ABSTRACT BOOK

GCMSN2023

Global Congress on

Materials Science and Nanotechnology

August 03-05, 2023 | London, UK

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About Conference

Dear Colleagues,

On behalf of the Conference Organizing Committee and Avouch Conferences, it is our pleasure to invite all the world famous/leading scientists, outstanding researchers, academic people and industrialists from all over the world to attend the Global Congress on Materials Science and Nanotechnology (GCMSN2023) which is to be held in London, UK during August 03-05, 2023.

We welcome you to join us and be a part of knowledge and views in respect to the theme "Exemplifying the Prominence of Materials Science and Nanotechnology in Today's World".

GCMSN2023 will provide a wonderful opportunity for academicians, researchers, scientists, engineers and pioneering students working in the fields of Materials Science and Nanotechnology to exchange, share and discuss their unique ideas, new knowledge and cutting-edge science, unveiling recent trends and advancement for accelerating scientific discoveries in the area, offering the opportunity to all delegates for networking, also globalizing the research by installing a dialogue between industries and academics for launching new technologies and applications.

We are looking forward to seeing you at this exciting event to meet with the world famous/leading scientists and outstanding researchers for sharing new and exciting ideas/results in Materials Science and Nanotechnology in London, UK.

Boron Nitride van der Waals Heterostructures for Advanced Electronics and Biomedicine

Yoke Khin Yap
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Abstract
I will review van der Waals heterostructures for electronics and biomedical applications in this plenary talk. These heterostructures are based on van der Waals adsorption of molecular-scale or quantum-scale materials on the surfaces or inside boron nitride nanotubes (BNNTs). We have demonstrated that BNNTs are electrically insulating and optically transparent [1, 2]. We have utilized the unique properties of BNNTs to enable the formation of single-electron transistors (SETs) without semiconductors [3]. We have also demonstrated the formation of 2D gold quantum materials with tunable optical band gaps [4], field-effect transistors (FETs) by Tellurium (Te) atomic chains inside BNNTs [5], and high-brightness fluorophores that could be 1000X brighter than existing dyes [6, 7]. The synthesis, characterization, and applications of these van der Waals nanostructures will be discussed in the meeting.

Keywords
van der Waals, heterostructures, boron nitride, single electron transistors, fluorophores

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Biography
Yoke Khin Yap is a professor of physics, director of the applied physics graduate program, and a University Professor at Michigan Technological University (MTU), USA. He earned his Ph.D. in 1999 from Osaka University as sponsored by the Japanese government as a Monbusho scholar. Before his appointment at MTU, he was a postdoctoral fellow of the Japan Society for the Promotion of Science (JSPS). His research interest is nanoscale van der Waals heterostructures and their applications in electronics, energy, and biomedicine. Professor Yap was honored with the National Science Foundation CAREER Award in 2005. He was a Charter member of the users' executive committee of the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory from 2005-2007 and the first elected user group chair in 2008. Professor Yap received the Bhakta Rath Research Award in 2011, was appointed as a Faculty Fellow in 2014-2016, was honored as an Osaka University Global Alumni Fellow in 2015, and received the MTU Research Award in 2018.

Towards Broadband Photocatalysis

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Abstract
Forming nanomaterials junctions and using plasmons represent two important, promising strategies for realizing broadband photocalysis in strategically important applications such as solar fuels and photocatalytic degradation of pollutants in our environments. In this talk, I will present some of our recent work on the rational design and realization of nanohybrid materials as well as their applications in solar fuel and photocatalysis. For instance, the construction of homojunctions of nanoplates made of metal–organic frameworks (MOF) led to broadened light absorption and increased photoactivity. The well-defined MOF homojunction was prepared by a facile one-pot synthesis route directed by hollow transition metal nanoparticles. The homojunction is enabled by two concentric stacked nanoplates with slightly different crystal phases. The enhanced charge separation in the homojunction was visualized by in-situ surface photovoltage microscopy. The as-prepared nanostacks displayed a visible-light-driven carbon dioxide reduction with very high carbon monooxide selectivity, and excellent stability. Another example is about the in situ synthesis of plasmonic Ag nanoparticles (AgNPs) and Ag-MOM (metal organic matrix) using one-step facile approach. The intimate and stable interface between the AgNPs and Ag-MOM and hot electron transfer from the plasmonic AgNPs to MOM led to highly efficient visible-light photocatalytic H2 generation in aqueous solution, which surpasses most of reported MOF-based photocatalytic systems. This work sheds light on effective electronic and energy bridging between plasmonic NPs and metal organic matrix.

Keywords
Solar full, photocatalysis, plasmonics, heterojunction

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[2] Nature communications, 2022, in press;
[3] Chemistry of Materials, 2021, 33, 695-705;
[4] Adv. Funct. Mater. 2019, 1902486.

Biography
Prof. Dongling Ma, holder of the Canada Research Chair (Tier 1) in Advanced Functional Nanocomposites, has been a professor at Institut national de la recherche scientifique (INRS) since 2006. Her main research interest consists in the development of various nanomaterials (e.g., semiconductor quantum dots, transition metal catalytic nanoparticles, plasmonic nanostructures) and different types of nanohybrids for applications in energy, environment, catalysis and biomedical sectors. She has co-authored >170 journal articles in a broad range of areas, centered on materials science, in selective, high-impact journals such as J. Am. Chem. Soc, Nat. Commun., Adv. Mater., Adv. Energy Mater., ACS Nano, Adv. Funct. Mater., Energy Environ. Sci., Chem. Mater. and Chem. Soc. Rev. with a H-index of 61 (Google Scholar). She has co-authored 6 patents (4 granted and 2 under review) and 4 book chapters. She has delivered >120 invited speeches at international conferences and prestigious universities/government laboratories. She is an associate editor of ACS Applied Nano Materials and also serves/served on multiple journal editorial advisory boards, including the prestigious ACS Energy Lett., Scientific Reports (Springer-Nature), Frontiers (Energy), PhotonX (Springer), etc. She also acted as the section Editor-in-Chief for the section “Solar Energy and Solar Cells” of Nanomaterials. Her recent awards include the 2022 Clara Benson Award from the Chemical Institute of Canada.

Hybrid Spintronic Materials and Devices

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Abstract
The next-generation spintronics1 focuses on the integration of the magnetic and semiconductor materials and so to add new capabilities to the future energy efficient and fast information technology. In this talk, I will report recent progresses of the research on a selection of hybrid nanomaterials including those based on ferromagnetic metal (FM) and alloys, half-metallic materials, and two-dimensional (2D) materials. FM and alloys have spontaneous magnetization and usually high Curie temperature (Tc), half-metallic materials possess high spin polarization near the Fermi level (EF), and the 2D materials have unique band structures such as the Fermi Dirac cone and valley degree of freedom of the charge carriers. Enormous progress has been achieved in terms of synthesizing the epitaxial hybrid spintronic materials and revealing their new structures and properties emerging from the atomic dimensions and the hetero-interfaces2. Apart from the group-IV, III-V, and II-VI semiconductors and their nanostructures, spin injection and detection with 2D nanomaterials such as graphene, transition-metal dichalcogenides (TMDs) and topological insulators (TIs)3 has become a new trend and a particularly interesting topic due to either the long spin lifetime or strong spin-orbit coupling induced spin-momentum locking, which potentially leads to dissipationless electronic transport.

Keywords
Spintronics, 2D materials, Spin-FET

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Biography
Professor Yongbing Xu, Director of the Nanjing-York Joint Center in Spintronics and NanoEngineering, Nanjing University, China; Chair in Nanotechnology, also heads the Spintronics and Nanodevice Laboratory, The University of York. He was an EPSRC Advanced Research Fellow in Cavendish Laboratory, Cambridge University. His research interests are in the areas of nanomaterials, spintronics and nanofabrication. He has published more than 500 refereed papers in leading academic journals including Science Advances, Physical Review Letters, Prog. Mater. Sci., Nature Communications, Nano Letter, Advanced Materials, ACS Nano, Scientific Reports, Applied Physics Letters and IEEE journals and given many invited talks/seminars at major international conferences including MRS, WUNSPIN, EMN and Intermag. He was chair of five international conferences in spintronics. He was editor-in-Chief of “Handbook of Spintronics” by Springer, and edited the very first spintronics book “Spintronic Materials and Technology” by CRC Press. He had interviews with BBC News24 and New Scientists.

Strongly-Confined Perovskite Quantum Dot Light-Emitting Diodes

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Abstract
Colloidal inorganic halide perovskite CsPbX3 quantum dots (QDs) show great promising for high-performance light emitting diodes (LEDs) owing to outstanding optoelectronic properties. However, the pure-blue and pure-red emission perovskite LEDs are still inferior. We are focusing on the design of the strongly confined QDs for high efficiency pure-color (blue and red) perovskite LEDs. A novel acid etching-driven ligand exchange strategy was devised for achieving small-sized (~3 nm) CsPbBr3 QDs with pure-blue emission (465 nm) and (~5 nm) CsPbI3 QDs with pure-red emission (630 nm). Subsequently, inorganic ligands were successively introduced to bond the residual uncoordinated sites of the QDs and attain in-situ exchange with the original long-chain organic ligands, resulting in near-unity quantum yield and remarkable stability. We achieved high efficiency pure-blue and -red LEDs based on the QDs: (1) Pure-blue (electroluminescence at 469 nm) LEDs with full-width at half-maximum (FWHM) of 21 nm, high external quantum efficiency (EQE) of 10.3 %, luminance of 12,060 cd/m2, and continuous operation half-life (T50) of 59 hours at initial luminance of 100 cd m-2. (2) Pure-red (emitting at 636 nm) LEDs with Commission Internationale de l'Eclairage (ClE) coordinates (0.703, 0.297) meeting the Rec. 2020 standard, high EQE of 21.8%, luminance of 3,775 cd/m2 and excellent stability.

Keywords
Light-emitting diodes; perovskite quantum dots; strongly confined; pure-blue; pure-red

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Biography
Jianjun Tian is a professor, and vice-dean of Institute for Advanced Materials and Technology, University of Science and Technology Beijing. He is member of editor board of Science China Materials, Int. J. Miner. Metall. Mater. Current research focuses on quantum dots and perovskites, and their applications in light emitting, solar cells and photodetectors. He published more than 150 peer-reviewed papers in high impact journals, such as Science, Adv. Mater., Angew. Chem. Int. Ed., Nano Lett.

Atomistic simulations of surface processes in materials for energy production and storage

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Abstract
Energy shortage and environmental issues call for the development of clean and sustainable fuel devices and devices for massive energy storage. Recently a great effort has been spent to study new materials to be employed in the next generation electrochemical devices. The main requirement is to design materials for electrodes made up of elements which are not toxic, easy to find on the Earth's crust, not too expensive, easy to recycle, and with a comparable or even better performance than the materials currently in use. Of major importance are also the properties of electrode surfaces and interfaces with polymeric materials (e.g. polymeric binders in batteries). Atomistic simulations are essential to spread light on the material properties not accessible to experiments and on the phenomena taking place on the surfaces and at the interfaces. They can be very helpful in accompanying material development. In this talk I will show our recent progress in the first-principles simulations of electrode materials. Systems, such as metal oxides and silicon anodes, will be addressed, with a particular emphasis for the interaction of silicon with newly proposed [1] binders based on self-healing polymers.

Keywords
Electrodes, Li ion batteries, self-healing, DFT

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Ionic Segregation in Nano Oxides

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Abstract
Segregation or surface excess is a thermodynamic phenomenon that occurs when atoms or ions of different types preferentially segregate to different regions of a material. This can lead to the formation of distinct phases or regions with different properties within the material. In nanomaterials, segregation can have significant impacts on their properties and performance due to the decrease of the interface energy. One type of segregation that can occur in nanomaterials is interface segregation. This occurs when certain atoms or molecules preferentially migrate to the surface or grain boundary of the nanomaterial, leaving behind a different composition in the interior. For example, in a doped nanoparticle the dopant may preferentially segregate to the interfaces of the nanoparticle, leaving the solvent enriched in the bulk. This can have significant effects on the chemical reactivity, interface energy and catalytic properties of the nanoparticle. Segregation can also occur during the synthesis of nanomaterials. For example, in a sol-gel synthesis of a nanoparticle, certain precursors may preferentially react with each other, leading to the formation of distinct regions with different properties. This can have significant effects on the morphology, size, and stability of the resulting nanoparticle. The effects of segregation on the properties and performance of nanomaterials can be both beneficial and detrimental. For example, in a catalytic reaction, surface segregation of certain atoms may enhance the reactivity of the nanoparticle towards a specific reaction. On the other hand, segregation may also lead to the formation of defects or regions with poor stability, which can degrade the performance of the nanomaterial over time. The study of segregation in nanomaterials is an active area of research, with significant implications for the design and synthesis of advanced materials. Techniques such as scanning transmission electron microscopy (STEM) and X-ray photoelectron spectroscopy (XPS) can be used to probe the composition and distribution of atoms in nanomaterials at the atomic scale. The work deals with the effects of segregation on the stability of particles and changes in properties such as: electrical conductivity, photocatalysis, colloidal chemistry, among others.

Keywords
segregation, surface excess, nanoparticles, nanostability

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Development and Applications of High-Performance Semiconducting Materials for Solution-Processed Electronic Devices

Jianping Lu[1,*],
Salima Alem[1], Yinghui He[1], Neil Graddage[1], Jianying Ouyang[2], Ta-ya Chu[1], and Ye Tao[1]
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Abstract
The semiconducting materials play a central role in printed electronics because their inherent properties determine the device performance for the target applications and their solubility significantly affects ink formulation and printing process. While design of the conjugated backbones of organic semiconductors has been a focus of intensive study, solubilizing side chains have received increasing attention as they offer a way to modulate solubility, film forming properties, and molecular packing in the solid state for organic semiconductors and thus affect device fabrication process and performance. In the first part of my talk, I will use several examples to highlight that both backbones and side chains play important roles in determining the performance of organic semiconductors. For the alternating copolymers of dithienosilole and thienopyrrole-4,6-dione (PDTSTPDs), their photovoltaic (PV) performance significantly increased from 5.1% to 8.1% when the side chain on the thienopyrrole-4,6-dione unit enlarged from C_4H_9 to C_8H_{17}. For dicyano-substituted bis(2-oxoindolin-3-ylidene)benzodifurandione n-type materials, a tiny change in the side chains (C16 vs C17) resulted in remarkable changes in the electron mobility by a factor of 7. Then, I will introduce our recent work on indoor OPVs. There has been a growing interest in the potential application of OPVs under indoor light, as the fast growth of the internet of things (IoT) creates a huge demand for off-grid electronic devices such as sensors and Bluetooth devices. We have designed and synthesized a new series of two-dimensional non-fullerene acceptors based on a rigid electron-deficient benzo[4,5]imidazo[2,1-a]isoindole central core. When blended with a p-type polymer (PM6), they demonstrated promising power conversion efficiency (PCE) above 20% under indoor LED illumination in PV cells with an active area of 1 cm^2. Finally I will present our work on NIR-II photodetectors using Ag_2Se quantum dots as the light sensing material. These nanoparticles were deposited from solution into a mesoporous TiO_2 scaffold, similar to that used in dye-sensitised solar cells, to increase the light absorption and charge separation, and reduce the exciton diffusion length. By incorporating a suitable hole-transporting layer between the active layer and Ag anode, the resulting devices showed a responsivity of 4.17 mA/W and an on/off ratio as high as 490 under 1 mW/cm^2 illumination at 1200 nm. These results demonstrate that Ag_2Se colloidal quantum dots are promising environmentally benign materials for near-infrared photodetectors.

Keywords
semiconducting materials, electronic devices, structure-property relationship, Organic solar cells, near-infrared photodetectors

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J. Ouyang, N. Graddage, J. Lu,* et al, ACS Applied Nano Materials 2021, 4, 13587-13601.

Biography
Dr. Jianping Lu received his PhD in physical chemistry from Tsinghua University, China, in 1998. Part of his PhD thesis research was carried out at CSIRO, Australia. Right after graduation, Dr. Lu did his postdoctoral research on organic light-emitting diodes (OLEDs) in Prof. Hay's group at McGill University from 1998 to 2000, and then in Prof. Winnik's group at University of Toronto working on the synthesis of block copolymers containing fluorescent dyes at the junction by anionic polymerization from 2000-2001. From 2001 to 2002, Dr. Lu worked for a high-tech startup company as a senior research scientist and project leader, responsible for the development of low-loss photo-patternable optical waveguide materials. In 2003, he joined Institute

for Microstructural Sciences, National Research Council of Canada, as an assistant research officer, conducting research on the design and synthesis of organic semiconductors for applications in organic electronic devices, such as OLEDs, organic field effect transistors (OFETs), and organic photovoltaics (OPVs). In 2012, Dr. Lu was promoted to senior research officer. So far, Dr. Lu has published about 80 papers in prestigious scientific journals, such as JACS, Adv Mater, Adv Funct Mater, Chem Mater, and ChemCommun. Dr. Lu has 15 awarded or filed patents. Dr. Lu has received multiple awards from NRC due to his research excellence and outstanding achievements.

Target-triggered DNA motors and their applications to biosensing

Hongquan Zhang
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Abstract
Inspired by endogenous protein motors, researchers have constructed various synthetic DNA motors based on the specificity and predictability of Watson-Crick base pairing. However, the application of DNA motors to signal amplification and biosensing is limited because of low mobility and difficulty in real-time monitoring of walking process. The objective of our work was to construct a new type of DNA motor termed target-triggered DNA motors that can walk for hundreds of steps in response to a single target binding event. To improve the mobility and processivity of DNA motors, we used gold nanoparticles (AuNPs) as scaffolds to build high-density, three-dimensional tracks. Hundreds of track strands are conjugated to a single AuNP. To enable DNA motors to respond to specific protein and nucleic acid targets, we adapted the binding-induced DNA assembly into the design of the target-triggered DNA motors. In response to binding of specific target molecules, DNA motors are activated to autonomously walk along AuNP, which is powered by nicking endonuclease or DNAzyme-catalyzed cleavage of track strands. Each moving step restores the fluorescence of a dye molecule, enabling monitoring of the operation of DNA motors in real-time. The motors can translate a single binding event into the generation of hundreds of oligonucleotides from a single nanoparticle. The motors have been applied to amplified detection of proteins and nucleic acids in test tubes and live cells. The motors were able to detect low pM concentration of specific protein and nucleic acid targets in homogeneous solutions without the need for separation. Target-triggered DNA motors are significant for broadening applications of DNA motors to molecular sensing, cell imagining, molecular interaction monitoring, and controlled delivery and release of therapeutics.

Keywords
DNA motors, biosensing, gold nanoparticles, signal amplification.

Biography
Dr. Hongquan Zhang is an Associate Professor in the Department of Laboratory Medicine and Pathology at the University of Alberta in Canada, specializing in the development of novel bioanalytical tools and nanosensors for the detection of biological targets in various research fields. His research projects include 1) exploring binding-induced DNA assembly to create ultrasensitive and point-of-care bioanalytical tools, 2) constructing target-triggered DNA nanomachines and nanodevices, 3) developing fluorescent nanosensors for real-time detection of specific biological targets in cellular environments, and 4) developing CRISPR-based diagnostic methods. Dr. Zhang has published over 60 peer-reviewed papers in prestigious scientific journals, including Nat. Commun., J. Am. Chem. Soc., Angew. Chem. Int. Ed.; ACS Nano; and Chem. Rev., with over 5400 citations on Google Scholar. He has also issued or filed seven patents. In addition, he has served as a guest editor for a Trends in Analytical Chemistry issue.

Unveiling the significant role of nano-particles in controlling microstructure and mechanical properties of additively manufactured hard-to-weld alloys

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Gan Li and Chuan Guo
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Abstract
Additive manufacturing has been widely applied in several industries due to its rapid fabrication of high-performance components with complex geometries. However, most engineering materials, particularly those hard-to-weld and high-strength materials with wide solidification temperature range, are associated with low processability due to their high cracking tendency. The addition of nano-particles into additively manufacturing alloys is often regarded as an effective and powerful route to eliminate the cracks while enhancing the mechanical properties. In this presentation, effects of nano-particles on cracking behaviour, microstructure and mechanical properties of several typical hard-to-weld alloys, including the 2xxx series and 7xxx series Al alloys, and IN738LC superalloys, will be demonstrated. The results indicated that the addition of 1 wt% low-cost TiO_2 nano-particles to a 2219 Al alloy during laser powder bed fusion (L-PBF) can substantially prevent hot-cracking in terms of significantly refining grains. The processed alloy displayed an excellent combination of high ultimate tensile strength (UTS) and elongation at both room and elevated temperatures. Adding a nano-TiN/Ti hybrid grain refiner to the L-PBFed 7050 alloy can noticeably refine the grains from 91.8 m to 775 nm, resulting in an UTS and ductility of up to 408–618 MPa and 13.2–8.8%, respectively. On the other hand, contrary to the observations in Al alloys, the cracks were well suppressed in the L-PBFed IN738LC superalloy by addition of nano-Y_2O_3 while grains were coarsened. Compared with the original IN738LC superalloy, the nano-Y_2O_3 modified IN738LC superalloy exhibited superior high-temperature mechanical properties and enhanced high-temperature oxidation resistance. These findings can provide new wisdom in the elimination of cracks and improvement of performance for L-PBFed hard-to-weld alloys.

Keywords
Additive manufacturing, hard-to-weld alloys, nano-particles, crack behaviour, mechanical performance

Biography
Prof. Qiang Zhu is currently a chair professor at the Department of Mechanical and Energy Engineering, Southern University of Science and Technology (China). He obtained his Dr.-Ing. Degree from the Universität Erlangen- Nürnberg, Germany in 1994. Now he is the Fellow of the Institute of Materials, Minerals and Mining (FIMMM), UK, and the director of the Shenzhen Key Laboratory for Additive Manufacturing of High-Performance Materials. His interests focus on (i) advanced forming (liquid and solid processing) theory and technology of metals; (ii) additive manufacturing of metals, (iii) Computer Aided Engineering (material design, forming simulation, property prediction, etc.) and (iv) failure analysis and fracture mechanics. Prof. Zhu gave a number of invited speeches to internationally well-known academic conferences as well as universities and enterprises, published more than 160 articles and as chief editor published two academic books. He is also applied or granted 1 International invention patent and 50 Chinese patents.

Nanotechnology for Advanced Dermal Drug Delivery: Potentials and Challenges of Phospholipid-based Nanovesicles

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Abstract
Phospholipid-based nanovesicles (liposomes) are physiologically acceptable drug nanocarriers composed of one or more phospholipid bilayer(s) surrounding inner aqueous compartment(s), thus allowing encapsulation of various drugs, differing in molecular weight and lipophilicity. (Phosho)lipid composition, size, surface charge and bilayer rigidity/elasticity of liposomes determine their stability and drug delivery abilities. Due to skin-like ingredients, liposomes have been widely investigated as nanopharmaceuticals for advanced skin delivery of drugs, dermal and transdermal 1 . They can be used to increase the drug solubility or improve the stability of instable compounds. The phospholipids building liposomes act as a penetration enhancer enabling the penetration of individual lipid components into stratum corneum and subsequently alter intercellular lipid matrix within the skin. Hence, encapsulation of hydrophilic drugs in liposomes can improve their penetration into the skin. Liposomes may also provide targeted delivery to skin appendages, increase localization of lipophilic drugs inside the skin and reduce their systemic absorption 2 . The superiority of the most promising liposome-based nanopharmaceuticals was confirmed by in vivo and clinical studies. This presentation will provide an overview of liposomes for tailored skin therapy, including anti-acne treatments, wound healing, antimicrobial skin therapy 3 as well as skin oncology 4 . Different types of liposomes commonly used in (trans)dermal drug delivery based on bilayer elasticity/rigidity, i.e., conventional, deformable, propylene glycol liposomes and ethosomes, will be discussed including their potentials and limitations.

Keywords
conventional liposomes, deformable liposomes, ethosomes, skin, topical drug delivery

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Biography
Dr. Željka Vanić is a full professor at the Department of Pharmaceutical Technology, Faculty of Pharmacy and Biochemistry, University of Zagreb, Croatia. She received PhD in 2002 at the Faculty of Pharmacy and Biochemistry, University of Zagreb, and conducted her postdoctoral research at the Pharmaceutical Institute, University of Freiburg (Germany). Her scientific interest includes pharmaceutical nanotechnology, particularly design and evaluation of phospholipid-based drug delivery nanosystems, liposomes, hydrogels and liposomes-in-semisolid bases formulations forimproved (trans)dermal and vaginal drug delivery.

Nanopesticide Formulation and Targeted Precise Controlled-Release Technology

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Abstract
Pesticides are commonly used in modern agriculture and are important for global food security. However, post application losses due to degradation, photolysis, evaporation, leaching, surface runoff, and other processes may substantially reduce their efficacy. Nanotechnology is considered an important driver of the agritech-revolution that promises more sustainable, efficient, and resilient agricultural systems, while also promoting food security. Nanotechnology is increasingly used to develop pesticides because it provides new tools and a means to upgrade the performance of bulk pesticide formulations through conversion to nanodelivery systems, which can improve the apparent solubility of poorly soluble active ingredients, realize controlled-release and reduced degradation of pesticides, and promote dimensional translocation of pesticides on leaf surfaces.
Controlled-release formulations can achieve the permeation-regulated transfer of an active ingredient from a reservoir to a target surface. Thus, they can maintain an active ingredient at a predetermined concentration for a specified period. This can reduce degradation and dissipation and other losses and has the potential to improve efficacy. Recent developments in controlled-release technology have adapted the concepts of intelligence and precision from the pharmaceutical industry. Biocompatible, biodegradable, intelligent, and responsive materials are currently an emerging area of interest in the field of efficient, safe, and green pesticide formulation. Using nanotechnology to design and prepare targeted pesticides with environmentally responsive controlled release via compound and chemical modifications has also shown great potential in creating novel formulations. Here, special attention has been paid to intelligent pesticides with precise controlled release modes that can respond to micro-ecological environment changes such as light-sensitivity, thermo-sensitivity, humidity sensitivity, soil pH, and enzyme activity. These technologies could increase pesticide-loading, improve the dispersibility and stability of active ingredients, and promote target ability.

1. Photoresponsive Controlled-Release Formulations.
Photoresponsive materials can exhibit physical changes in properties such as color, conductivity, and solubility, or chemical reactions such as photolysis, dimerization, polymerization, and isomerization after absorbing light energy. These special properties can be obtained by introducing photosensitive groups onto the main chain or side chain of the polymers.
2. Temperature-Responsive Controlled-Release Formulations.
Temperature-responsive materials can produce reversible responses to temperature stimuli. When exposed to external temperature changes, these materials can change their physical structures and chemical properties. After heating, the solubility of some temperature-sensitive polymers decreased, sometimes even resulting in precipitation, which contrasts with the general behavior of most substances.

3. pH-Responsive Controlled-Release Formulations.
The responsive functional groups on pH-responsive materials can be divided into acidic and basic groups. Acidic groups include carboxyl and sulfonyl groups, which can swell under alkaline conditions, as observed for polyacrylamide hydrogel. By contrast, basic groups, such as amino groups, lead to swelling under acidic conditions, as observed for chitosan.

4. Enzyme-Responsive Controlled-Release Formulations.
In response to attacks by herbivorous insects plants release defensive enzymes. If the encapsulation material of pesticides can be hydrolyzed rapidly in response to changes of these enzymes to induce release of active ingredients, then timely and effective insect control could be realized. Enzyme-responsive materials include polymers, nanoparticles, and hydrogels. The damage to crops caused by pests is associated with a variety of enzymes, such as cellulase, pectinase, and protease. Enzyme-responsive release of drugs or pesticides can facilitate accurate and smart control of harmful organisms.

Keywords

nanopesticide, nanotechnology, precise controlled release, environmental response, nanodelivery system

Biography

Wang Yan, she is a professor and doctoral supervisor of the Institute of Environment and Sustainable Development in Agriculture of Chinese Academy of Agricultural Sciences (CAAS), a national high-level talent, and an inductee of the “Agricultural Science Talent Program” of CAAS. She is also the chief scientist of the “Multifunctional Nanomaterials and Agricultural Application” team of the Agricultural Science and Technology Innovation Program of CAAS, the deputy director of the Environmental Engineering Research Office, and a member of the Agricultural Chemistry Committee of the Chinese Chemical Society. Her research focuses on the synthesis and agricultural application of nanocarrier materials, efficient and green nanopesticide/veterinary drug formulations and targeted precise controlled release. She presided over National High Technology Research and Development Program, the sub-task of collaborative innovation project of the Agricultural Science and Technology Innovition Program, National Natural Science Foundation of China, Natural Science Foundation of Beijing and many other programs. She has published more than 80 papers in academic journals such as ACS Nano, Coord. Chem. Rev., Environ. Sci. Nano, authorized 18 patents, and won one Chinese Agricultural Science and Technology Award.

FunctionalizedSBA-15 as a futureenvironmental-friendlymaterial for metal uptake

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Abstract

Heavy metals in soils and groundwaterpotentiallythreatenlivingorganisms, but theirlong-term environmentalimpacthasyet to be fullyunderstood. However, itisknownthat heavy metals, overtime, can be included in the food chain of plants and animals, threateninghumanhealth and life. Theseeffectsresult from the dynamic development of industrialization and heavy industry, constantlyproviding waste containingmetals. As a result, for severaldecades, newsolutions and materials havebeensought to solvesuchproblems, improving the quality of the environment, comfort, and quality of life on Earth.

One of the most promising modern solutions to limit environmentalpollutionis the fabrication of bio-perforated, mesoporous SBA-15 silicawith a largesurfacearea of ~ 800m^2/g. At the same time, structurallyamorphous SBA-15 formsuniaxialorderedhexagonalchannels with a diameter of 5 nm and length of the order of micrometersu niformlydistributedthroughout the entirevolume. Suchpropertiesassumed, in theory, high capillaryproperties. SBA-15 isalsoneutral for the environment and livingorganisms (itdoes not show anytoxicorirritatingeffects). At the same time, itsphysicochemicalpropertiesmay be easilymodifiedusingtechnologicalprocesses. High elasticity in chemicalmodificationallowsfunctionalizing SBA-15 usingpractically anytype of functionalgroups (outer- orinnerwalls) with the determination of precisecontrol of theirconcentration in the volume.

Achievement of individualstructurestowardenvironmentalprotectionhasbeenachieved, as proposed by ourresearch team, through the activation of mesopores by a specificfunctionalgroup. For thispurpose, n-active (n = 1-3) unitshavebeenconsidereddepending on the type of metal capturedthatcan be uptake. Hence, a functionalization was made by the use of propyl-carbonate (metal-binding I, e.g., silver), propyl-phosphate (metal-binding II, e.g., copper), and cyclam (1,4,9,11 tetraazacyclodecane) with the ability to chelate metal chlorides: copper, chromium, cobalt, nickel, etc. with the simultaneousassumption of the homogenousdistribution of functionalgroupsinsidesilicapores.

BET and spectroscopytechniques (AAS, ICP-MS) verified the metal ionuptakepotential. Time-dependent metal uptakecurvesallowestimation of the real-time SBA-15 sorptionpotential. The sorptionpotentialchecked on individuallyprepared SBA-15 pelletshasbeenmechanicallystudied. For thispurpose, the Young moduluspar ametershavebeenestimatedusingfourlevels of forces (AFM: nN, nanoindenter, and microcombitester: N, mN, testingmachine: N) to determine the mechanicalproperties of the SBA-15 nanochannel and SBA-15 pallets' stability in longworkflow in the environment. Allmethods of SBA-15 porewallfunctionalities and checking the sorptionpotentialaredirectedinto developing anentirelynewclass of materials with uniqueproperties for the remediation of contaminatedenvironments.

Keywords

SBA-15, functionalization, metal uptake, Young modulus, environmental application

Acknowledgment

M.D. and L.L. are thankful for the financial support from the National Center of Science (NCN) based on 2020/37/B/ST8/03637.

Biography

Dr. Mateusz Dulski receivedhisPh.D. in physics from the University of Silesia in Katowice, Poland, in 2015. His dissertationfocused on the structural and physicochemicalcharacterization of a newclass of luminescent

(rondorfite) and porous (mayenite) minerals. A part of hisPh.D. thesisresearch, mainly in spectroscopy, was carried out during the Le MansUniversité, France internship and financed by a national grant. Aftergraduation, Dr. Dulski was employed as the Assistant Professor in the Department of Informatics and Materials Science. In 2015, he started a newstage of hiscarrier, focusing on synthesizing and developing newideas for implementing metal-dopedsilicananostructuresinto engineering coat-forming structures on biomedicalimplants. Researchstudieshavebeenrealized in the project leader SONATA finished by developing a newclass of human-friendly, biocompatible, and biologicalactivecoating, improvingNiTialloy'sfunctionality. In 2021, he increased the applicability of the silicas by itssurfacemodificationusingactivegroups to improve metal ionuptake. The idea correlated with developing environmentallyfriendlymolecularsieves to remediategroundwater and soil. Researchprovidedinto OPUS grant. So far, Dr. Dulski haspublishedabout 140 papers in prestigiousscientificjournals, such as Nanoscale, ASS, Mater. Sci. Eng. C, ACS Appl. Mat. & Inter., etc. Dr. Dulski participated in 10 national and twointernationalgrants. Dr. Lu hasreceivedmultipleawards for hisresearch excellence and outstandingachievements.

High Brightness Fluorophores with Controllable Brightness

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Abstract
Here we describe a new method for producing high-brightness fluorophores (HBFs) that can be 1000 times brighter than any known fluorescence dyes [1]. The brightness of HBFs is widely tunable, with a molar extinction coefficient ( ) ranging from 10^7 to 10^9, more than three orders of magnitude higher than existing dye.

Biomedical detection relies on various non-invasive techniques such as fluorescent microscopy and flow cytometry. Organic dyes and fluorescent proteins are widely used for these applications where fluorophores are specifically bound to the target biomolecules. The brightness of dyes is important for sensitive and accurate detection. Organic dyes are low cost but not as bright as protein dyes such as PE (extinction coefficient, = 2.5x10^6 M^{-1} cm^{-1}; quantum yield, QY= 0.8) and APC (=7.0x10^5 M^{-1} cm^{-1}, QY=0.68). According to the physics of fluorescent brightness, one can produce bright dyes by enhancing QY and [2, 3]. There has been a tremendous effort in designing new molecules with high quantum yield (QY ranging from 0 to 1). In contrast, we focused on creating HBFs by controlling , which can be tuned across several orders of magnitude. The physics and chemistry of designing these HBFs will be presented in the meeting. Results indicated that the brightness of HBFs based on boron nitride nanotubes (BNNTs) is 450% higher than those based on carbon nanotubes (CNTs).

High-brightness fluorophores (HBFs) are co-developed by StabiLux Biosciences. This project is supported by the National Science Foundation (IIP 1521057, IIP 1738466).

Keywords
boron nitride, fluorescence dye, fluorophores

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(Review) D. Zhang ***et al.*** J. Materials Research **37**, 4605 (2022).

Biography
Dongyan Zhang is a research associate professor in the Department of Physics at Michigan Technological University (MTU), USA. She earned her Ph.D. in 1999 from Osaka University on the mechanisms of enterobacterial infection. Dr. Zhang has developed an exceptional career in microbiology, biochemistry, immunology, molecular biology, biotechnology, and bio-nanotechnology in the past 20 years. She has published a series of review articles and book chapters on nanotechnology and bio-nanotechnology.

Quantum Technologies Experimental Platform

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Abstract

The QUANTEP project aims at the development and implementation of a com- plete Silicon Photonic Integrated Circuit in the approach of Linear Optics Quan- tum Computing. A prototype of this kind of circuit is the universal two-qubit Controlled-NOT gate. This scheme makes use of linear, coincidence basis gate that performs all the operations of a controlled-NOT gate and requires only single photons at the input.

Single Photon Sources will be integrated through ion implantation in silicon of emitter centers in the telecom C-band. A heterojunction of Bi2Se3, a topo-logical insulator with efficient IR absorption and Dirac–like metallic surface, and n-Si will be used on the optical chip for the detection stage.

The potential of novel quantum-device concepts, realized by using as basic building blocks heterostructured semiconductor nanowires, graphene and other 2D materials will be explored in order to control over the light polarization.

The integrated linear optics quantum circuits will be characterized and the logic tested in the fully integrated version.

Title: Curcumin-Coated Iron Oxide Nanoparticles: as a Promising Theragnostic Agent

Samia Aboushoushah
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Abstract
Iron oxide nanoparticles (IONPs) have manymedical applications including diagnosis and therapy. Diagnosis purposes include contrast agents in magnetic resonance imaging and auto-florescence probes for molecular imaging.Therapypurposes include controlled drug delivery systems, thermal therapy for tumour treatment, and radiosensitizers for cancer treatment. Yet some uncertainty in the biodistribution, clearance, and toxicity of IONPs still lingers. The properties of IONPs significantly depend on the synthesis conditions, their size, shape, crystallinity, surface potential, magnetic properties, and surface modifications. Coating of IONPs with different materialscan improve their function. Coating iron oxide nanoparticles using medicinal plants such as curcumin (Cur-IONPs) hasthe potential toenhancetheirstability and biosafety profile while increasing curcumin bioavailability. This talk addresses key aspects in the assurance of the biosafety of Cur-IONPs, namely, green synthesis of the inorganic nanoparticle core, curcumin coating process to make IONPs stable and biocompatible, characterization of the prepared Cur-IONPs, and in vivo studies on the short- and long-term biodistribution, clearance, and toxicity in rodent modelsand how these characteristics are affected by single and multidose.

Biography
Dr. Samia Aboushoushah is an associate professor and medical physicist in the Department of Physics, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia. She obtained her PhD degree from Sir Peter Mansfield Magnetic Resonance Imaging Centre, Nottingham University, United Kingdom in 2011. Her research interests include developing Magnetic Resonance Imaging (MRI) methods for medical applications and developing Functional Magnetic Resonance Imaging (fMRI) techniques to investigate the human brain. She has served as Supervisor of the Department of Physics Ladies Section from 2012-2016. Samia translated the book “MRI: the Basics” Third Edition by Ray Hashman Hashemi, William G. Badley Jr, and Christopher J. Lisanti into Arabic. Samia has been researching nano-materials compatible in the MRI environment and has studied their medical applications as contrast agents in MRI and drug delivery systems. Currently, Samia has directed her research towards the synthesis and characterization of biocompatible and nontoxic nano-materials for various medical applications.

In vivo biological effects of biosilica and marine collagen scaffolds on the process of healing in tibial bone defect in osteoporotic rats

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Abstract

Osteoporosis as a 'progressive systemic skeletal disease characterised by low bone mass and microarchitectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. Due to the reduced bone mass, osteoporotic patients have an impaired ability of bone consolidation after the occurrence of a fracture, presenting a high risk of developing pseudoarthrosis or even non-union fractures. Rigid fixation devices, such as intramedullary nails, bridge plates and tension band constructs are commonly used in the surgical procedures to treat osteoporotic fractures. However, in these situations, a high risk of implant failure and a poor biological fixation is presented due to the compromised bone and insufficient osteogenesis which cannot integrate with the implant. Considering these important issues, the use of biomaterials (mainly metallic implants and active cements) able of fixating fractures and stimulating bone ingrowth and improving tissue-implant osteointegration has been of high demand. Due to bioactive properties, the introduction of sponging-like collagen (SPG) into the biosilica (BS), both of them extracted from marine sponges, would present an enhanced biological material for improving osteoporotic fracture healing by increasing bone formation rate. Then the aim of the present work is to characterize the morphology of the BS/SPG scaffolds by Scanning Electron Microscopy (SEM), the chemical bonds of the material by Fourier transform infrared spectroscopy (FTIR) and the evaluation of the orthotopic ***in vivo*** response of BS/SPG scaffolds into tibial defects of osteoporotic fractures in rats (histology, histomorphometry and immunohistochemistry) in 2 experimental periods, 15 and 30 days. SEM showed that scaffolds were porous, showing the spicules of BS and fibrous aspect of SPG. FTIR showed characteristics peak of BS and SPG. For the ***in vivo*** studies, after 30 days BS and BS/SPG showed a high amount of newly formed bone compared to the first experimental period, observed both in the periphery and in the central region of the defect. For histomorphometry, BS/SPG presented higher %BV/TV compared to other groups. Furthermore, after 15 days, BS presented higher volumes of collagen type I and after 30 days, all groups presented higher volumes of collagen type III compared to 15 days experimental period. Additionally, after 30 days, BS/SPG presented higher immunostaining of osteoprotegerin compared to other groups at the same experimental period. The results presented that BS and BS/SPG scaffolds were able of improving bone healing. Furthermore, future research should focus on BS/SPG effects on long term periods in vivo studies.

Keywords

Bone Tissue Engineering; Biosilica; Spongin-like Collagen; Marine Sponges; in vivo studies; Osteoporosis

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Biography:

Associate Professor at the Federal University of Sao Paulo and Productivity CNPQ 1B scholarship holder.

Postdoctoral fellow at Radbond University in the area of Biomaterials and Bone Tissue Engineering. He holds a master's degree and a doctorate from the Federal University of São Carlos, and a sandwich doctorate from the Griffith University- Australia. She is currently advisor for the Graduate Program in Bioproducts and Bioprocesses (Biotechnology area)/Unifesp and for the Graduate Program in Health Sciences (Unifesp). Develops both clinical and experimental projects in applied and basic areas. In its line of clinical research, it develops projects also investigating the action of physical activity programs and electrophysical resources in the evaluation of balance, posture, gait, function, quality of life, among several other analyses used in diverse populations such as healthy elderly women, individuals with osteoarthritis, osteoporosis and fibromyalgia, among others. In his line of experimental research, he works in the area of biotechnology, Tissue Engineering and Biomaterials, investigating the action of ceramic materials, polymers and natural materials (mainly extracted from marine sponges) in the tissue repair process through in vivo and in vitro experiments.

Water-Activated Carbon-Capture: From Nanostructured to Hybrid-Integrated Membranes

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Abstract
While a wide range of carbon-capture efforts are being developed around the world to help mitigate the adverse effects of global climate change, advances in membrane technologies that combine greatly improved CO_2 separation efficacy with low cost, facile fabrication, upscaling and implementation, and mechanical robustness are still needed. Our previous efforts in this spirit have focused on modifying nanostructured polymers. While their CO_2 selectivity does not change much, their CO_2 permeability can be enhanced through the use of solvent templating and hydrothermal annealing. With promising structure-property relation-ships in hand, we begin to nanoengineer polymer systems via combinatorial means. In one study, nanocellulose is coated with a CO_2-/hydrophilic ionic liquid that permits rapid diffusion of CO_2 under hydrated conditions. By independently controlling the CO_2 solubility and diffusion, it is possible to enhance CO_2 selectivity, subject to the same trade-off encountered with most polymer membranes. In a more recent study, however, we introduce an integrated membrane strategy wherein a high-permeability thin film is functionalized with a highly CO_2-philic open, brush-like surface layer. This nanofabrication scheme is based on a low-diffusivity, high-solubility mechanism that relies on enrichment of CO_2 in the surface layer naturally hydrated by the water vapor present in all targeted gas streams, followed by fast CO_2 transport through a supported thin film of a highly permeable polymer. Spectroscopic methods confirm the existence of the amine surface layer, which also enhance surfaces roughness and, thus, separation area. Integrated multilayer membranes prepared in this fashion are not diffusion-limited and, in some cases, are able to retain much of their inherently high CO_2 permeability while their CO_2 selectivity is increased in some cases by over ~150x, far exceeding the upper bound that traditionally reflects the trade-off between gas permeability & selectivity. These new design paradigms indicate that nanoengineered membranes can exhibit the necessary functionality to achieve improved carbon capture.

Keywords
Carbon capture, CO_2 membrane, functional polymer, nanocellulose

Biography
Richard J. Spontak, a Distinguished Professor at NC State University, received his Ph.D. from UC Berkeley and pursued post-doctoral research at Cambridge University before joining P&G in 1990 and NC State in 1992. He has published over 300 peer-reviewed journal papers and 40 book chapters and invited works. He has received numerous research awards including the NC State Holladay Medal for Excellence, the ACS-PMSE Tess Award, the SPSJ International Award, the IChemE Underwood Medal, the ACS-RUBB Chemistry of Thermoplastic Elastomers Award, and the IOM3 Colwyn Medal. An IOM3, ACS-PMSE, APS and RSC fellow, he is a member of the Norwegian Academy of Technological Sciences.

Multiplexing Rubbing-Induced Site-Selective (RISS)Production of Bi_2Se_3 Based Memristive Devices

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Abstract
Bismuth selenide (Bi_2Se_3)has attracted huge attention as a quasi-2D layered material, potentially for making topological insulator (TI) and thermoelectric devices. [1-4] Recently it wasreported that Bi_2Se_3heterostructures processed with oxygen injectionexhibita resistance switching (RS) behavior,revealing its potential as a memristive material. [5,6] Pristine few-layered Bi_2Se_3 flakes are usually fabricated by mechanical exfoliation from bulk ingots or chemical vapor deposition (CVD) methods.[7] However, to manufacture large arrays of Bi_2Se_3nano/microscale devices, resist-based lithography and plasma etching have to be performed on such fragile layered materials, generating detrimental contaminations and damages. In addition, the current standard cleaning methods for nanofabrication (e.g., piranha cleaning) can hardly eliminate such lithography-introduced contaminations without causing serious damages to the device features. Such lithography-introduced contamination could greatly compromise the electrical and mechanical properties of the devices and degrade the device-to-device consistency or uniformity in the arrays. Our previous work demonstrated a rubbing-induced site-selective (RISS) method capable of generating arbitrary MoS_2 patterns with no need of additional lithography or etching processes.[8,9] To further generalize the RISS process for producing Bi_2Se_3device arrays, additional nanomanufacturing research is needed to obtain working Bi_2Se_3 device arrays.
In this paper, we report our recent progress in leveraging the RISS technology to realize site-selective growth of Bi_2Se_3 features. We further report the memrsitive switching behavior observed from the resistors made from such RISS-produced Bi_2Se_3 channels, which reveals the potential of RISS-produced Bi_2Se_3 in the application fields related to neuromorphic devices. This work presents a novel nanomanufacturing method for fabricating-Bi_2Se_3 memristor arrays and shows the potential for site-selectively growing other 2D layered materials.

Biography
Dr. Xiaogan Liang is currently working as an Associate Professor at The Mechanical Engineering Department of University of Michigan (UM). His current research interests are focused on nanofabrication, nanomanufacturing, microsystem integration, nanoelectronics and optoelectronics based on low-dimensional nanostructures, biosensors, and microdrone sensors. Dr. Liang has coauthored 73 journal publications and >50 conference presentations, has given >30 invited presentations, and has 8 US patents. Dr. Liang is the recipient of NSF CAREER Award, and he is the member of Sigma Xi, IEEE, and ASME. Dr. Liang obtained a Ph.D. in Electrical Engineering from Princeton University.

Spin reorientation in layered perovskite oxyfluoride $Pb_3Fe_2O_5F_2$

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Abstract

Control of spin alignment in magnetic materials is crucial for developing switching devices. In molecular magnets, magnetic anisotropy can be rationally controlled by varying their ligands that allow tuning of ligand field splitting energy. However, the inherent weak magnetic interaction between spins or spin-cluster results in spin reorientation (SR) occurring only at low temperatures. Here, we show that layered perovskite oxyfluoride $Pb_3Fe_2O_5F_2$ exhibits a SR transition at 380 K, with the magnetic moments changing from perpendicular to parallel to the c-axis. It is found that the SR is caused by a ferroelectric-like phase transition, where the magnetic HOMO-LUMO interaction changes upon the structural transition due to the concerted effect of the heteroleptic FeO_5F coordination and the steric effect of Pb. This finding indicates that the design of spin orientation by local coordination environment, which is common in molecular magnets, can be extended to extended oxides by introducing different anions.

Keywords

Mixed anion compounds, Oxyfluoride, Spin-reorientation, Ruddlesden-Popper type perovskite, Iron

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Biography

He received the Ph. D. of science from Kyoto University in 2010. He worked as a postdoctoral fellow in Institute for Solid State Physics, The University of Tokyo in 2010, and moved to Materials and Structures Laboratory, Tokyo Institute of Technology as an assistant professor (2010-2014). He was an assistant professor of Department of Applied Chemistry, Faculty of Science and Engineering, Chuo University from 2014 to 2019. He is currently a lecturer at Department of Applied Chemistry, Faculty of Science and Engineering, Kindai University

Green Solutions Involving Enzymes and Biomaterials

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Abstract
The oral presentation will show some green solutions using enzyme and biomaterials that were developed by our research group with others researches from Brazil. Enzymes play an important role in biotechnological applications due to their extreme versatile with respect to substrate and the ability to perform very specific chemical transformations with high catalytic efficiency and selectivity, producing fewer by-products. In addition, they are renewable and biodegradable catalyst and acts efficiently in mild reactions. Due to these characteristics, enzymes have the potential to make industrial processes environmentally friendly and more sustainable. In my lecture, I will present two studies by our research group that used enzyme in the bioremediation of contaminated water. One focuses on the use of enzyme in the biodegradation of crude oil from spills into water and the other on the biodegradation and biotransformation of pharmaceutical waste in water. Moreover, it will be presented the use of enzyme as green alternative to replace chemical catalyst in the biofuel production. To close the presentation of green solutions using enzymes, the development of a biosensor for disease diagnosis will be shown. Next, some green solutions involving biomaterials developed by ourresearch group will be presented. The first study refers to the development of mini-emulsions based on protic ionic liquids and oleic acid for treatment of dermatophytosis and the second deals with the synthesis of films based on chitosan and protic ionic liquids to be used as wound dressing on the oral mucosa. In conclusion, the aim of this oral presentation is to give an overview of some green applications using enzymes and biomaterials, inspiring newresearch ideas.

Keywords
enzyme, green solutions, bioremediation, biosensor, biomaterials, mini-emulsions,films

Biography
Roberta Bussamara is graduated in Chemical Engineering. He completed her master's and PhD in Cellular and Molecular Biology from the Federal University of Rio Grande do Sul (UFRGS - Brazil). She worked at Hayward Ind. Products in product development and marketing. She was the majority shareholder of the company InovaBio Indústria Biotecnológica de Enzimas, incubated at the Biotechnology Center / UFRGS for the period from 2008 to 2012. From 2013 to 2015, she served as Adjunct Professor in Biotechnology at the State University of Rio Grande do Sul (UERGS). She was Director of the Technological Park at UFRGS-Zenit from 2020 to 2022. In 2015, Roberta was pointed as Professor of Bioinorganic Chemistry at Federal University of Rio Grande do Sul (Brazil). She has experience in the area of Biotechnology, Biocatalysis, Nanobiocatalysis, Biomaterials and Bioinorganic Chemistry with an emphasis on health, biofuels, immobilization of enzymes, microorganisms, ionic liquids and nanoparticles.

Materials Design and Characterization Using Multiscale Modelling

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Abstract
In my talk, I will present my multiscale modeling research. As multiscale modeling spans different time and length scales, it is inherently cross-disciplinary, and so is my research. My talk will thus include different areas of research. I will primarily focus on the hydration behavior of nonfouling zwitterionic materials and the origin of chiroptical properties in 2D achiral-chiral hybrid halide perovskites (mixed-2DCHP). Additionally, I will briefly discuss on ***ab initio*** design of tungstate-based solar absorbers and high-entropy ceramics.

Keywords
Multiscale modelling, materials design, zwitterionic hydration, 2D-chiral hybrid halide perovskites, high-entropy ceramics.

Biography
Dr. Pranab Sarker is currently a postdoctoral research associate in the Department of Chemical Engineering at Howard University. Previously, he was a postdoc at the Center of Materials Genomics at Duke University. He obtained his Ph.D. in Condensed Matter Physics from the University of Texas at Arlington, USA, and a B.Sc. in physics from the University of Dhaka, Bangladesh. His research covers a broad range of topics and interests—solar energy conversion (PV and PEC), high-entropy ceramics, bio-nano interface, and zwitterionic polymers—focusing on ab initio materials design and multiscale characterization.

Integration of Carbon Nanotube Hybrid Active Textile Systems in PPE for the Ohio Fire Service

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Abstract

Firefighters (FF), experience significant hazards such as physical demands, temperature stress, exposure to toxic chemicals and other hazards. Per the 2018 National Fire Protection Agency (NFPA) injury report, the most common fireground injury were overexertion, slips/trips, and falls (1-2). Studies from our group also showed that exposures to combined shift work and heat stress detrimentally impacted FF's dynamic postural balance resulted in increased fall risk (3-4). Cumulative buildup of fatigue due to combined effects of shiftwork and overexertion in extreme environments can contribute to increased susceptibility to compromised neuromuscular health influencing their ability to sustain safe dynamic postural stability while firefighting. The economic burden of firefighter injury is estimated to range between $1.6 billion and $5.9 billion annually (2). Therefore, there is a critical need for a preventative solution to reduce firefighter injuries and hence the financial burden resulting from treatment and after-care of these injuries. Carbon Nanotube (CNT) integrated Personal Protective Equipment (PPE) can minimize thermal burden and cumulative buildup of associated fatigue resulting in reduced injuries, overexertion, slips/trips, and falls. The project will focus on measuring effectiveness and commercial viability of CNT based PPE, particularly the team's Active Textile (AT) system integrated into Firefighter Turnout Gear. Our innovative solution has the potential to prevent on the job injuries and improve workforce safety and comfort for Ohio Firefighters in the near- and long-term future. The specific goal of the project is to produce and test the industry manufactured prototype of an AT integrated removable turnout coat liner that interfaces with existing compliant V-Force turnout coats. We will work in partnership with Lion Protects, the National Institute of Occupational Safety and Health (NIOSH) and Ohio Firefighters to develop the prototype. The turnout coat will demonstrate AT technology. Main aims are to develop: (1) ***Air-Conditioned Turnout Coat*** - Protecting FF from heat related injuries caused by environmental stress and metabolic heat and compression burns. Forced air convection, optional CO2 sublimation, and CNT fabric together provide cooling by rapidly moving heat and moisture.; (2) ***Shielding Layer*** - Impermeable CNT fabric prevents toxic gases, smoke particles, liquids, viruses, blood borne pathogens, and electromagnetic radiation from reaching the body, and increases flame resistance.

Project activities include a) **Material and garment compliance testing** to meet required NFPA and ISO standards, b) **Shielding and cooling system evaluation** of AT integrated PPEvs. existing PPE, c) **Simulation testing** Sweating mannequin and environment simulation testing with NIOSH to monitor heat stress and core body temperature, d) **User-centered Ergonomic Testing**: Biomechanical and neuromuscular evaluation of postural stability, body scanning and fit analysis, design feedback and focus group with Firefighters, e) **Live Burn Testing** with Firefighters to evaluate the ability of CNT based AT system PPE to protect from hyperthermia and maintain safe postural stability, f) **Commercialization Study** to compare performance with existing industry-standard solutions, market position, and future steps for manufacturing and distribution to Ohio Firefighters, g) **Dissemination** of results to Ohio Fire Service and Fire Departments in Ohio.

CNT hybrid fabric may become a new commercial textile that our industry partners can integrate into their PPE products and provide an optional liner product. AT coats will reduce injuries and potentially save lives by providing personalized individual climate control to minimize heat stress, reduce injuries and by preventing skin exposure to carcinogens, and reduce falls. Our main goal is to evaluate the potential of our intervention to reduce injuries for Firefighters in our state.

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Can Nano Biomaterials Save Global Warming ?

Thomas J. Webster
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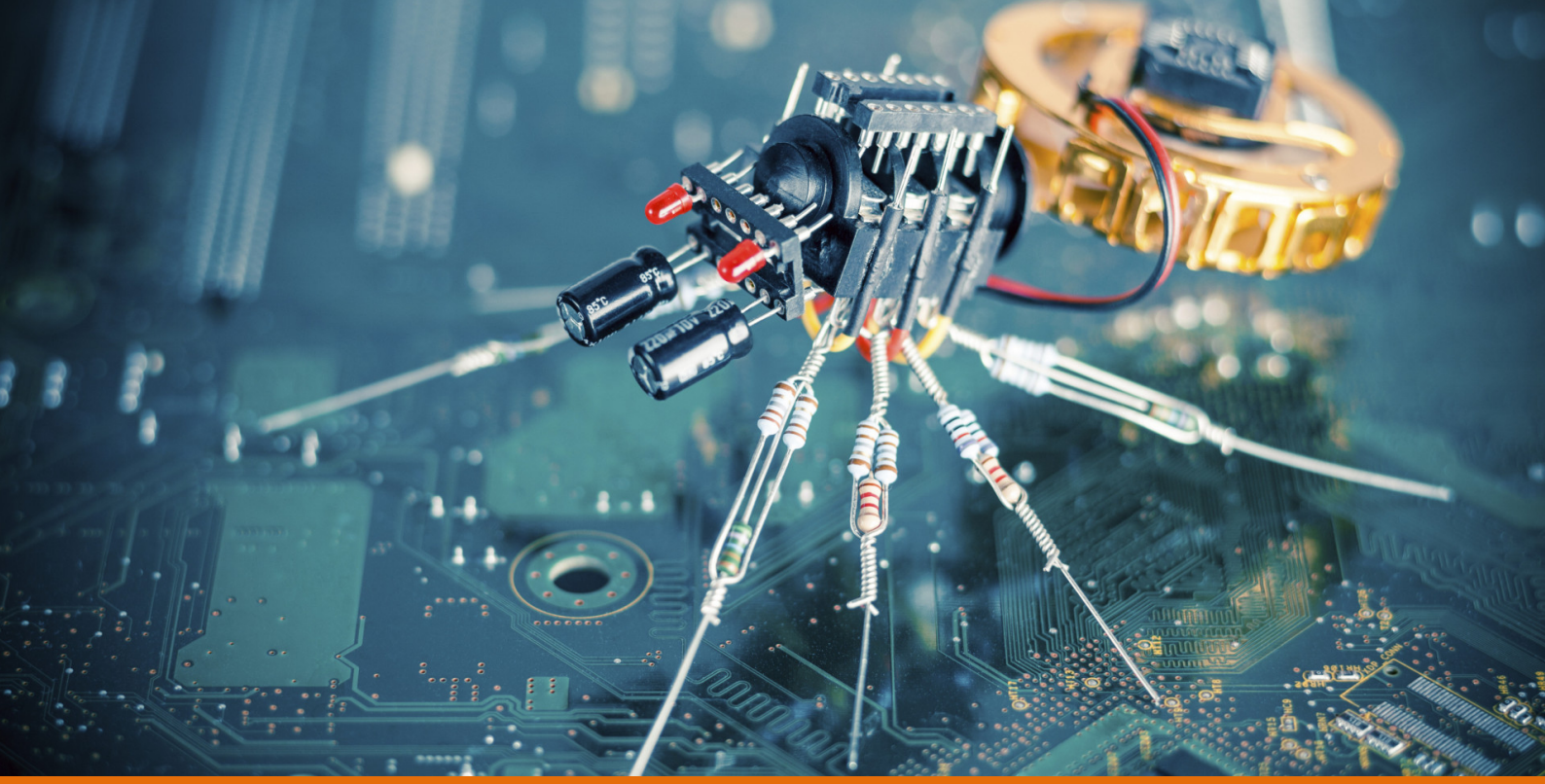
Abstract
Biomaterials are composed of some of the same materials as those used in non-medical applications (such as automobile, aerospace, consumer goods, etc.). While these other fields have moved away from using materials that are not environmentally friendly (such as those which contribute to greenhouse gases, are not environmentally degradable, have a large carbon footprint, etc.), the medical device community continues to use non-environmentally friendly plastics, metals, and other materials throughout medicine. This is despite the fact that numerous agencies have found that medical devices contribute to a large component of waste causing greenhouse gases. This is also despite the fact that plastics have been predicted to contribute 2.8 gigatons of CO_2 emissions by 2050, up from 850 million metric tons of greenhouse gases in 2019 with only 16% of plastics currently being recycled. This presentation will highlight the current failures of the medical device industry in promoting the environmentally safe production as well as the use of products that can decrease greenhouse emissions. It will also highlight recent research on the use of natural as well as biodegradable materials for a wide range of medical applications. Most importantly, it will highlight that we need a paradigm shift in all fields, not just non-medical fields but most importantly in medical fields, to reduce greenhouse emissions to reduce global warming.

Keywords
Nanotechnology, global warming, CO2 emissions, natural, biomaterials

Biography
Thomas J. Webster's (H index: 117; Google Scholar) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995; USA) and in biomedical engineering from RPI (Ph.D., 2000; USA). He has served as a professor at Purdue (2000-2005), Brown (2005-2012), and Northeastern (2012-2021; serving as Chemical Engineering Department Chair from 2012 - 2019) Universities and has formed over a dozen companies who have numerous FDA approved medical products currently improving human health. He is currently helping those companies and serves as a professor at Hebei University of Technology, Saveetha University, Vellore Institute of Technology, UFPI, and others. Dr. Webster has numerous awards including: 2020, World Top 2% Scientist by Citations (PLOS); 2020, SCOPUS Highly Cited Research (Top 1% Materials Science and Mixed Fields); 2021, Clarivate Top 0.1% Most Influential Researchers (Pharmacology and Toxicology); 2022, Best Materials Science Scientist by Citations (Research.com); and is a fellow of over 8 societies. Prof. Webster is a former President of the U.S. Society For Biomaterials and has over 1,350 publications to his credit with over 53,000 citations. He was recently nominated for the Nobel Prize in Chemistry (2023).



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