NETPORE

4th SUMMER SCHOOL

Palma, July 21-24, 2025

Porous semiconductors and oxide materials science and the development of innovative applications

Organizers:

Rodrigo Picos
Universitat de les Illes Balears (Spain)

Lluís Marsal
Universitat Rovira i Virgili (Spain)

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the European Union

UIB Universitat de les Illes Balears

Universitat Rovira i Virgili

PROGRAM

	21 July	22 July	23 July	24 July
9h 30 10h 30		Dr Nefeli Lagopati	Dr Salvatore Surdo	Dr Narcis Duțeanu
		Coffee		
11h 00 12h 00		Dr Paula Ferreira	Dr Vicente Torres-Costa	Dr. Joan Cerdà
		Lunch		
14h 00	Welcome			
14h 30 15h 30	Dr Aurelien Viterisi	Dr Nikola Ž. Knežević	Dr Stéphane Hocquet	Free Time - Sun and fun
	Coffee			
16h 00 17h 00	Dr Lluís Marsal	Ph.D. Pitch	Ph.D. Pitch	
	Break			
17h 30 18h 00	Mr Theo Zacharis			
19h 00	Social Dinner At Training School			

Day 1 — Monday JUL 21

14h 00 WELCOME

14h 30 **NOVEL MATERIALS FOR THE TRANSFORMATION OF CO2 INTO ADDED-VALUE CHEMICALS**
Dr. Aurelien Viterisi
Centre National de la Recherche Scientifique, Pau, France

15h 30 COFFEE BREAK

16h 00 **ADVANCED NANOPOROUS ANODIC ALUMINA STRUCTURES VIA ELECTROCHEMICAL ENGINEERING: APPLICATIONS AND PERSPECTIVES**
Dr. Lluís Marsal
Universitat Rovira i Virgili, Tarragona, Spain

17h 00 BREAK

17h 30 **BEYOND THE SURFACE: POROSITY-DRIVEN INNOVATION IN ENERGY AND SENSING APPLICATIONS**
Mr. Theo Zacaris
Kinesis Innovation Center, bioGLOT Ventures and Greek Scientists Society, Greece

19h 00 SOCIAL DINNER at Training School

Day 2 — Tuesday JUL 22

9h 30 **INTRODUCTION TO NANOMEDICINE: INVESTIGATION OF THE BIOLOGICAL EFFECT OF VARIOUS NANOMATERIALS**
Dr. Nefeli Lagopati
National and Kapodistrian University of Athens, Greece

10h 30 COFFEE BREAK

11h 00 **DESIGNING POROUS THIN FILMS FOR ELECTRONIC FUNCTIONALITY**
Dr. Paula Ferreira
University of Aveiro, Portugal

12h 00 LUNCH at Training School

14h 30 **DEVELOPMENT AND APPLICATIONS OF POROUS SILICON, SILICA AND ORGANOSILICA NANOMATERIALS**
Dr. Nikola Ž. Knežević
Biosense Institute, University of Novi Sad, Serbia

15h 30 COFFEE BREAK

16h 00 PhD PITCH

19h 00 SOCIAL DINNER at Training School

Day 3 Wednesday JUL 23

9h 30 LIGHT-MATTER INTERACTION IN NANOPOROUS MEDIA: FUNDAMENTALS AND APPLICATIONS
Dr. Salvatore Surdo
Universita Di Pisa, Italy

10h 30 COFFEE BREAK

11h 00 OPTICAL PROPERTIES OF POROUS MATERIALS AND THEIR APPLICATIONS
Dr. Vicente Torres-Costa
Universidad Autónoma de Madrid, Spain

12h 00 LUNCH at Training School

14h 30 MACRO- AND MICROPOROUS BIOCERAMICS PREPARED BY CLASSICAL AND ADDITIVE TECHNOLOGIES FOR BONE REGENERATION APPLICATIONS
Dr. Stéphane Hocquet
Belgian Ceramic Research Centre (CRIBC), Belgium

15h 30 COFFEE BREAK

16h 00 PhD PITCH

19h 00 SOCIAL DINNER at Training School

Day 4 — Thursday JUL 24

9h 30 **FUTURE OF HYDROGEN USAGE**
Dr. Narcis Duțeanu
Universitatea Politehnica Timisoara, Romania

10h 30 COFFEE BREAK

11h 00 **DIPOLAR POLYMERS AND BRUSHES INSIDE PORES AND CHANNELS: FROM GLYCOCALYX TO CHROMATOGRAPHIC APPLICATIONS**
Dr. Joan Cerdà
Universitat de les Illes Balears, Spain

12h 00 LUNCH at Training School

13h 00 SUN & FUN

END OF THE 4TH NETPORE SUMMER SCHOOL

PhD Pitch – Short talks

Day 2 — Tuesday JUL 22

16h 00 *Beyond antibiotics: silica nanomaterials functionalized with organotin compounds for antibacterial and antibiofilm applications*
Victoria García Almodóvar*
Universidad Rey Juan Carlos, Spain

16h 15 *Stability of air plastrons on rough hydrophobic surfaces underwater*
Alexander Tesler*
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

16h 30 *Nanomaterials designed to cross the blood–brain barrier: a promising strategy against ALS*
Nagore Grasa Gude*
Universidad Rey Juan Carlos, Spain

16h 45 *Synthesis, characterization, and application of novel periodic mesoporous organosilica nanoparticles for skin protection and treatment*
Aleksandra Pavlović
BioSense Institute,Serbia

17h 00 *Utilizing anodic porous alumina membranes as hosts for pharmaceutical ingredients*
Busra Cincin
Universität Osnabrück, Germany

17h 15 *From complexation to nanoencapsulation: mesoporous silica delivery of Cu(II) and Co(II)-chrysin complexes as novel antidiabetic candidates*
Diogo Marinheiro
Universidade de Aveiro, Portugal

17h 30 *Functionalized Mesoporous Silica-based Nanocarriers for sensing and targeted treatment of tumor microenvironment*
Minja Mladenović
BioSense Institute,Serbia

Day 3 Wednesday JUL 23

16h 00 *Surface morphologies achieved through electrochemical etching of GaAs*
Hasan Yüngeviş*
Karamanoglu Mehmetbey University, Türkiye

16h 15 *Engineering Nanoporous Anodic Alumina for Biosensing Applications*
Josep Maria Cantons Pérez
Universitat Rovira I Virgili, Spain

16h 30 *Advanced caracterization of TiO2 and Ag-TiO2 nanoparticles obtained by electrochemical synthesis from green liquids*
Ionela Cristina Petcu
National University for Science and Technology POLITEHNICA Bucharest, Romania

16h 45 *Porous polymer films as potential substrates for the investigation of plasma membranes by high-resolution microscopy*
Daniel Koddle
Universität Osnabrück, Germany

17h 00 *pH-responsive Nanosystems for Targeted Drug Delivery to Glioblastoma Multiforme and MRI-facilitated Monitoring of Content Release*
Mirjana Mundžić
BioSense Institute,Serbia

17h 15 *Tailored ultrathin macroporous substrates for high-resolution microscopy*
Jenrik Bergjan
Universität Osnabrück, Germany

Book of ABSTRACTS

NOVEL MATERIALS FOR THE TRANSFORMATION OF CO2 INTO ADDED-VALUE CHEMICALS

Dr. Aurelien Viterisi
Centre National de la Recherche Scientifique, Pau, France

The negative impact of global warming caused by the anthropogenic release of CO2 into the atmosphere has prompted governmental institutions to take drastic actions to mitigate its outcome. Therefore, converting CO2 into renewable fuels presents itself as a straightforward alternative, as it generates added revenues.
The electrochemical reduction of CO2 constitutes one such approach. Despite being promising for the transformation of CO2 into products such as carbon monoxide, methane, ethylene or alcohols, it is not yet competitive on the industrial scale. Although the design of industry-compatible electrolysers is relatively well established, their typically poor selectivity and short lifetime remain major limiting factors. So-called flow cells and membrane electrode assembly (MEA) electrolysers are the most viable alternatives for industrialisation. My talk will provide a general overview of CO2 reduction from an academic perspective, focusing on our work in developing novel catalysts for the above reaction. It will encompass inorganic catalysts, such as metallic copper and its oxides, as well as a novel type of silver and copper organometallic clusters. Finally, we will delve into the importance of porous membranes for the CO2 reduction reaction under industrial rates. As such, recent results on the use of nanoporous alumina membranes as gas-diffusion layers in a flow cell electrolyser will be presented.

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Aurelien Viterisi graduated from the University in Edinburgh (UK) in 2009, where he carried out a PhD in supramolecular chemistry in the group of David Leigh. He subsequently moved to the field of organic and hybrid photovoltaics, working in Tarragona for several years at the ICIQ (Prof. Palomares) and at the University of Tarragona (Prof. Marsal). He finally moved to the petrochemical industry as the head of R&D in a Spanish local company (Tarragona), where is stayed for about 2 years. He joined the IPREM in February 2020, where he currently holds a lecturer position focusing on projects related to the transformation and capture of CO2 in a broad sense.

ADVANCED NANOPOROUS ANODIC ALUMINA STRUCTURES VIA ELECTROCHEMICAL ENGINEERING: APPLICATIONS AND PERSPECTIVES

Dr. Lluís Marsal
Universitat Rovira i Virgili, Tarragona, Spain

In recent years, structurally engineered nanoporous materials have attracted significant interest due to their potential applications in fields such as nanophotonics, biotechnology, sensing, catalysis, drug delivery, tissue engineering, batteries, and membrane separation.

Among these, nanoporous anodic alumina (NAA) stands out due to its excellent physicochemical properties, cost-effective and scalable fabrication process, and full compatibility with standard micro- and nanofabrication technologies [1,2]. NAA is obtained by the electrochemical anodization of aluminum and can form a self-ordered hexagonal array of cylindrical nanopores with tunable diameters ranging from 5 to 300 nm. Its pore diameter, length, and interpore distance can be finely tuned by adjusting anodization parameters such as voltage, current density, temperature, and electrolyte composition [1,2]. NAA also features high chemical resistance, thermal stability, and intrinsic photoluminescence.

Recent advances have enabled the engineering of complex pore geometries (e.g., modulated, funnel-shaped, serrated) through tailored anodization and post-treatment methods like etching or annealing. Applying periodic variations in current or voltage during anodization allows the fabrication of 2D and 3D photonic structures with tunable stop bands in the UV-VIS-NIR range [3,4].

Another notable development is the creation of anodic alumina nanotubes via pulse anodization under galvanostatic conditions. The geometry of these nanotubes (length, inner and outer diameters) can be controlled by adjusting pulse duration and current density [5].

Thanks to its high surface area, NAA is also an ideal platform for sensing and controlled release applications. The surface can be functionalized for molecular selectivity or coated with biodegradable or pH-responsive agents to regulate the release of active compounds. Additionally, metallic or magnetic nanoparticles can be added to further expand its functionality.

In this lecture, we will present recent progress in the design and fabrication of NAA-based nanostructures, focusing on electrochemical strategies to tailor pore geometry and surface functionality. We will highlight applications in photonic devices, optical sensing, drug delivery, and cell culture.

References:

[1] A. Santos et al., Phys. Status Solidi A, 2012, 209, 2045.
[2] A. Santos et al., Phys. Status Solidi A, 2011, 208, 668.
[3] L.K. Acosta et al., ACS Appl. Mater. Interfaces, 2020, 12, 19778.
[4] L.K. Acosta et al., ACS Appl. Mater. Interfaces, 2019, 11, 3360.
[5] J.T. Domagalski et al., Microporous Mesoporous Mater., 2020, 303, 11026

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Prof. Lluís F. Marsal is a Distinguished Professor at Universitat Rovira i Virgili (URV), where he leads the NEPHOS research group. He has over 30 years of experience in photonics, optoelectronics, and nanotechnology, with research focused on nanoporous materials and hybrid structures for applications in optical sensors, photonic devices, drug delivery, and tissue engineering.

He has published over 255 articles in international journals, co-authored several books and book chapters, and holds three patents. He has supervised more than 25 Ph.D. theses and participated in over 60 national and international research projects, securing more than €4.5 million in competitive funding as Principal Investigator. His work has received more than 9,800 citations (h-index 54) and has been recognized with several awards, including the ICREA Academia Award (2014 and 2021), the UniSA Distinguished Researcher Award (2014), and the URV Research Career Award (2012).

He is a Fellow of OPTICA (formerly OSA), a Fellow of the European Optical Society (EOS), a Senior Member of IEEE, and an active member of scientific societies such as ECS, SEDOPTICA, and RSEF. He has served as Chair of the Spanish Chapter of the IEEE Electron Devices Society and is currently a member of its Board of Governors. He is also co-founder of the spin-off company MATCH BioSystems SL and currently coordinates the COST Action CA20126, a European initiative on research and innovation in porous semiconductors, with more than 350 members across 40 countries.

BEYOND THE SURFACE: POROSITY-DRIVEN INNOVATION IN ENERGY AND SENSING APPLICATIONS

Mr. Theo Zacharis
Kinesis Innovation Center, bioGLOT Ventures and Greek Scientists Society, Greece

Porous semiconductors and oxide materials are at the forefront of a materials revolution driving innovation in sustainable energy, environmental sensing, and healthcare technologies. This talk explores how engineered porosity—at the micro-, meso-, and nanoscale—unlocks novel functionalities, enhances surface interactions, and enables smart responses in diverse application domains. Through selected case studies, we will examine recent advances in photocatalysis for solar fuels, high-sensitivity gas sensors, and next-generation batteries, highlighting how tailored structures (e.g., anodic TiO_2, mesoporous ZnO, hybrid oxides) translate into real-world impact. Emphasis will be placed on the link between structure–function relationships and application performance, bridging fundamental science with device-level innovation. The session will also briefly touch on emerging directions such as porous materials in wearables and data-driven material design. Attendees will gain insights into practical strategies for designing porous materials with application intent, and how COST Action NETPORE can serve as a springboard for collaborative innovation in this field.

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Theo Zacharis is a visionary, proactive, strategic thinker with excellent analytical, interpersonal and presentation skills. He is a Business Consultant engaged in a great variety of projects and advisory in a multitude of fields and business aspects. Astute strategist who improves profitability by targeting inefficiencies, minimising expenses, and improving processes. Motivational leader with proven record to envisage, empower and enable multi-functional and multi-skilled teams to perform at their full potential. Innovative leader with a track record of assessing and capitalising on opportunities to streamline operations and increase P&L results. Resourceful problem solver with a strong work ethic and ability to motivate staff to excellence. Results-oriented manager who views challenges as an opportunity. Solid grasp of key business drivers and corporate functions.
Theo Zacharis holds a B.Sc. in Business Administration from the State University of New York Empire State University, and an MBA from ALBA Athens Graduate Business School.
He was Marketing Manager at adidas Hellas before he established his Consulting firm, Strategic Foresight Hellas in 1997. In 2018, he established bioGLOT Ventures, in Cambridge, UK, an Innovation & Strategy Advisory firm.
In December 2020, Theo introduced and now leads the Greek Scientists Society (GSS), which is the largest global network of Greek Scientists and Technologists with 30,000 members within a span of two years.

He is deeply committed to promoting scientific cooperation, knowledge exchange, and innovation, and believes in the transformative power of collaborative research and the huge impact of the scientific community on society.

Recently, he was appointed as the Executive Director of a post-Action sustainability initiative, Kinesis Innovation Center (KIC), the first post-Action Sustainable Project with CA20104 – Network on evidence-based physical activity in old age (PhysAgeNet) and the GSS, having as a flagship initiative a digital biobank on Physical Activity.

Furthermore, he has been involved in conducting campaigns to promote various initiatives, raising awareness and engagement within target audiences, the society at large, and policymakers.

His consulting work includes, Organizational & Management Consultancy in more than 120 large, medium-sized and family-owned SMEs, advisory and project execution for almost all functions of a business entity with exceptional results in every case (Strategic Planning, Business Plans, Business Development, BPR, Financial Planning, Information Systems, TQM Lean Mgt, Quality Systems – ISO 9000, ISO 14000, ISO 18000, HACCP – Marketing, Sales, Operations, Human Resources), Training Instructor for Finance, Sales, Organization and other topics, Internal Auditor in Athens Stock Exchange ASE listed company, Management, Implementation and Administration of National and European co-financed Projects, Applications under Greek Investment Law and other European funded programs, Project partner in European Projects, and more.

He has sufficient understanding of biomedical concepts and principles, patents, VC funding, start-up support, as well as ample command of IT-related technologies & Digital Transformation and is a follower of scientific advancements and futuristic sciences and technologies.

As an Innovation & Strategy Advisor, Technology Transfer, Start-up Advisor provides the following services Business planning and advisory – pre-acceleration and acceleration growth programs, preparation of business plans for spin-off or start-up companies considering the market, positioning, regulatory, development, IP strategy, team and financials Technology and other tie-ups, spin-offs, joint ventures Development of investor pitch Development of Proof of Concept (PoC) and/or Minimum Viable Product (MVP), Investment attraction strategy – contact potential private investors or VCs and assistance in the fundraising and negotiation of early-stage capital raising and investor relations Interim CEO – leading the team until identifying and hiring a full-time CEO or Board observer when necessary Definition of the licensing strategy – in-licensing and out-licensing activities, Technology Transfer, R&D commercialization, Networking with support eco-systems players – innovation hubs, R&D centres, technology parks, business angel networks, science parks and business support agencies – to build innovation ecosystems in national and/or international scale Public Grants and EU Framework Programmes for Research and Development and government subsidies (e.g. UK Innovation) for commercialisation of innovative ideas Development and validation of the Business Model Implementation, Team Formation.

INTRODUCTION TO NANOMEDICINE: INVESTIGATION OF THE BIOLOGICAL EFFECT OF VARIOUS NANOMATERIALS

Dr. Nefeli Lagopati
National and Kapodistrian University of Athens, Greece

Nanotechnology is defined as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers and includes various fields of science, such as semiconductor physics, surface science, chemistry, biology, energy storage, microfabrication, molecular engineering and many others. It is reasonable that various applications have been developed, in order to exploit the potential of this scientific field. The use of the achievements of nanoscience in medicine, pharmacology and biology (also in cosmetology, veterinary, dentistry and agriculture) has reasonably a great impact, aiming to improve the quality of life. This special scientific and interdisciplinary field is called nanomedicine.

Nanomaterials can be considered as promising candidates for several diseases ad=nd disorders, as bioactive pharmaceuticals or as carriers of other drugs. The multivariate context of cancer has been addressed by various approaches. Recent studies focus on personalized treatments by employing nanomaterials or composite materials, minimizing the undesirable consequences of the conventional methods, such as chemotherapy and radiotherapy. Other strategies focus on the development of modalities for accurate cancer cell detection, fascilitating thus molecular imaging. Innovation of alternative effective therapeutic schemes remains to be held. Photocatalytic nanoparticles can fill this scientific gap, as a part of their extended range of applications. Particularly, nanostructured titanium dioxide (TiO_2) among its numerous applications of daily routine and of advanced technology, due to its biocompatibility, it has also a great number of biomedical applications. It is now clear that photo-excited TiO_2 nanoparticles, can induce generation of pairs of electrons and holes which react with water and oxygen to yield reactive oxygen species (ROS) that have been proven to damage cancer cells, triggering controlled cellular processes.

The aim of this lecture is to provide insights into the field of nanomedicine and particularly into the wide context of TiO_2-NP-mediated anticancer effect, shedding light on the achievements of nanotechnology and proposing this nanostructured material as a promising anticancer photosensitizer.

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Dr. **Nefeli Lagopati** is an Assistant Professor in Biology-Nanomedicine at the Laboratory of Biology, at the Medical School of the National and Kapodistrian University of Athens. She performed her PhD in Biology, in cooperation with the National Centre for Scientific Research "Demokritos". She has a BSc in Physics, from the University of Athens, and received also MSc in Radiation Physics, MSc in Advanced Materials and MSc in Technoeconomic Systems, in parallel with continuous training and seminars, reflecting her dedication in lifelong learning.

Her research interests include applications of nanotechnology in cancer treatment, environmental technologies etc. Specifically, Dr. Nefeli Lagopati focuses on the oxidative stress induced apoptotic effect and the anticancer activity of nanomaterials. She has worked as a Research Fellow in various research projects, and had the honor to receive full national scholarships as a PhD candidate, as well as Postdoc researcher (IKY, Heraclitus II), through her continuous and strategic collaborations with several Universities and Research Institutes. In the past decade, she has focused on the development of drug delivery systems, biomaterials, hybrid materials, cellular senescence, radiobiology, Monte Carlo simulation, and dosimetry in nuclear medicine, and also projects related to artificial intelligence and SARS-CoV-2.

Dr. Nefeli ‘s Lagopati work is reflected in a significant number of scientific publications (Google Scholar, h-index 24). She also has numerous participations in national and international conferences, which highlights her persistence and devotion to her research activity. She has served as a Substitute board member of the Hellenic Public Health Organization and as a consultant of the General Secretariat for Research and Innovation of the Ministry of Development and Investment of Greece.

DESIGNING POROUS THIN FILMS FOR ELECTRONIC FUNCTIONALITY

Dr. Paula Ferreira
CICECO, Department of Materials and Ceramic Engineering, University of Aveiro, Portugal

Multiferroic materials, exhibiting two or more ferroic properties such as ferroelectricity, ferromagnetism, and ferroelasticity, are key to next-generation electronics, especially in data storage. However, reducing thin film thickness often leads to loss of ferroic functionality due to strain relaxation and other nanoscale effects. In this lecture, we explore how nanoporosity can enhance rather than hinder the properties of ferroelectric and multiferroic thin films. Using sol-gel and block-copolymer templating methods, we fabricate nanoporous $PbTiO_3$ and $BaTiO_3$ films with tailored pore architectures. These films show improved crystallization, enhanced piezoelectric response, and lower coercive fields. Nanoporosity also enables the creation of hybrid multiferroic systems by incorporating magnetic nanoparticles like cobalt or nickel into ferroelectric matrices. Furthermore, nanopatterned porous films extend functionality by offering uniform nano-arrays suitable for integration in microelectronic devices. Materials like $BiFeO_3$ and $CoFe_2O_4$ demonstrate how porosity boosts electric, magnetic, and even photocatalytic performance. This bottom-up chemical assembly approach provides a cost-effective and scalable route to design multifunctional materials for future electronic applications.

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Paula Ferreira is a Senior Researcher at CICECO – Aveiro Institute of Materials, University of Aveiro, where she has been conducting research since 2004 and leading scientific initiatives as a Coordinator Researcher since 2017. With a background in Analytical Chemistry and a PhD in microporous and mesoporous materials, her international experience includes an Alexander von Humboldt Fellowship at the Technical University of Munich. Her research focuses on the design and characterization of functional materials for applications in electronics, sustainability, and biomedicine. She has authored over 169 scientific publications, secured funding for numerous national and European projects, and supervised a wide range of early-career researchers. Dr. Paula Ferreira is committed to collaborative science, mentorship, and advancing the societal impact of materials research

DEVELOPMENT AND APPLICATIONS OF POROUS SILICON, SILICA AND ORGANOSILICA NANOMATERIALS

Dr. Nikola Ž. Knežević
Biosense Institute, University of Novi Sad, Serbia

Porous silicon-based nanomaterials exhibit favorable characteristics for their numerous possible applications in the research areas of drug delivery, imaging, separation science, sensing and heterogenous catalysis. Different types of nanoparticles can be constructed, which can be broadly classified based on their prevalent atomic structure. Hence, materials containing prevalent Si-O bonds are known as Mesoporous silica nanoparticles (MSNs), the particles with Si-Si bonds are porous silicon, while the particles containing organic bridges (R) between the Si atoms (Si-R-Si) are known as porous organosilica nanoparticles or periodic mesoporous organosilica (PMO). These structural differences induce varieties in the characteristics of nanomaterials, which also influences their applicability in different research fields. This lecture offers an overview of the characteristics of Si-based nanomaterials as a function of their applicability in different fields. The presentation will include methodologies for synthesis, functionalization and characterization of Si-based nanomaterials, with an overview of research advances in their health-related applications.

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Dr. Nikola Ž. Knežević is employed as a Full research professor at the Biosense Institute, Novi Sad, Serbia. He received his doctorate degree in 2009 at Iowa State University, USA, in the area of mesoporous silica nanoparticles for stimuli-responsive and targeted drug delivery. He gained further research experience as a postdoctoral fellow at the University of Houston (research in the field of multistep organic synthesis), Universidad Complutense de Madrid (nanomaterials science, mesoporous silica), Institute Charles Gerhardt Montpellier (nanomaterials science, porous silicon and organosilica), FP7–ERA ERA Chairs postdoctoral fellow at the Vinča Nuclear Institute and as Pole Chimie Ballard Visiting Professor at the University of Montpellier. Nikola is the author/co-author of over 50 peer-reviewed journal publications and one patent. Nikola was the coordinator of one H2020 project (NANOFACTS GA 952259), three Serbian national projects (PRECAST—6060755, proof of concept—5566, technology transfer -1135), and two bilateral research projects (with France and Germany). He also participated in two innovation projects with industry as a principal investigator. His main research interests include the synthesis of functional bioresponsive nanostructured materials for protection of health and the environment.

LIGHT-MATTER INTERACTION IN NANOPOROUS MEDIA: FUNDAMENTALS AND APPLICATIONS

Dr. Salvatore Surdo
Universita Di Pisa, Italy

This course introduces the fundamentals of light interaction with nanoporous materials, focusing on both theory and applications in optics and photonics. Topics include geometrical optics, electromagnetic waves, and Maxwell's equations, with particular attention to absorption, reflection, and refraction phenomena. A key element is the use of effective medium theories (EMT), such as the Bruggeman model, to describe how light propagates in porous dielectrics with sub-wavelength features. Applications covered include Fabry-Pérot interferometers, Bragg reflectors, waveguides, GRIN lenses, and resonant microcavities.

The course is aimed at Ph.D. students seeking insight into the optical behavior of nanoporous media for applications in sensing, imaging, microscopy, and spectroscopy. No prerequisites are required.

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Dr. Salvatore Surdo is a senior researcher tenure track at the Department of Information Engineering, University of Pisa, Italy. He received his Ph.D. in Information Engineering from the same university in 2012, after earning a master's degree in electronic engineering in 2008. From 2014 to 2022, he worked as a postdoctoral researcher at the Istituto Italiano di Tecnologia (IIT). He has collaborated with various industries and academic institutions such the Universitat de Barcelona (Spain), Chinese Academy of Sciences (China)., University College of London (UK), and Monash University (Australia).

His research focuses on the design, fabrication, and characterization of micro- and nanostructured optical materials and systems, with applications in optics, photonics, (bio)sensing, and nanomedicine. Dr. Surdo has authored over 60 scientific contributions, including peer-reviewed articles, conference proceedings, book chapters, and patents. His work has been presented in numerous international conferences.

OPTICAL PROPERTIES OF POROUS MATERIALS AND THEIR APPLICATIONS

Dr. Vicente Torres-Costa
Universidad Autónoma de Madrid, Spain

This lecture will provide an insight on the peculiar optical properties of meso- and nanoporous materials and their potential applications. Due to their nanometric morphology, porous materials behave, from the perspective of visible and infrared radiation, as homogeneous media whose effective optical properties strongly depend on the average (optical) density of the material. As a consequence, a precise control over such optical properties (namely, the complex refractive index) can be achieved by controlling the porosity and pore morphology of the material. Additionally, the possibility of controlling porosity profiles along one or more dimensions open the way to the fabrication of optical complex interferece structures such as Bragg mirrors, optical microcavities, precision notch filters, optical biosensors, filtered photodetectors and more.
In this lecture, two opposite approaches will be introduced to achieve this porosity control: electrochemical etch of suitable semiconductors, and oblique-angle evaporation, and a variety of practical applications of such materials will be presented.

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Upon obtaining his Degree in Physics, **Prof. V. Torres-Costa** started his research career at the Department of Applied physics of the Universidad Autónoma de Madrid working on the design and fabrication of antireflecting coatings for ophtalmic lenses. This provided him with an experties on optical properties of solids, optical characterization techniques, and the design and characterization of optical interference filters. At the same time he started working on nanostructured porous silicon, a mesoporous nanomaterial with peculiar optical roperties. In 2006 V. Torres-Costa presented his PhD about the optical properties of nanostructured porous silicon and developed several applications with photonic and optoelectronic devices such as integrated filtered photodetectors, precision interference filters, photonic crystals and optical chemical and biological sensonrs, among others.
V. Torres-Costa is full professor of UAM since 2023 at the Department of Applied Physics. His current research interest focus mainly on advanced applications in electronics, photonics and optoelectronics of several nanostructured materials, mainly silicon, silicon-germanium, TMDs and nanoarchitectured materials. Parallel research lines also include biomaterials, optical and electronic sensors for chemistry, defence and biomedicie, among others.

MACRO- AND MICROPOROUS BIOCERAMICS PREPARED BY CLASSICAL AND ADDITIVE TECHNOLOGIES FOR BONE REGENERATION APPLICATIONS

Dr. Stéphane Hocquet
Belgian Ceramic Research Centre (CRIBC), Belgium

Calcium phosphates, and more specifically hydroxyapatite (HA) and beta-tricalcium phosphate (β-TCP), are ceramic materials with numerous advantages for applications in bone regenerative medicine. Their chemistry, closely resembling that of natural bone tissue, provides them with exceptional biological properties, enabling cells to use them to rebuild defective bone structures following trauma, malformation, or degenerative disease.

Beyond the chemical aspect, a biomaterial capable of supporting bone regeneration must also mimic its macro- and microporous structure. In this presentation, several methods for manufacturing bioceramic bone substitutes will be explained. Each of these methods is mastered to achieve precise control over the size and shape of macropores, as well as the adjustment of surface microporosity. Two methods are considered "classical": the replication of a PMMA bead scaffold on one hand and freeze-drying on the other. The other methods involve the use of 3D printing systems, tailored for the fabrication of ceramic parts. The presentation will also address the use of nano- and femtosecond lasers for surface roughness modification.

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Stéphane Hocquet is a Program Manager at the Research Centre of the Belgian Ceramic Industry (BCRC) and a lecturer at the University of Mons, where he teaches advanced ceramics to Master's students in Materials Science.

He graduated in 1999 with a degree in Chemical Sciences, earning high distinction from the University of Mons. He then pursued doctoral studies and defended his PhD thesis in 2002, titled *"Crystallization, morphology, and melting of linear polyethylene single crystals: a critical approach"*.

Stéphane Hocquet joined the BCRC on July 1, 2003, to focus on research in ceramic materials. His initial work involved carbon-based refractories for the steel industry, piezoelectric systems for non-destructive testing, and the sintering of complex-shaped ceramics using Spark Plasma Sintering (SPS).

In 2013, he initiated and coordinated the COST action "NEWGEN" (2013–2017), a project aimed at bringing together the scientific and industrial communities around the growing field of personalized biomaterials produced via additive manufacturing.

Currently, within the Research and Innovation department of the BCRC, he leads projects focused on ceramics for healthcare. His work encompasses the shaping of macroporous calcium phosphate systems and composites through 3D printing and laser texturing. These innovations have diverse applications, including regenerative medicine, bioreactors, and chromatography processes.

FUTURE OF HYDROGEN USAGE

Dr. Narcis Duteanu
Politehnica University Timisoara, Romania

Extensive development of human society leads at an increase for energy demands leading at increase of fossil fuels consumption. Rapid climate change during last decades make necessarily the development of new energy production systems. In 1874 Jules Verne wrote in his book The Mysterious Island:" ..... water will one day be employed as a fuel, that hydrogen and oxygen that constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable. Someday the coal rooms of steamers and the tenders of locomotives will, instead of coal, be stored with these two condensed gases, which will burn in the furnaces with enormous caloric power...I believe, that when the deposits of coal are exhausted, we shall heat and warm ourselves with water... Water will be the coal of the future.... ". Student will be able to understand the future hydrogen usage. Topic covered include introduction in hydrogen usage and will let participants to understand the future of hydrogen as energy vector.

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DIPOLAR POLYMERS AND BRUSHES INSIDE PORES AND CHANNELS: FROM GLYCOCALYX TO CHROMATOGRAPHIC APPLICATIONS

Dr. Joan Cerdà
Universitat de les Illes Balears, Spain

Pores and channels can be functionalized with polymer coatings grafted onto their inner lumen. A particular subclass of these systems are dipolar polymers which offer the possibility to control their structure and behavior through external fields. In this talk we will review several of those systems and how they are interrelated: from the Endothelial Glycocalyx found in all of us that play key vital roles, to narrow coated slits/pores that can be potentially used for several types of analytics separation techniques.

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Joan is an associate professor (Titular d'Universitat) in the area of Physics of Condensed Matter since 2021 at the University of the Balearic Islands (UIB). Master (Llicenciat) in Physics in 1998 and also in Chemistry in 2003 at UIB with the special distinction award. Ph.D. in Physics at UIB in 2005. Between 2006 and 2011, he developed his research and teaching activity in Germany: first at the Frankfurt Institute for Advanced Studies (FIAS, Goethe Universität, Frankfurt am Main) and later at the Institute for Computational Physics (University of Stuttgart). At the end of 2010, he returned to the UIB where he joined the Physics Department as a PhD assistant professor while also working as a postdoctoral researcher at IFISC. In 2015, he began a postdoctoral research contract sponsored by the local government of the Balearic Islands (CAIB) to dedicate himself exclusively to research. He rejoined the physics department in September 2016 as an interim contracted professor, a position he held until his promotion to associate professor. To know more about him and his research and collaborations: https://onl.uib.eu/people/Cerda-Joan/index.html