invited Presentations and has working as Invited Organizer/Chair for Special Sessions on Nanocarbon materials in Progress into The Symposia 'Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials: III - VII. Now, for this Symposium 10th edition 2021, Dr. N.G. Tsierkezos has working as Invited Presenter for "New Frontiers in Multi-dimensional Carbons" FORUM.**

(project, an example) Electrochemical Biosensorics on doped and functionalized by metal nanoparticles Multi-Walled Carbon Nanotubes

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Nitrogen-doped, nitrogen-phosphorous- doped and boron –doped multi-walled carbon nanotubes, were studied as and nitrogen-doped MWCNT's were decorated with metal nanoparticles (Rh, Pd, Ir, Pt, Au) and applied for simultaneous analysis of ascorbic acid (AA), dopamine (DA), and uric acid (UA). In N-MWCNTs/MNPs composite films three well-separated (not overlapped) oxidation waves were obtained for AA, DA, and UA analytes permitting their simultaneous analysis. Slight dependence of separation between oxidation waves of studied biomolecules on type of nanoparticles used for modification of N-MWCNTs was observed. Consequently, within the MNPs studied, AuNPs appear to improve better the electrocatalytic activity and sensitivity of N-MWCNTs. Namely, on N-MWCNTs/AuNPs the oxidation overpotential of AA decreases significantly and well-separated oxidation waves for interfering AA and DA compounds can be obtained. In addition, on N-MWCNTs/AuNPs well-separated oxidation waves for DA and UA can be observed. Consequently, the detection ability of N-MWCNTs/AuNPs towards simultaneous oxidation of AA, DA, and UA appears to be greater compared to other composite films.

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4 Maurizio Prato

11.05 (O.24) CONTROL ID number NHRNF

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Maurizio Prato graduated in Padova, where he was appointed Assistant Professor in 1983. He moved to Trieste in 1992, to become Professor in 2000. In 2015 he joined CICbiomaGUNE, Spain, as Ikerbasque Research Professor. He worked at Yale and University of California, Santa Barbara. He was the recipient of an ERC Advanced Research Grant in 2008 and became a Member of Accademia Nazionale dei Lincei in 2010. His research focuses on the synthesis of new functional materials, for applications in medicine and energy fields, in particular in spinal cord repair, splitting of water, reduction of carbon dioxide into useful chemicals.

The research of the Carbon Bionanotechnology laboratory focuses on the development of functional carbon-based interfaces with enhanced performance in the field of biosensing and diagnostics. Carbon nanotubes (CNTs) and graphene (G) are having a tremendous impact in biosensor design and preparation, in particular as electron transducers in electrochemical devices. In practice, CNT- or Gbased interfaces lead to electrodes with large surface areas, which enhance the surface loading of desired biomolecules and increase the sensitivity.

Prof. Maurizio Prato has made numerous significant scientific contributions to the field of Organic Chemistry applied to Nanosciences by enabling innovative, controlled and reproducible ways to make intractable materials, such as carbon nanotubes and graphene, useful materials for sensing, catalysis, drug delivery, as well as in neurosciences and energy-relevant technologies.

In addition, the surfaces possess excellent conductivities with small band gaps, which are beneficial for transferring electrons between the biomolecules and the electrode surface. Besides, the possibility of covalent or non-covalent functionalization of these carbon forms allows for the fine-tuning of the materials intrinsic chemical and physical properties along with the attachment of different recognition motifs (e.g. antibodies or genetic material) or other functional materials. All these properties enhance exponentially the fields of action of the modified electrodes, ranging from the highly sensitive detection of cancer cells to the adsorption of enzymes for improved catalysis.

The group also carries out basic research, studying a wide variety of methodologies for functionalization of carbon-based materials (GBMs), such as supported unsupported graphene, reduced graphene oxide or CNTs, mainly based on new cycloaddition and radical reactions. Of interest is also the preparation of multifunctional GBMs for broader applications, such as the design and preparation of new molecular materials with useful optical, electronic and/or biomedical properties.

Has published more than 600 papers on international peer reviewed Journals, with a total of around 40,000 citations and an h-index of 97. Has been invited to more than 200 conferences and workshops in the last 10-15 years as a plenary or keynote speaker, and has given more than 50 invited talks in Universities or research centers all around the world.

PUBLICATIONS – view on
https://pubs.rsc.org/en/results?searchtext=Author%3aMaurizio+Prato&SortBy=Latest%20to%20oldest&PageSize=25&tab=all

key presentation

Biointegrated Interfaces with Carbon Nanostructures

Maurizio Prato

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Nanostructured interfaces can be shaped for the molecular control of physical/chemical adsorption, with enhanced surface area to promote interfacial chemistry, nano-catalysis, and bio-inspired interfaces. For instance, connecting nanostructured materials to biological compartments is a crucial step in prosthetic applications, where the interfacing surfaces should provide minimal undesired perturbation to the target tissue. Ultimately, the (nano)material of choice has to be biocompatible and promote cellular growth and adhesion with minimal cytotoxicity or dis-regulation of, for example, cellular activity and proliferation. In this context, carbon nanomaterials, including nanotubes and graphene, are particularly well suited for the design and construction of functional interfaces. This is mainly due to the extraordinary properties of these novel materials, which combine mechanical strength, thermal and electrical conductivity. Our group has been involved in the organic functionalization of various types of nanocarbons, including carbon nanotubes, fullerenes and, more recently, graphene. The organic functionalization offers the great advantage of producing soluble and easy-to-handle materials. As a consequence, since biocompatibility is expected to improve upon functionalization, many modified carbon nanomaterials may be useful in the field of nanomedicine. In particular, we have recently shown that carbon nanotubes and graphene can act as active substrates for neuronal growth, a field that has given so far very exciting results. Nanotubes and graphene are compatible with neurons, but, especially, they play a very interesting role in interneuronal communication. Improved synaptic communication is just one example. During this talk, we will discuss the latest and most exciting results obtained in our laboratories in these fast developing fields.

5 Alberto Bianco

11.25 (O.2.5) CONTROL ID number CHWMB

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Editor, Journal Carbon in 2011
https://www.journals.elsevier.com/carbon/editorial-board/alberto-bianco

The research activity of Alberto Bianco is mainly focused on the development of novel vectors based on carbon nanomaterials (carbon nanotubes, graphene, and adamantane) for biomedical applications. We are exploring the multi-functionalization of carbon nanomaterials to link different types of molecules. Our objective is to create multimodal systems not only capable of delivering a therapeutic agent but that can also be tracked and are capable of reaching the desired organ or tissue once modified with a targeting ligand.
Alberto Bianco is also comprehensively studying the health impact and the toxicity effects of functionalized carbon nanomaterials and analyzing the mechanisms of cell penetration, organ biodistribution, routes of elimination, and biodegradability profile. We have recently proposed a new concept based on the functionalization of carbon nanomaterials with specific ligands to enhance their biodegradability. This will allow the design of safer conjugates. We believe that our findings support the development of functionalized carbon nanomaterials as a promising class of carriers in biomedicine.

Selected Publications:

1. Martín C, Kostarelos K, Prato M, Bianco A*. Biocompatibility and biodegradability of 2D materials: graphene and beyond. *Chem. Commun.*, **2019**, *55*, 5540-5546. DOI: 10.1039/c9cc01205b
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4. Merino S, Martín C, Kostarelos K, *et al*. Nanocomposite Hydrogels: 3D Polymer-Nanoparticle Synergies for On-Demand Drug Delivery. *ACS Nano* **2015**, *9*, 4686-4697. DOI: 10.1021/acsnano.5b01433

(key presentation)

Multifunctional low-dimension carbon materials

Alberto Bianco

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Graphene and other related materials are considered unique systems for many applications in different fields, including biomedicine. They are offering the possibility of original chemical functionalization and design of complex multifunctional systems that allow further their exploitation in therapy, imaging and diagnosis. In this lecture, I will present the chemical strategies to functionalize graphene-based nanomaterials with appropriate functional groups and therapeutic molecules in view of their biomedical applications. I will present few examples of their use in cancer therapy and imaging. I will also describe how it is possible to enhance the biodegradability and tune the toxic effects of these different materials.

11.55 (O.2.6) CONTROL ID number Q304E

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Fields of Interest and Expertise: Dr. Jun Maruyama is a Chief Research Scientist of Osaka Research Institute of Industrial Science and Technology (ORIST) in Japan. After receiving his PhD from Kyoto University in 1999, he started working in ORIST and has been engaged in the research on carbonaceous electrocatalysts for polymer electrolyte fuel cells, Zn-air batteries, water electrolyzers, redox flow batteries, and porous carbon materials. He currently focuses his interest on the development of 3D-ordered structure and atomic-level metal inclusion in the carbon materials.

Selected publications:

1. J. Maruyama, T. Shinagawa, M. Watanabe, Y. Kashiwagi, S. Maruyama, T. Nagaoka, W. Matsuda, Y. Tsutsui, S. Seki, H. Uyama, Helical pore alignment on cylindrical carbon. *Small*, **2019**, 1905916. (accompanying a back inside cover)

2. J. Maruyama, S. Maruyama, T. Fukuhara, Y. Takao, K. Miyazaki, Nanoscopic combination of edge and flat planes in active site for oxygen reduction and evolution. *Eur. J. Inorg. Chem.*, **2019**, 4117–4121. (accompanying a cover feature, p. 4488)

3. J. Maruyama, T. Amano, S. Inoue, Y. Muramatsu, N. Yoshizawa, E. M. Gullikson, Carbonaceous two-dimensional lattice with FeN_4 units. *Chem. Commun.*, **2018**, 54, 8995–8998.

4. H. Nishihara, T. Hirota, K. Matsuura, M. Ohwada, N. Hoshino, T. Akutagawa, T. Higuchi, H. Jinnai, Y. Koseki, H. Kasai, Y. Matsuo, **J. Maruyama**, Y. Hayasaka, H. Konaka, Y. Yamada, S. Yamaguchi, K. Kamiya, T. Kamimura, H. Nobukuni, F. Tani, Synthesis of ordered carbonaceous frameworks from organic crystals, *Nat. Commun.*, **2017**, 8, 109.

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key presentation

Synthesis of Cylindrical Carbon with Helically Aligned Pores

<u>Jun Maruyama</u>[1], Tsutomu Shinagawa[1], Mitsuru Watanabe[1], Yukiyasu Kashiwagi[1], Shohei Maruyama[1], Toru Nagaoka[1], Wakana Matsuda[2], Yusuke Tsutsui[2], Shu Seki[2], Hiroshi Uyama[3]

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Cylindrical self-assembly of uniform polystyrene nanoparticles (PS NPs) with fructose was carried out by hydrothermal treatment in the presence of both carbon nanofiber and sodium alginate, which is followed by heat treatment in an inert atmosphere [1]. The carbonization generated fructose-derived honeycomblike carbon walls with helically-aligned nanopores left after the polystyrene decomposition (Figure 1). The diffuse reflectance circular dichroism measurements gave peaks with opposite signs for the D- and Lfructose-derived cylindrical carbons. Circularly polarized light sensitivity in transient photoconductivity was confirmed apparently in the carbon-based helical structures. This sensitivity as well as straightforward formation of composites with another component to give helicity showed potential applications of the helically-aligned pores.

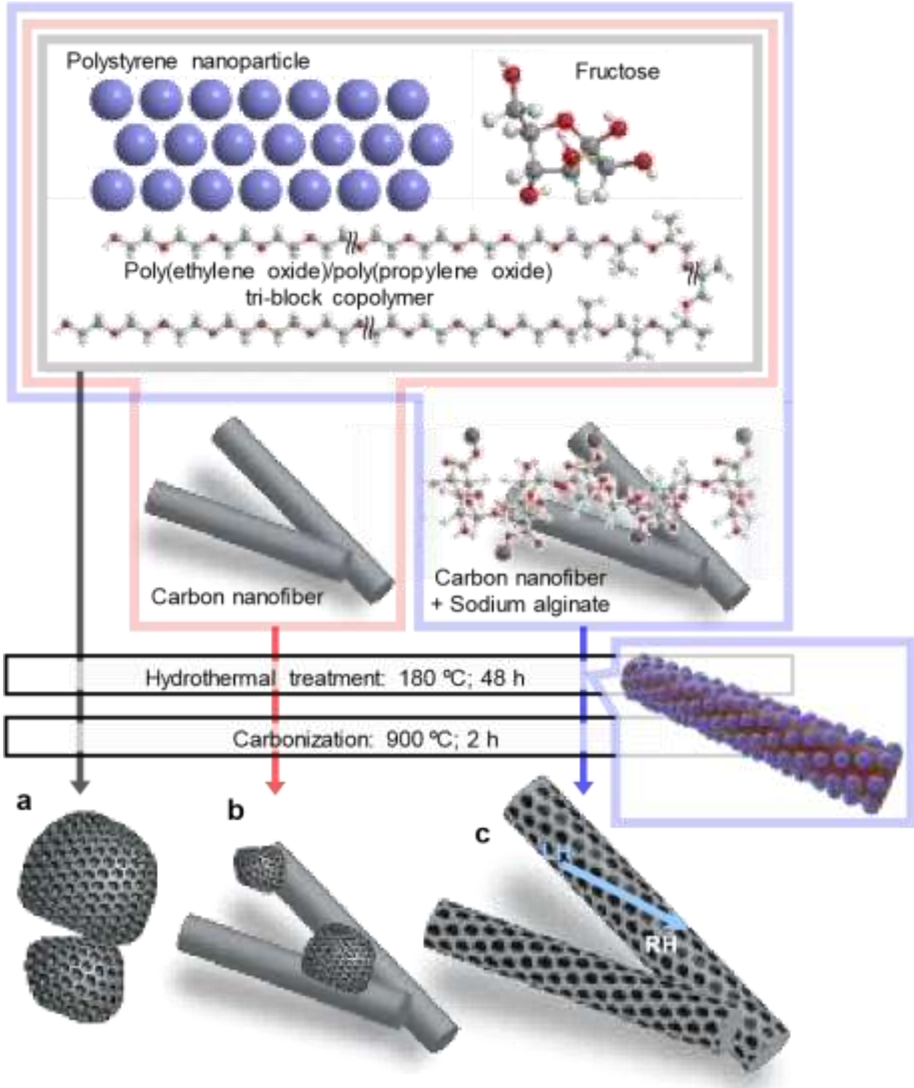

Figure 1. Schematic diagram for producing porous carbons. (a) Irregularly-shaped particles with ordered pores derived from the self-assembly of PS NPs during the hydrothermal treatment and their decomposition. (b) Mixture of porous particles and carbon nanofibers. (c) Cylindrical carbon with helically-aligned pores. Light blue and white arrows on the cylindrical carbon show left- (LH) and right-handed (RH) helices, respectively. Raw materials for products (a) and (b) are shown in black and red enclosures, respectively. Blue enclosures show raw materials for product (c) and intermediate with self-assembled polystyrene nanoparticles and carbon precursor generated during hydrothermal treatment. Sizes in this figure are arbitrary adjusted to show characteristics.

[1] J. Maruyama, T. Shinagawa, M. Watanabe, Y. Kashiwagi, S. Maruyama, T. Nagaoka, W. Matsuda, Y. Tsutsui, S. Seki, H. Uyama, Helical pore alignment on cylindrical carbon. *Small*, **2019**, 1905916.

Application of Cylindrical Carbon with Helically Aligned Pores

Jun Maruyama[1], Tsutomu Shinagawa[1], Mitsuru Watanabe[1], Yukiyasu Kashiwagi[1], Shohei Maruyama[1], Toru Nagaoka[1], Wakana Matsuda[2], Yusuke Tsutsui[2], Shu Seki[2], Hiroshi Uyama[3]

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Potential applications of cylindrical carbon with helically aligned pores were explored based on its concomitant properties [1]. The first example is transient photoconductivity ($\phi\Sigma\mu$), in which ϕ is the photocarrier generation yield and $\Sigma\mu$ is the sum of the charge-carrier mobilities. The flash-photolysis time-resolved microwave conductivity (FP-TRMC) technique was conducted using circularly polarized light excitation at 532 nm. The $\phi\Sigma\mu$ difference at the cylindrical carbon synthesized using D-fructose was observed for the left- (LH) and right-handed (RH) circularly polarized light (Figure 1a). In contrast, no appreciable $\phi\Sigma\mu$ difference was observed for the cylindrical carbon synthesized using the racemic fructose (Figure 1b). These results indicated the potential to form an optoelectronic device that could change the conductivity by the circularly-polarized light.
The second example is the feasibility to form composites with the helical structure due to easy access of the constituents to the pores. Figure 1c shows a TEM image of the composite of the cylindrical carbon and colloidal Au nanoparticles (Au NPs). The composite was formed by immersing the cylindrical carbon in the colloidal Au dispersion in toluene and rinsing with the dispersion medium. The Au NPs were included in most of the pores forming clusters with random orientation of the NPs in each pore, and the Au NPs clusters were helically aligned like stepping stone. This simple formation method enabling the helical alignment of the Au NP clusters implied the potential of the cylindrical carbon as a platform for feasible generation of helical structures, which could be utilized, for example, in generation of a new liquid crystal structure and corresponding novel optical properties, based on recent studies about the interaction between the liquid crystals and nanoparticles, nanorods, and nanowires of Au and Ag.
Another composite with proteins will be shown in this round table discussion. However, more uniform pore alignment is necessary to enhance the potential of the material for applications in various fields and further studies are underway.

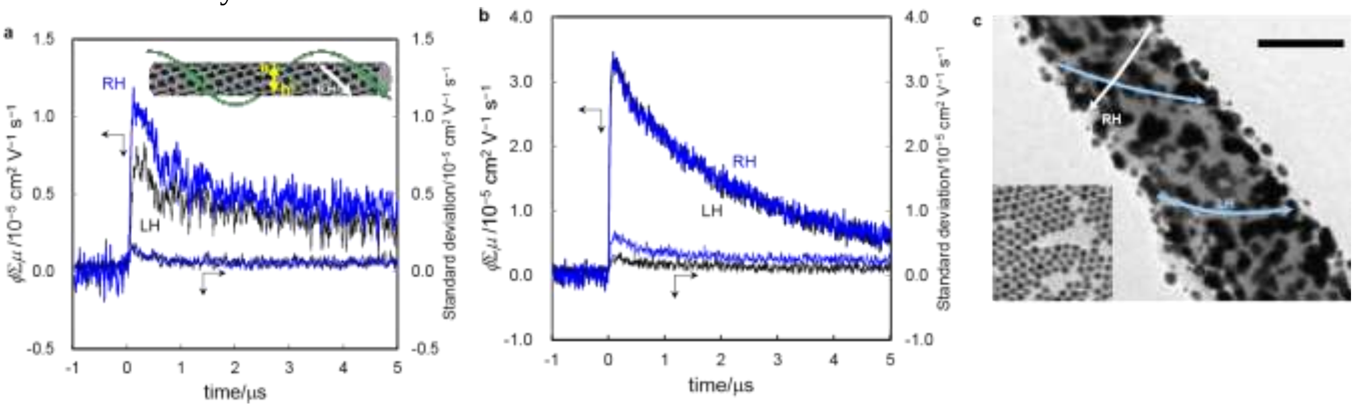

Figure 1. Photoconductivity transients at cylindrical carbon synthesized using (a) D-fructose and (b) fuctose racemic mixture observed in FP-TRMC upon excitation by LH and RH circularly polarized laser light at 532 nm. Mean values and standard deviations of four measurements are shown. Inset shows schematic diagram of photocarrier generation by interaction between helicity of cylindrical carbon (white arrow) and RH circularly polarized laser light (green arrow). (c) Helical alignment of Au NPs loaded on cylindrical carbon. Scale bar is 100 nm. (Inset: TEM image of colloidal Au. Scale bar is 50 nm.)

[1] J. Maruyama, T. Shinagawa, M. Watanabe, Y. Kashiwagi, S. Maruyama, T. Nagaoka, W. Matsuda, Y. Tsutsui, S. Seki, H. Uyama, Helical pore alignment on cylindrical carbon. *Small*, **2019**, 1905916.

7 Aidan Quinn

12.15 (O.2.7) CONTROL ID number P6JNH

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Dr. Aidan Quinn is Head of the Nanotechnology Group at the Tyndall National Institute, University College Cork, Ireland. The group's research programme includes development of chemical synthesis, molecular self-assembly and agile processing routes for scalable fabrication and integration of nanostructures and electrodes. Applications include nanoscale sensing and energy storage, novel graphene-based transparent electrodes and resistive memories. He has published over 60 papers in leading peer-reviewed journals and has filed two patent applications. Aidan has extensive experience in national and international research initiatives. He has participated in research projects within the EU Fourth, Fifth, Sixth and Seventh Framework Programmes' Esprit, Marie Curie, IST, IHP, ICT, NMP, Environment and Security actions. Within FP7, Aidan coordinated the FP7 NMP project FUNMOL, and currently co-ordinates the Environment project ECO-India and the Security project ROSFEN. Nationally, he has participated in the Irish Government Higher Education Authority PRTLI Cycles 1, 3, 4 & 5 Initiatives and currently leads the PRLTI-5 TYFFANI programme. He was an investigator in Science Foundation Ireland's Research Frontiers Programme, a co-investigator in the FORME Strategic Research Cluster and is a funded investigator in the CONNECT SFI Centre. He co-wrote the successful proposal for the Tyndall-led Technology Centre, the Collaborative Centre in Applied Nanotechnology (CCAN). Aidan has acted as a consultant on future research directions in Nanotechnology in Ireland, both as a member of the ICSTI Nanotechnology Task Force and a panel member of the Forfás NanoIreland Technology Assessment Exercise. He lectures (part-time) to undergraduates and postgraduates in the Electrical & Electronic Engineering and Physics departments at UCC on Nanoelectronics (UE6005) and Computational Physics (PY2105), respectively. He has acted as external examiner for Ph.D. candidates in Ireland, the Netherlands and Sweden and has delivered invited tutorial presentations at postgraduate summer schools in Italy and the United Kingdom. Aidan is a member of the Institute of Physics, the American Physical Society, the American Vacuum Society and the Materials Research Society. He has acted as a reviewer for several peer-reviewed journals, including Advanced Materials, IEEE Transactions on Nanotechnology and Small.

Compostable materials for sensing: Rapid laser fabrication of 3D porous graphene from chitosan biopolymer formulations

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There is increasing interest in laser methods for direct-write formation of graphitic and graphene-like carbon structures from polymers, especially under ambient conditions. Applications include direct incorporation of sensing functionality (e.g., electrochemical, temperature, humidity, strain) onto plastic components. While the most popular material for laser-induced graphitization is polyimide, laser-induced graphitization of renewable materials through multiple lasing processes has been explored recently. Chitosan, the second most abundant natural polysaccharide after cellulose, is derived from partial deacetylation of chitin (found in insect exoskeletons, some crustaceans and fungi cell walls). Here we report on site-selective laser-induced formation of porous 3D graphene on flexible and water-soluble chitosan films using low-cost lasers. Raman spectroscopy demonstrates formation of high-quality graphene through the presence of sharp 2D peak. Measured full-width at half maximum intensity values (FWHM) values for the 2D peak were FWHM(2D) < 100 cm-1 (wavenumbers). We have also demonstrated proof-of-principle electrochemical sensing of with two redox systems: outer-sphere $[Ru(NH_3)_6]3$ /2 and inner-sphere $[Fe(CN)_6]3-/4-$. Quasi-reversible Nernstian behavior was observed in cyclic voltammetry measurements for both systems over time scales ~ 20 minutes. Measurements at longer time-scales showed evidence of electrode degradation, consistent with dissolution of the biopolymer substrate. These results showcase the potential of these exciting materials for development of compostable sensors which could be used in sustainable packages for perishable food, e.g., dairy or meat products.

12.30 (O.2.8) CONTROL ID number 9MNCG

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Ravi Silva is the Director of the Advanced Technology Institute (ATI) and Heads the Nano-Electronics Centre (NEC), which is an interdisciplinary research activity. The ATI has over 150 active researchers working on multidiscipline programmes with the NEC being a major research group within the institute. He joined Surrey in 1995. Ravi's secondary education was in Sri Lanka, after which he joined the Engineering Department at Cambridge University for his undergraduate and postgraduate work. He was a recipient of Cambridge Commonwealth Trust Fellowship while at Cambridge and member of Clare College.
From ground-breaking research centres and groups to pioneering academics, outstanding researchers and exceptional contributors to social innovation and environmental impact through enterprise, the University is home to a wide range of award-winning individuals in a variety of fields.
Excellence and ambition are in ample evidence amongst the University's community. The University values all our recipients of Royal honours, highly cited researchers, Fellows of the Royal Society, the Royal Academy of Engineering, and many other Learned Societies, Regius Chair and a myriad of medal and award winners. All such esteem is built on the efforts and strength of the University's community, and we celebrate and champion their achievements below.

Moth-eye and 2D nanocarbon absorbers for strong light-matter interactions, lens mimicking and space structures

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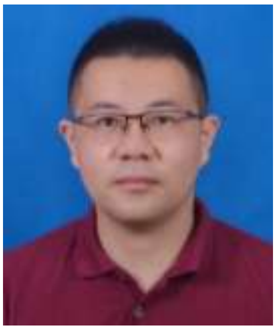
The development of novel optical and optoelectronic devices that harness the properties of two-dimensional (2D) nanocarbons such as graphene and carbon nanotubes (CNTs) depends on the ability to develop techniques that maximise the integration between these nanocarbons and the optical field. These techniques must be compatible, scalable, and also enable a suitable level of control of the light-matter interaction, in order to suit the particular application. Free-standing graphene is only able to absorb a small percentage of light, and thereby remains blind for most optical applications. In addition, current methods to obtain graphene (such as growth by chemical-vapour deposition) require growth temperatures circa 1000°C. As such, many of today?s devices are suited only for a limited range of experimental purposes, but are far from ideal for industrialisation. Here we show the viability of a low-temperature technique that has already proven commercial implementations for the case of multiwalled nanotube growth. We present our in-house development for the purpose of producing graphene layers on the surface of moth-eye nanostructures, to arrive at a super-absorbing surface. With this, we demonstrate the ability to produce strong levels of optical absorption, despite the absorber layer being ultrathin. We also show the means to integrate this nature-inspired structure into a commercial micro-electromechanical device. With this, we demonstrate a complete solution that enables strong light-matter interaction with graphene layers across a wide range of the electromagnetic spectrum, spanning from the ultraviolet to the mid-infrared. Although the details for the absorption mechanism are not fully understood, our computer model shows the moth-eye is able to funnel light along channels that maximise the extent of the interaction of the wave with the graphene absorber. In addition, we further show this growth method can be used to produce patterned arrays of vertically-aligned (VA) CNTS, to produce a nanostructure that feature a highly anisotropic absorption coefficient. The nanostructures can be encapsulated into a transparent polymer, to produce a material with remarkable optical properties. We show examples of this material, and how it can be used to mimic the effect of flat-lensing. When wrapped around curved surfaces, the material features close resemblance to the compound fly?s eye. With this, we conclude in the realization of bio-inspired carbon-based technologies that enhance the coupling to light across a wide range of wavelengths, and thereby opens the field of opto-electronics to these. This development, together with the fabrication capabilities described here, pave the way to new fabrication methodologies for optical devices requiring light management at the nanoscale, and allow us to harness new opportunities that will significantly improve our way of life.



12.45 (O.2.9) CONTROL ID number C5RDG

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Biomimetic Turbinate-like Artificial Nose for Gas Sensing Based on Laser-induced Graphene

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Inspired by the biomimic turbinate-like structure in dog nose of biological olfaction, a biomimetic artificial nose for hydrogen (H2) detection based on 3D porous laser-induced graphene (LIG) decorated with Palladium (Pd) nanoparticles has been developed for room temperature (RT) hydrogen (H2) detection. Compared with a traditional chemical vapor deposition (CVD) method, the 3D porous biomimetic turbinate-like network of graphene was synthesized by simply irradiating an infrared laser beam onto a polyimide (PI) substrate, which could also be further transferred onto another flexible substrate such as polyethylene terephthalate (PET) to broaden its application. The sensing mechanism is based on the catalytic effect of the Pd nanoparticles on the surface of the depleted biomimetic LIG turbinate-like microstructure, which allows the adsorption and desorption of electrons to the nonpolar H2 molecules across the biomimetic artificial nose. Also, the LIG based H2 sensor showed good mechanical flexibility and robustness for potential wearable and flexible device applications.

14.00 (O.2.10) CONTROL ID number 8LZEM

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ANTONINA P. NAUMENKO graduated from the Faculty of Physics of Kyiv State University. Taras Shevchenko, specialty "General Physics" (specialization "Solid State Optics") in 1974. He has been working at the university since 1974: Art. laboratory assistant, engineer, graduate student, junior researcher, researcher, senior researcher. She defended her dissertation "Dynamics of crystal lattices and symmetry of energy states in non-metallic crystals containing pyramidal structural elements" in 1999. In 2007 she received the title of senior researcher. For many years she was a responsible executor of economic contracts, scientific secretary of the programs of the SCSTC of Ukraine. Research interests and research are related to the study of features of structure of ceramics, semiconductor and layered materials by methods of vibrational spectroscopy. Author of 80 scientific papers and 1 invention.

VICTOR A. GUBANOV Taras Shevchenko National University of Kyiv, Faculty of Physics. Ph.D student (1968-71), head educational laboratory of the Department of Experimental Physics (1971-76), Assistant Professor (1977-80), senior lecturer (1981-83), Associate Professor of Experimental Physics (з 1983). In 1975 he defended his candidacy. dissertation “Optical studies of exciton-impurity states and energy spectrum of small impurity centers in hexagonal silicon carbide”. In 1987 he received the title of associate professor. Research interests and research are related to the study of optical properties (spectroscopy) of semiconductor crystals and nanoscale formations - fullerenes and nanotubes, the development of group theory methods for the interpretation of energy spectra of quantum systems. He has more than 180 sciences. publications. Laureate of the State Prize of Ukraine in the field of science and technology (1993).

(key presentation)

Dispersion, Spin-Orbit Interaction and Thin Spin-Depended Splittings of Electronic States in Graphite and Graphene

A.P.Naumenko ,V.O.Gubanov
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The correlation between the vibrational and electron excitation modes in the energy spectra of single-layer graphene and crystalline graphite, as well as the dispersion dependences of those modes, has been studied. The methods of the theory of projective representations of the point and spatial symmetry groups are used for the first time in order to interpret those correlations. The correlations of vibrational and electron excitation spectra and the compatibility conditions for irreducible projective representations in the descriptions of quantum states of graphene and crystalline graphite at various points of their Brillouin zones are determined. For the projective representations of all projective classes belonging to the hexagonal system, standard factor-systems are constructed for the first time. In particular, the factor-systems for electron states are first determined. The results obtained are used to calculate, also for the first time, the correct spinor multiplication tables, i.e. the multiplication tables for elements in double symmetry groups. The developed method is applied to classify all high-symmetry points in the Brillouin zones of single-layer graphene and crystalline graphite with respect to the symmetry type of vibrational excitations.

11 Alexina Ollier

14.20 (O.2.11) CONTROL ID number 75FBR

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ALEXINA OLLIER is Ph.D student of University of Basel supervised by Prof. Ernst Meyer. She has started her PhD program on January 2019 as a part of the Swiss Nanoscience Institute that is a center of excellence for nanosciences and nanotechnology. Her research interests are energy dissipation on 2D materials and quantum systems using the pendulum geometry atomic force microscope. The technique enables to measure energy loss of free-standing graphene sheets.

PhD student Alexina Ollier – **Invited Presenter at The Young Investihator Forum and Frontiers in Multi-dimensional Carbons FORUM, The E-MRS Symposium "Bioinspired and biointegrated materials as new frontiers nanomaterials" Xth Edition at The E-MRS Spring Meeting –Virtual Conference 2021.**

ERSNT MEYER received his Ph.D. at the University of Basel in 1990. The topic of force microscopy on ionic crystals and layered materials was treated in his thesis. After a postdoctoral stay at the IBM Research Center Zurich, he started his present position at the University of Basel. Currently, he is executive board member of the Swiss Nanoscience Institute and is national representative of the COST Action „Understanding and Controlling Nano and Mesoscale Friction" (MP1303). Her research is focussed on scanning probe microscopy investigations of physical processes at surfaces. Friction and energy loss mechanisms on the nanometer scale as well as photovoltaics related experiments are topics of interest. Recent highlights are the frictional properties of graphene nanoribbons and the observation of Majorana bound states on Fe wires deposited on a Pb superconductor.

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Energy dissipation on suspended graphene

Ph.D student **Alexina Ollier1,2**, Marcin Kisiel1, Urs Gysin1 and Ersnt Meyer1

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Understanding nanoscale energy dissipation is nowadays among few priorities particularly in solid state systems. Breakdown of topological protection, loss of quantum information and disorder-assisted hot electrons scattering in graphene are just few examples of systems, where the presence of energy dissipation has a great impact on the studied object [1]. It is therefore critical to know, how and where energy leaks. Pendulum geometry Atomic Force Microscope (pAFM), oscillating like a pendulum over the surface, is perfectly suited to measure such tiny amount of dissipation [2,3], since a minimum detectable power loss is of the order of aW. We report on a low temperature (T=5K) measurement of striking singlets or multiplets of dissipation peaks above graphene nanodrums surface. The stress present in the structure leads to formation of few nanometre sized graphene wrinkles and the observed dissipation peaks are attributed to tip-induced charge state transitions in quantum-dot-like entities. The dissipation peaks strongly depend on the external magnetic field (B=0T-2T). The magnetic field induce Peierls phase that shit the peaks to lower energy. At large magnetic field this shift induces the vanishing of the peaks. [1] D. Halbertal, et.al., Nanoscale thermal imaging of dissipation in quantum systems, Nature539, (2016), 407?410. [2] - B.C. Stipe, et.al., Noncontact Friction and Force Fluctuations between Closely Spaced Bodies, Phys. Rev. Lett.87, (2001), 096801. [3] - M. Kisiel, et.al., Suppression of electronic friction on Nb films in the superconducting state, Nature Materials10, (2011), 119-122.

16. 00 (O.3.2) CONTROL ID number B1NPP

Low frequency noise in suspended graphene

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Understanding nanoscale energy dissipation is nowadays among few priorities particularly in solid state systems. Breakdown of topological protection, loss of quantum information and disorder-assisted hot electrons scattering in graphene are just few examples of systems, where the presence of energy dissipation has a greet impact on the studied object. It is therefore critical to know, how and where the energy leaks. High sensitivity pendulum geometry Atomic Force Microscope (pAFM), oscillating like a pendulum over the surface, is perfectly suited to measure tiny amount of dissipation. The tip position on the sample is controlled with atomic accuracy owing to a tunneling current line and the enhanced sensitivity allows to distinguish between electronic, phononic or van der Waals types of dissipation.

In this work we performed energy dissipation measurments on a suspended graphene sheet at room temperature under UHV. The graphene is deposited on a hole patterned substrate in order to have suspended circular (diameter of 6.5 um) graphene sheet. The experiments allows to invetiguate the phohonic and electronic energy dissipation of the suspended graphene.

14.35 (O.2.12) CONTROL ID number CR5RK

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Khuloud T. Al-Jamal is a Chair of Drug Delivery & Nanomedicine at King's College London (KCL). She was awarded the Overseas Research Award Scheme Scholarship from The University of London (2000-2004) to complete her PhD in Drug Delivery from The School of Pharmacy (currently known as UCL-School of Pharmacy). She was awarded the prestigious CW Maplethorpe Research and Teaching Postdoctoral Fellowship from The University of London (2005-2007) and started her academic career as a lecturer at KCL in 2011. She was awarded the prestigious Royal Pharmaceutical Society Science Award in 2012 in recognition for her outstanding scientific achievements in the field of Nanomedicine. She has developed an extensive experience in designing and developing novel nanoscale delivery systems including dendrimers, liposomes, quantum dots, polymers, viral vectors, chemically functionalized carbon nanotubes and graphene oxide. Her current work involves pre-clinical translation of novel nanomaterialsdesigned specifically for drug, protein, nucleic acids and radionuclide delivery for therapeutic or diagnostic applications.

Khuloud T. Al-Jamal is a senior lecturer in nanomedicine at the Institute of Pharmaceutical Science of King's College London. She received her PhD in drug delivery from The University of London in 2005. In 2012, she was awarded the Royal Pharmaceutical Society Science Award in recognition of scientific achievements in the field of nanomedicine

Publications impact: More than 4004 citations, H-index=33, 151095 Readers

Publications recent :

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2. Renuka Managuli, Julie T Wang, Farid Nazer Faruqu, Varun Kushwah, Sushil Yadaorao Raut, Ajjappla B Shreya, Khuloud T Al-Jamal, Sanyog Jain, Srinivas Mutalik, Asenapine maleate-loaded nanostructured lipid carriers: optimization and in vitro , ex vivo and in vivo evaluations, Nanomedicine, 2019, DOI: 10.2217/nnm-2018-028
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(key presentation)

Application of carbon nanotubes in cancer vaccines: Achievements, challenges and chances

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Tumour−specific, immuno−based therapeutic interventions can be considered as safe and effective approaches for cancer therapy. Exploitation of nano−vaccinology to intensify the cancer vaccine potency may overcome the need for administration of high vaccine doses or additional adjuvants and therefore could be a more efficient approach. Carbon nanotube (CNT) can be described as carbon sheet(s) rolled up into a cylinder that is nanometers wide and nanometers to micrometers long. Stemming from the observed capacities of CNTs to enter various types of cells via diversified mechanisms utilising energy−dependent and/or passive routes of cell uptake, the use of CNTs for the delivery of therapeutic agents has drawn increasing interests over the last decade. Here we review the previous studies that demonstrated the possible benefits of these cylindrical nano−vectors as cancer vaccine delivery systems as well as the obstacles their clinical application is facing.

16. 00 (O.3.1) CONTROL ID number B1NPP

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Publications impact: More than 1400 citations, H-index=27 (Scholar)

Dr. **Paula E. Colavita** joined the School of Chemistry at Trinity College Dublin in 2008 and in 2014 was elected College Fellow and promoted to Associate Professor. Her work focuses on understanding chemical reactions and achieving control of interfacial chemical processes at non-crystalline materials, particularly carbons and nanocarbons. Her group has used materials design in order to investigate fundamental processes such as charge transfer and photochemical surface transformations. In turn, molecular level understanding of surface reactivity can be leveraged to create smart interfaces with enhanced functionality. Fundamental understanding of interfacial transformations at carbons is relevant for important applications that are currently under investigation in her group: the development of antifouling coatings, the development of thin-film electrodes for the fundamental study of carbon electrocatalysis for energy conversion, and the rational design of metal/carbon composite materials. Prof. Colavita is the recipient of research funding from Science Foundation Ireland (SFI), the Environmental Protection Agency Ireland (EPA), Irish Research Council (IRC), Enterprise Ireland (EI) and EU FP7 Access funding from Rutherford Appleton Laboratories (UK). She has been a National Science Foundation (NSF) Postgraduate Research Fellow and a visiting researcher at Livermore National Laboratories (USA). She is the author of 77 publications and is co-inventor of three patents. She is co-founder of Glycome Biopharma, a biotech start-up company based in Trinity College.

Publication

1. Nanocarbon Electrochemistry, Editor(s): Nianjun Yang, Guohua Zhao, John Foord, First published:29 November 2019, |DOI:10.1002/9781119468288 © 2020 John Wiley & Sons Ltd
2. Joana M. Vasconcelos, Federico Zen, M. Daniela Angione, Ronan J. Cullen, Maria J. Santos-Martinez, Paula E. Colavita, Understanding the Carbon–Bio Interface: Influence of Surface Chemistry and Buffer Composition on the Adsorption of Phospholipid Liposomes at Carbon Surfaces, ACS Appl. Bio Mater. 2020, 3, 2, 997-1007
3. Behan, J. A.; Iannaci, A.; Domìnguez, C.; Stamatin, S. N.; Hoque, M. K.; Vasconcelos, J. M.; Perova, T.; Colavita, P. E, Electrocatalysis of N-doped Carbons in the Oxygen Reduction Reaction as a function of pH: N-sites and Scaffold Effects, Carbon, 148, 2019, p224 - 230

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5. Viviana Maffeis, Ruairí O. McCourt, Rita Petracca, Olivier Laethem, Adalberto Camisasca, Paula E. Colavita, Silvia Giordani, Eoin M. Scanlan, Photocatalytic Initiation of Radical Thiol-ene Reactions Using Carbon-Bi2O3 Nanocomposites, ACS Applied Nano Materials, 1, 2018, p4120 - 4126
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Challenges in Dopamine Sensing at Carbon Electrodes: Dopamine Adsorption Properties and Electrode Fouling at Physiological pH

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Due to its role in the operation of nervous response and renal, hormonal and cardiovascular systems, quantitation of dopamine (DA) in vivo has received great interest. Electrochemical sensing allows detection of nanomolar dopamine concentrations, and carbon-based electrodes are particularly suitable for this application due to their biocompatibility, ease of manufacture, low cost and functionalisation potential. However, carbon electrode current responses are influenced by DA-surface interactions and suffer from fouling by adsorption and accumulation of oxidation by-products, collectively called ‘polydopamine’ (PDA). Herein, we present a study of DA adsorption at carbon electrodes functionalised with N-/O-groups and the fouling properties thereof at physiological pH. Electrodes with smooth, reproducible morphologies, tuneable functionality types and concentrations and, crucially, tuneable sp3/sp2 ratios were synthesised via sputtering deposition and thermal/electrochemical treatments. The influence of surface graphitisation and surface chemistry was investigated using cyclic voltammetry and x-ray photoelectron spectroscopy to rationalise the connection between DA adsorption and electrode fouling, with preliminary AFM studies characterising the surface roughness. The ability of fouled surfaces to recover their sensing ability was also evaluated using acid cleaning and repeated fouling, to elucidate factors which promote/inhibit PDA adsorption. Our results suggest effective methods for optimising carbon electrode composition as a means of minimising fouling in DA electroanalysis.

16. 00 (O.3.4) CONTROL ID number GHQZP

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Phanee Manganas is a post-doctoral researcher at IESL-FORTH. She received her BSc in Biology (Specialisation in Biomolecular Sciences and Biotechnology) and MSc in Molecular Biology and Biomedicine from the University of Crete. She then continued her studies at the University of Glasgow (UK), from where she obtained a PhD in Biochemistry and Molecular Biology, while working on oxidative regulation mechanisms in the mitochondrial intermembrane space. Since joining the team of the Ultrafast Laser Micro- and Nano-Processing (ULMNP) group, she has been interested in interpreting the effect of 3D architecture on various cellular processes – including growth, survival, adhesion and differentiation – from a molecular and biochemical viewpoint, in order to understand the ways in which cells interact with the fabricated environment.

Cytotoxicity assessment of reduced graphene oxide and laser micropatterned structures for ocular drug delivery applications

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Glaucoma is the second most common cause of blindness worldwide [1]. It is estimated that in 2020, 80 million people worldwide had some form of glaucoma. Glaucoma is a group of ophthalmic diseases that lead to progressive damage of the optical nerve responsible for the transfer of information in the brain. With the appropriate treatment, glaucoma can be cured. The reduction of intraocular pressure (IOP) is associated with slowing down the risk of disease progression to a great extent. Nowadays, the majority of people with glaucoma use eye drops to tackle the problem. The biggest hurdle arising from their continued use is that many patients do not comply with their treatment. In attempting to address the above problem, various drug delivery systems have been developed to ensure consistent administration of the appropriate drugs [2], but have failed to overcome significant limitations, such as the delivery of hydrophobic drugs and their high cost. Therefore, it is necessary to develop new and innovative systems, including features such as: i) the use of biocompatible materials (graphene oxide and biodegradable polymers) with the appropriate biological, electrical and mechanical properties; ii) the appropriate glaucoma drugs; iii) a controlled pharmacokinetic mechanism based on the use of ultrafast lasers for micro-nano patterning of the ocular devices; and iv) the inter-relation of the intraocular pressure and controlled drug release rate by the ocular patch. Ultrafast pulsed laser irradiation is considered a simple and effective microfabrication method to produce structures controlling the structure geometry and pattern regularity [3]. Such structures have been shown to enhance cellular growth and alignment (eg in neuronal cells [4,5]). Additionally, due to their biocompatibility, graphene and its derivatives have been used in a number of different biomedical applications, such as biosensors, tissue engineering and drug delivery systems. In this study, graphene oxide and a series of reduced graphene oxide preparations, prepared using green reducing agents, were tested for cytotoxicity, as well as better drug deposition and release. The structures were characterised in terms of their homogeneity, morphology and optical properties. The cytotoxicity of the functionalised structures with a fibroblast cell line and with corneal cells is further investigated. This research has been co?financed by the European Union and Greek national funds under the calls RESEARCH CREATE INNOVATE (project code: ?1EDK-02024, MIS:5030238), NFFA (EU H2020 framework program) and H2020 FET-open (project name: Biocombs4NanoFibers, Grant Agreement No. 862016). [1] Blomdahl S. et al., Acta Ophthalmol Scand 1997; 75 (5): 589?591. [2] Knight, O.J. & Lawrence, S.D., Curr Opin Ophthalmol. 2014; 25(2):112-7. [3] Ranella A. et al., Acta Biomaterialia 2010; 6: 2711. [4] Simitzi C. et al. Biomaterials. 2015; 67:115-128. [5] Angelaki D. et al., Mater. Sci. Eng. C, 2020; 115:111144

15 Oleksandr Ivanyuta

16. 00 (O.3.5) CONTROL ID number C377J

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Dr. **Oleksandr Ivanyuta** completed his studies in Radiophysics and Electronics at the Taras Shevchenko National University of Kyiv, Ukraine in 1993 and afterwards he performed at this University in the laboratory of solid physics his research work to receive the Master of Science Degree (1995) and the Ph.D – Candidate of Physical and Mathematical sciences (2003).
He worked as academic researcher at this Faculty (2001-2004). From September 2004 to March 2011 Dr. O. Ivanyuta has worked as academic researcher, and performed his Habilitation at this Faculty. After the successful Habilitation defense (March 2011) Dr. O. Ivanyuta became Private Docent at the Taras Shevchenko National University of Kyiv. He has profound experience in spectrometry and electro--physic methods as well as in the field of hybrid organometallic physic investigations. He is author /co-author more than twenty articles at refereed journals and co-author two invited chapters at special books (Publ. World Scientific).

Dr. O. Ivanyuta **is The E-MRS Member during 2016 -2019 and worked as Invited Organizer/Chair for Special Sessions on Nanocarbon materials at The E-MRS Symposia 'Bioinspired and Biointegrated Materials as New Frontiers Nanomaterials" next editions: VI 2016, VII 2017, VIII 2018 and IX 2019.**
For these Symposia 10th edition - Symposium O 2021, Dr. O. Ivanyuta has working as Invited Chief Working Team for this FORUM Virtual.

Botanic DNA - templated molecules C_{60} in a layered film on silicon oxide surface in photovoltaic chip

N. Tsierkezos, U. Ritter, P. Scharff (2), O.Ivanyuta, E. Buzaneva (1)

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The trend of organic thin films research toward conductivity - photovoltaic chip has allowed using the/films from ds-DNA templated naocarbons molecular layers obtained by biotechnology. On the base of the review deals to analysis of electronic properties, photosensitivity, photoelectron moving force (PhEMF) and their stability under UV-vis irradiation for nanocarbon films with DNA molecules, we selected the thin films from silf-assembled layers of fullerene C60/C60 oxygen derivatives/ds-DNA on silicon for the detail investigations. The developing model of conductivity, and photovoltaic effect, in these layerss takes in account that C60 molecule is an acceptor of electrons. And the effect enhances with formation of C60 oxygen derivatives: 6-5 open fullerene C60 as we showed in first time [1].The evidence of self-assembling of these layers with (ds-DNA) in the nanostructured films on Si surface were obtained on the base of STM and SEM images of the films with the assembles (8-10 and 30-40 nm in diameter).The conductivity of the films was modulated by diode characteristics of fullerene C60/6-5 open fullerene C60 and C60/ ds-DNA contacts for n-type semiconductors fullerenes witch were determined by STP - tunneling spectroscopy. The discovered dynamic behavior of photosensitivity to 200-400 nm irradiation and PhMF appearance (0,25-0,37 eV) at 400-1000 nm irradiation (during 10 min - 1 h) of these films with several structures allow to consider these nanostructured layers/films as conducting/ photovoltaic chips. The examples for an application of these chips based on conductivity/photovoltaic models which have been developed for organic nanostructured thin films from C60 fullerene/ds-DNA molecular assemblies are discussed. Ref.,{1] E. Buzaneva, A. Gorchinskiy, P. Scharff, K. Risch, A. Nassiopoulou, C. Tsamis, Yu. Prilutsyy, O. Ivanuta, A. Zhugayevych, D. Kolomiyets, A. Veligura, DNA, DNA/Metal Nanoparticles, DNA/Nanocarbon and Macrocyclic Metal Complex/Fullerene Molecular Building Blocks for Nanosystems: Electronics and Sensing, In Book Frontiers of multifunctional integrated nanosystems, Eds: Eugenia Buzaneva and Peter Scharff, NATO Science Series, II-Mathematics, Physics and Chemistry?Vol 64, Kluwer Akademic Publishers, Dordrecht, 251-276, 2004.

The C_{60} fullerol characterization for advanced applications in biological systems: the UV-vis spectroscopy and MALDI mass spectrometry study

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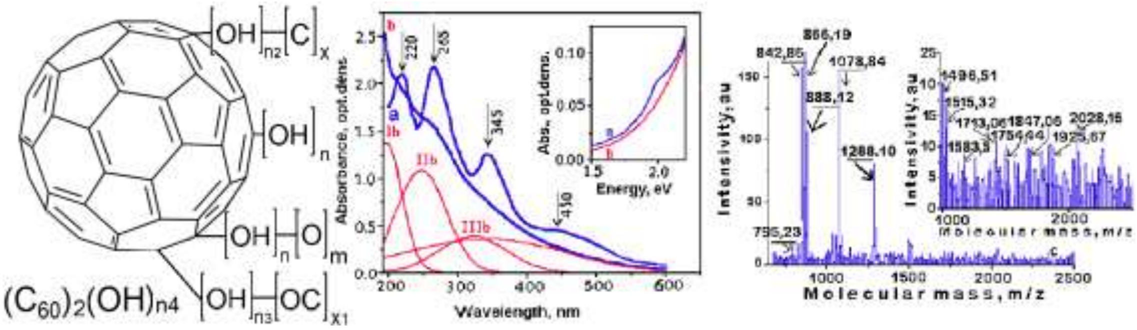
The medical $C_{60}(OH)_{24-26}$ fullerol nanoparticles and their aqueous solutions in the compare to the C_{60} , oxidized C_{60} aqueous solutions and the photochemically derivatised C_{60} nanocrystals in aqueous suspension were tested by the UV-vis absorbance spectroscopy in (200-800)nm range and the matrix - assisted laser desorption/ionization (MALDI) mass spectrometry in molecular masses (650– 2500 m/z) range. In this respect, $(OH)_n$, $(O)_m$, $(OC)_x$, $(C)_y$ at the fullerene core and the fullerol clusters with hydrogen bonds between two molecules were detected using analysis of electron transitions around 265, 340 nm, in the 400–700 nm range, and molecular masses in the 800–2250 m/z range. Fullerol aqueous solutions as containing fullerene molecules with these atoms groups, single atoms at the core and linked by hydrogen bond in cluster were characterized. These results are important for the optimization of contains for OH, OC groups and O, C atoms at the fullerene core with the aim to control of fullerol photoexcited electron transitions in photoactivite probe for biological systems.



Groups and single atoms $(OH)_n$, $(O)_m$, $(OC)_x$, $(C)_y$ at the fullerene core and the fullerol clusters with hydrogen bonds between two molecules were detected using analysis of electron transitions around 265, 340 nm in the 400–700 nm range, and molecular masses in the 800–2250 m/z range. It is found that general electron transitions are around 265 nm similar to the transition in the fullerene and at 415, 493 nm which respect to HOMO-LUMO band gaps as we assume for the fullerol with and without (O)m at the core. These results are important for the optimization of contains for OH, OC groups and O, C atoms at the fullerene core with the aim to control of fullerol photoexcited electron transitions in photoactivite probe for biological systems.

Keywords: fullerol; photoactivite probe; spectrometry; aqueous solution

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Dr. Romana Schirhagl in 2011 ETH-Zurich postdoctoral position in the group of Prof. Degen at the Department of Physics, (Biosample preparation for nanoMRI and surface chemistry of diamond for magnetic imaging purposes) Since 2018 University of Groningen University Medical Center Groningen, Department of BioMedical Engineering as Tenured Adjunct Professor

Quantum Sensing to investigate intracellular free radical response upon bacterial infections by using nanodiamond-bacteria conju

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Low concentrations of reactive oxygen species (ROS) mediate various signaling processes in phagocytic cells (e.g. macrophages) when infected by bacteria [1]. Production of a suitable probe is needed to measure these events. However, most methods used to investigate the intracellular ROS share the same problems, including photobleaching, low sensitivity, lack of spatial and temporal resolution [2]. Here, we elucidate the utility of diamond magnetometry for studying the transient free radical response of macrophages upon Staphylococcus aureus (S. aureus) infection, without influence on the intracellular redox reactions or enzymatic activity. Nitrogen-Vacancy (NV) defect centers in diamond crystals can detect magnetic noise nearby (< 10 nm), which is produced by the spin of unpaired electrons of free radicals3. Diamond magnetometry is specific for paramagnetic ROS also called free radicals (for example nitric oxide, superoxide anion radicals, or hydroxyl radical) [4]. They are particularly important since they are the most reactive ROS[1,5,6]. In this study, we report the formation and characterization of nanodiamond-bacteria conjugates, S. aureus-FNDs. By using these conjugates, we can optically monitor the transient free radicals in phagosomes via measuring the spin-lattice relaxation (T1) of NV defects after macrophages internalized the conjugates. In conjunction with appropriate control groups, bacteria-FNDs conjugates appear to be a powerful tool for unraveling bacteria-infected pathways and pathogenesis that involve free radicals. References [1] Dupré?Crochet, S.; Erard, M.; Nü?e, O., ROS production in phagocytes: why, when, and where? Journal of leukocyte biology 2013, 94 (4), 657-670. [2] Nüsse, O., Biochemistry of the phagosome: the challenge to study a transient organelle. The Scientific World JOURNAL 2011, 11. [3] Perona Martinez, F.; Nusantara, A. C.; Chipaux, M.; Padamati, S. K.; Schirhagl, R., Nanodiamond Relaxometry-Based Detection of Free-Radical Species When Produced in Chemical Reactions in Biologically Relevant Conditions. ACS Sensors 2020. [4] Morita, A.; Nusantara, A. C.; Martinez, F. P. P.; Hamoh, T.; Damle, V. G.; van der Laan, K. J.; Sigaeva, A.; Vedelaar, T.; Chang, M.; Chipaux, M., Quantum monitoring the metabolism of individual yeast mutant strain cells when aged, stressed or treated with antioxidant. arXiv preprint arXiv:2007.16130 2020. [5] McCord, J. M.; Fridovich, I., The utility of superoxide dismutase in studying free radical reactions I. radicals generated by the interaction of sulfite, dimethyl sulfoxide, and oxygen. Journal of Biological Chemistry 1969, 244 (22), 6056-6063. [6] Wang, Q.; Ding, F.; Zhu, N.; Li, H.; He, P.; Fang, Y., Determination of hydroxyl radical by capillary zone electrophoresis with amperometric detection. Journal of Chromatography A 2003, 1016 (1), 123-128.

17 Katalin Balazsi

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Dr. **Katalin Balázsi**, material scientist, graduated in 2002 (Slovak Technical University, Bratislava). She got her PhD in 2005 from the Slovak Technical University, Bratislava. She is leading the team with 40 researchers, engineers and technicians of Thin Film Physics Department of Institute for Technical Physics and Materials Science, Centre for Energy Research (MTA EK). She has a long-time expertise on field of transmission electron microscopy. She is author/co-author of 100 scientific papers with 800 independent citations. She was a visiting professor at Institute of Materials Science, Slovak Academy of Sciences Visits in 2012.
She is a president of Assosiation of Hungarian Woman in Science (2018-2021), secretary of the Hungarian Society for Material Sciences (2013-2020), secretary and treasurer of the Hungarian Microscopic Society (2018-2022), council member of European Ceramic Society (2018-2020), Delegate in Nanometer Structure Division of IUVSTA (2013-2019). Dr. Balázsi is working as PI in several national and EU FP7, M-ERANET projects.

Publications: https://www.mendeley.com/profiles/katalin-balazsi/publications/ Selected Publications:

1. Lamnini S, Károly Z, Bódis E, Balázsi K, Balázsi C, Influence of structure on the hardness and the toughening mechanism of the sintered 8YSZ/MWCNTs composites, Ceramics International (2019) 45(4)
2. Jenei P, Balázsi C, Horváth Á, et al. The influence of carbon nanotube addition on the phase composition, microstructure and mechanical properties of 316L stainless steel consolidated by spark plasma sintering, Journal of Materials Research and Technology (2018)
3. Lamnini S, Fogarassy Z, Horváth Z, et al. The role of the attrition milling on the grain sizeand distribution of the carbon nanotubesin YSZ powders, Boletin de la Sociedad Espanola de Ceramica y Vidrio (2018)

Influence of structure on the hardness and the toughening mechanism of the sintered 8YSZ/MWCNTs composites

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Composites consisting of 8 mol.% yttria-stabilized zirconia (8YSZ) and 1 wt%, 5 wt% and 10 wt% multiwall carbon nanotubes (MWCNTs) have been prepared by attrition milling and spark plasma sintering (SPS). The effect of sintering temperature and MWCNT content on the microstructural features including apparent density, phase transition, crystal size and mechanical properties were investigated. The phase transformation during the sintering process was observed with X-ray diffraction. The MWCNT stability was investigated by Raman spectroscopy. Vickers hardness and indentation fracture toughness of 8YSZ/MWCNTs composites were evaluated and compared with reference 8YSZ composite. The crack propagation mechanisms of composites were determined. MWCNT pull-out, crack bridging and crack deflections were found and constituted a key factor of fracture toughness enhancement in the composites with MWCNT addition.
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Prof. Dr. Dirk M. Guldi, Chair of Physical Chemistry I, has been elected to the European Academy of Sciences. EURASC is an independent international organisation of renowned scientists who conduct cutting-edge research and promote the development of advanced technologies, particularly with regard to their role in social and economic developments.
Prof. Dr. Guldi is one of the most frequently cited chemists worldwide. In 2004, after almost 10 years at the Radiation Laboratory of the University of Notre Dame / USA, he accepted the offer of the W3-Professorship for Physical Chemistry I at FAU.
The Guldi lab and its network are among the leaders in worldwide research on solar energy conversion and have experience not only in "advanced photon and charge management", but also in the synthesis of tailor-made materials and molecular modelling. The Guldi are creator investigator of novel class functional materials – the carbon nanocolloids.
For the publications, impact h = 100 go to view https://www.chemistry.nat.fau.en/person/dirk-guldi/

KEY PRESENTATION-LECTURE

(project) (key presentation) **Optical processes in carbon nanocolloids**

Dirk M.Guldi

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Light is the original source of most energy on Earth, allowing us to see and live. It is also central to many technological processes. Therefore, innovative nanomaterials that can absorb, generate, or further exploit light are of utmost importance, having the potential to become pervasive in our lives. This is the case for carbon nanocolloids, which are ubiquitous, biocompatible, and inexpensive, which are the three important prerequisites for their broader application in different fields of technology. Yet, despite intense research for a number of years, a unifying picture describing the excited-state properties of these nanocolloids is lacking. It is possibly the time when this approach should be reversed, embracing the inherent diversity of excited states in carbon-based particles, which enable us to focus on engineering their optical properties based on their structural variability. A deeper understanding of the molecular features of carbon nanocolloids is emerging as one of the key factors, which will allow unlocking excited-state processes appearing out of reach, unfolding the full potential of optical processes in this potent family of nanomaterials.

19 Christina Schütze

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The aim of Christina Schütze's work is to provide the nanoparticles with fluorescent properties and thus to make their path into the cell membrane visible and to clarify the mechanism of interaction. This could mean that the effectiveness of drugs could be tested much better in the future and that huge progress could be made in research in the fight against cancer and HIV diseases. Working group: Prof. Dr. Peter Scharff / apl. Prof. Dr. Uwe Ritter
Topic: "Development of water-soluble organic nanocarbon compounds for applications in cancer therapy and organic photovoltaics"

Research interests and activity Nanocarbon chemistry (fullerenes, nanotubes), Synthesis of fullerene-based cytostatics, Development of fullerene-based donor-acceptor compounds for organic photovoltaics, Surface functionalization with dyes and dye synthesis, Synthetic organic chemistry, Cycloaddition reactions, amidations, oxazolidinone chemistry, Elucidation of structure-activity relationships in membranes, Analytics (NMR, MS, IR, Raman, UV / Vis, HPLC, GC / MS, fluorescence spectroscopy, fluorescence microscopy, elemental analysis), Inorganic Synthesis, Coordination of laboratory staff, Internship management and conception University teaching

ABSTRACT FOR INVITED PRESENTATION

The E-MRS Symposium O Work Team
On behalf of The E-MRS Symposium O Scientific Committee

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Frank Schwierz received the Dr.-Ing. and Dr.-habil. degrees from Technische Universität (TU) Ilmenau, Ilmenau, Germany, in 1986 and 2003, respectively. Together with partners from academia and industry, he was involved in the development of the fastest Si-based transistors worldwide in the late 1990s, of Europe's smallest MOSFETs in the early 2000s, as well as of the fastest GaN HEMTs on Si and the fastest GaN tri-gate HEMTs worldwide in the 2010s. His recent work on 2-D materials made a major contribution to the current understanding of the merits and drawbacks of graphene transistors. He is currently a Privatdozent with TU Ilmenau and the Head of the RF and Nano Device Research Group. He is conducting research projects funded by the European Community, German government agencies, and the industry. He has authored or co-authored 270 journal and conference papers including 45 invited/keynote papers. He has authored two books Modern Microwave Transistors–Theory, Design, and Performance (John Wiley & Sons, 2003) and Nanometer CMOS (Pan Stanford Publishing, 2010) and edited the book Two-Dimensional Electronics–Prospects and Challenges (MDPI, 2016). His current research interests include novel device and material concepts for future electronics, particularly interested in 2-D electronic materials.,Dr. Schwierz serves as a Distinguished Lecturer of the IEEE Electron Devices Society and an Editor of the IEEE TRANSACTIONS ON ELECTRON DEVICES. He is one of the key contributors to the Emerging Research Devices Technology Working Groups of the 2013 and 2015 ITRS editions.

Recent Key Publications

1. F. Schwierz, Boron nitride switches for 5G and beyond, Nature Electronics, 3(8), 444-445. (2020).
2. Y. Y. Illarionov, T. Knobloch, M. Lanza, D. Akinwande, M. I. Vexler, T. Mueller, M. Lemme, G. Fiori, F. Schwierz, and T. Grasser, Insulators for 2D nanoelectronics: The gap to bridge, Nature Communications 11, 3385 (2020)
3. F. Schwierz and J. J. Liou, Status and future prospects of CMOS scaling and Moore's Law – A personal perspective, Invited Paper, Latin American Electron Devices Conference LAEDC, San Jose, Costa Rica (2020).
4. F. Schwierz, 2D Electronics – Opportunities and Challenges, IEEE EDS Distinguished Lecture, IEEE Germany Chapter, Giessen, Germany (2020).
5. F. Schwierz, 2D materials and 2D electronics – Prospects, merits, and limitations, Invited Seminar, Slovak University of Technology (STU), Bratislava, Slovakia (2019)
6. F. Schwierz, 2D electronics – Opportunities and challenges, IEEE EDS Distinguished Lecture, IEEE ED/SSC New York Chapter, Columbia University, New York City, NY, USA (2019).

KEY PRESENTATION – LECTURE

(project) (key presentation- lecture). **2D MATERIAL GRAPHENE and 2D ELECTRONICS**:

STATUS and PROSPECTS

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