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STILL PLENTY OF ROOM AT THE BOTTOM; Surface Aligned Reaction Suggests New Paths to Nanofabrication

John C. Polanyi
University of Toronto, Canada

Abstract

Nanofabrication requires molecular collisions. Our understanding of such collisions was advanced by the introduction of crossed molecular-beams more than half a century ago. In this classic crossed-beam chemistry the molecular beams were aimed at one another, but the molecules were not. In the past year it has been shown how to go further so as to aim the molecules, rather as one aims the balls in billiards. The trick is to collimate the beam of ‘projectile’ molecules using slits of molecular size. As usual nature got there first; molecules recoiling across a crystalline surface are naturally collimated by the pattern of atoms below. In this talk we show how this concept grew, permitting Scanning Tunneling Microscopy to reveal collimated surface-molecular-beams of CF$_2$ directed along the rows of copper atoms on single-crystal Cu (110). The CF$_2$ projectiles subsequently struck a fixed chemisorbed’ target’ molecule, e.g. an adsorbed vinyl radical, at a selected impact parameter (selected miss-distance). If the impact parameter was small enough then, and only then, the projectile bound chemically to the target - nanofabrication was under way.

Biography

Dr. John Charles Polanyi, (born January 23, 1929, Berlin, Germany), chemist and educator who, with Dudley R. Herschbach and Yuan T. Lee, received the Nobel Prize for Chemistry in 1986 for his contribution to the field of chemical-reaction dynamics.

Born to an expatriate Hungarian family, Dr. Polanyi was reared in England and attended Manchester University (Ph.D., 1952; D.Sc., 1964). He accepted a research position with the National Research Council of Canada in 1952 and began teaching at the University of Toronto in 1956, accepting the title of university professor in 1974.

Dr. Polanyi developed a technique that is known as infrared chemiluminescence based on the observation that molecules, when excited, emit infrared light. By means of spectroscopic analysis of the changes in emitted light that take place during a chemical reaction, he was able to trace the exchange of chemical bonds, thus helping to detail the disposal of excess energy that occurs during the process of chemical reaction.
**Impact of Nanobiotechnology on the Future of Medicine: The Road from Nanomedicine to Precision Medicine**

**Shaker A. Mousa**  
*Endowed Chair, Tenure Professor of Pharmacology, Executive Vice President, and Chairman*  
*The Pharmaceutical Research Institute, ACPHS, Albany, NY*

**Abstract**

Over the past few years, evidence from the scientific and medical communities has demonstrated that nanobiotechnology and nanomedicine have tremendous potential to profoundly impact numerous aspects of cancer and other disorders in terms of early diagnosis and targeted therapy. The utilization of nanotechnology for the development of new nano-carrier systems has the potential to offer improved chemotherapeutic delivery through increased solubility and sustained retention. One of the major advantages of this cutting-edge technology is its unique multifunctional characteristics. Targeted delivery of drug incorporated nanoparticles, through conjugation of tumor-specific cell surface markers, such as tumor-specific antibodies or ligands, which can enhance the efficacy of the anticancer drug and reduce the side effects. Additionally, multifunctional characteristics of the nano-carrier system would allow for simultaneous imaging of tumor mass, targeted drug delivery and monitoring (Theranostics). A summary of recent progress in nanotechnology as it relates specifically to nanoparticles and anticancer drug delivery will be reviewed. Nano Nutraceuticals using combination of various natural products provide a great potential in diseases prevention. Additionally, various Nanomedicine approaches for the detection and treatment of various types of organ specific delivery, vascular targeting, vaccine, and impact of Nanoscaffold in enhancing stem cell role in regenerative medicine will be briefly discussed.

**Biography**

Dr. Mousa finished Ph.D. from Ohio State University, College of Medicine, Columbus, OH and Post-doctoral Fellowship, University of Kentucky, Lexington, KY. He also received his MBA from Widener University, Chester, PA. Dr. Mousa is an endowed tenure Professor of Pharmacology and Executive Vice President and Chairman of the Pharmaceutical Research Institute at ACPHS since 2002. Prior to his academic career, Dr. Mousa was a Senior Scientist and fellow at The DuPont and DuPont Merck Pharmaceutical Company for 17 years where he contributed to the discovery and development of several FDA approved and globally marketed diagnostics and Therapeutics.

He holds over 400 US and International Patents discovering novel anti-angiogenesis strategies, antithrombotics, anti-integrins, anti-cancer, and non-invasive diagnostic imaging approaches employing various Nanotechnology platforms. His has published more than 1,000 peer journal articles, book chapters, published patents, and books as editor and author. He is a member of several NIH study sections, and the editorial board of several high impact Journals. His research has focused on diagnostics and therapeutics of angiogenesis-related disorders, thrombosis, vascular and cardiovascular diseases bringing novel concepts from the bench to bedside to market.
MARCO-Targeting PLG Nanoparticles Modulate Inflammatory Monocytes for Amelioration of (Neuro) Inflammatory Diseases

Stephen D. Miller
Department of Microbiology-Immunology, Northwestern University Medical School, IL

Abstract

Acute inflammatory injuries are characterized by the rapid extravasation of blood-born inflammatory monocytes to the injured tissue site followed by their release of inflammatory cytokines which amplify the tissue damage and are detrimental to repair and recovery. We have developed a strategy for targeting inflammatory monocytes using carboxylated 500 nm nanoparticles comprised of the FDA-approved biopolymer poly(lactide-co-glycolide) (PLG) which we have termed immune-modifying particles (IMPs). PLG IMPs are uptaken by inflammatory monocytes via a class A scavenger receptor, termed the macrophage receptor of collagenous structure (MARCO). We have shown that I.V. infusion of IMPs has a profound ameliorating effect by limiting tissue destruction and promoting recovery in multiple inflammatory conditions including myocardial infarction, graft vs. host disease (GvHD), and importantly in a variety of neuroinflammatory conditions in mouse models including West Nile virus encephalitis, multiple sclerosis, acute spinal cord and brain injury, and epilepsy. Mechanistic studies have shown that IMPs operate by diverting blood born inflammatory monocytes from sites of tissue injury to the spleen where they induce apoptotic cell death as well as the activation of regulatory T cells with anti-inflammatory properties.

Biography

Dr. Miller is internationally known for his research on pathogenesis and regulation of autoimmune diseases and is co-inventor of the Cour toleragenic immune modifying particle technology platform. Dr. Miller is the Judy E. Gugenheim Research Professor of Microbiology-Immunology at Northwestern University Feinberg School of Medicine in Chicago. He is a consultant to a number of biotechnology and pharmaceutical companies, having assisted in the development of three new chemical entities from proof of concept through to Phase 3 testing. He has served or currently serves on grant review panels for the National Institute of Health, the National MS Society, the Immune Tolerance Network and the Juvenile Diabetes Research Foundation and on the editorial boards of multiple journals. He received his Ph.D. in 1975 from the Pennsylvania State University and did postdoctoral training at the University of Colorado Health Sciences Center before joining the faculty at Northwestern in 1981.

Two Decades of Commercializing Nanomedicine (With FDA Approval)

Thomas J. Webster
Chemical Engineering, Northeastern University, MA

Abstract

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

Dr. Thomas J. Webster’s (H index: 87) degrees are in chemical engineering from the University of Pittsburgh (B.S., 1995) and in biomedical engineering from Rensselaer Polytechnic Institute (M.S., 1997; Ph.D., 2000). Dr. Webster has graduated/supervised over 149 visiting faculty, clinical fellows, post-doctoral students, and thesis completing B.S., M.S., and Ph.D. students. He is the founding editor-in-chief of the International Journal of Nanomedicine (pioneering the open-access format). Dr. Webster currently directs or co-directs several centers in the area of biomaterials: The Center for Natural and Tropical Biomaterials (Medellin, Colombia), The Center for Pico and Nanomedicine (Wenzhou China), and The International Materials Research Center (Soochow, China). He regularly appears on NBC, CNN, MSNBC, ABC News, National Geographic, Discovery Channel, and BBC News talking about science and medicine. He has received numerous honors and is currently a fellow of AANM, AIMBE, BMES, NAI, and FSBE.

Science and Technology of Multifunctional/Biocompatible Ultrananocrystalline Diamond (UNCD™) Coatings and Applications to a New Generation of Implantable Medical Devices

Orlando Auciello

University of Texas-Dallas, Materials Science and Engineering and Bioengineering, TX
Co-Founder/Equity Holder/Investor, Advanced Diamond Technologies, IL
Co-Founder and CEO, Original Biomedical Implants (OBI-USA)
Co-Founder, OBI-Mexico

Abstract

New paradigms in the research and development of nanocarbon thin films are providing the bases for new physics, materials science, chemistry, and biological processes, impacting a new generation of multifunctional biomedical devices.

This talk will focus on discussing the science and technology of the new paradigm material named ultrananocrystalline diamond (UNCD™) in thin film form and integration into a new generation of medical devices and implants as described below:

UNCD films co-developed and patented by O. Auciello and colleagues are synthesized by novel microwave plasma chemical vapor deposition and hot filament chemical vapor deposition techniques using an Ar-rich/CH₄ chemistry that produces diamond films with the smallest grain size demonstrated today (2-5 nm). The fundamental science underlying the synthesis and properties of the UNCD films and applications to devices will be discussed. The UNCD films exhibit the lowest friction coefficient (0.02-0.04) compared with metals (≥ 0.5) currently used in many prostheses (e.g., hips, knees), electrically conductive UNCD coatings with nitrogen in grain boundaries can enable a new generation of neural electrodes, UNCD coatings are extremely biocompatible, and have been demonstrated to provide superior scaffolds for embryonic cell growth and differentiation. Original Biomedical Implants (OBI-USA) and OBI-Mexico, founded by Auciello and colleagues, are developing new generations of implantable medical devices based on the biocompatible UNCD coatings, namely: a) new generation of Li-ion batteries with ≥ 10x longer life and safer, using UNCD-based electrodes, membranes and inner wall battery case, enable next generation of defibrillator/pacemakers; b) new generation of implantable prostheses (e.g., dental implants, hips, knees) coated with UNCD eliminates failure of current metal-based implants due to synergistic mechanical wear / chemical corrosion by body fluids; c) UNCD-coated polymer with brain neurons tailored stiffness enables next generation less invasive electrodes for neural stimulation; d) UNCD-based MEMS energy generation cantilever powered by biting heart cells to power new generation defibrillator/pacemaker; e) UNCD-based MEMS cantilevers have been demonstrated as high sensitivity biosensors. A key medical device where UNCD coating has made an impact is a UNCD-coated silicon based microchip implantable inside the eye as a key component of the artificial retina to return partial vision to people blinded by genetically-induced degeneration of photoreceptors (a device named Argus II is currently in the market by Second Sight, returning partial vision to people blinded by retinitis pigmentosa).

Biography

Chair - University of Texas - Dallas. Auciello is directing basic and applied research programs on multifunctional oxide and novel ultrananocrystalline diamond (UNCD) thin films and application to industrial, high-tech and medical devices. The UNCD film technology is commercialized for industrial products by Advanced Diamond Technologies, founded by Auciello and colleagues, (2003, profitable in 2014), and by Original Biomedical Implants (OBI-USA, 2013) and OBI-Mexico (2016) for medical devices. Auciello has edited 20 books and published about 500 articles in several fields, holds 20 patents, He is associate editor of APL and Integrated Ferroelectrics, He was President of the Materials Research Society (2013). Auciello is Fellow of AAAS and MRS.

Printing of Nano and Microscale Electronics and Sensors on Flexible and Rigid Substrates

Ahmed Busnaina
Northeastern University, MA

Abstract

A new disruptive technology will be presented that will enable the fabrication of nanoelectronics at a cost of 10-100 times less than conventional fabrication while allowing device designers the use of any organic or inorganic semiconducting, conductive or insulating material on flexible or rigid substrates. This will also include leveraging nanomaterials such as two-dimensional (2D) materials, quantum dots, nanotubes, etc. Printed electronics can significantly lower electronics and sensor costs by 10-100 times. However, most currently printed systems are at 20 micron line width and larger and utilizing mostly organic semiconductors. The new technology is enabled by directed assembly-based nanoscale printing at ambient temperature and pressure that prints 1000 faster and 1000 smaller (down to 20nm) structures than ink-jet based printing. The technology enables a nanoscale printing platform, enabling heterogeneous integration of interconnected circuit layers (like CMOS) of printed electronics and sensors at ambient temperature and pressure.

The directed assembly-based printing processes were specifically created to be scalable, sustainable and designed to enable precise and repeatable control of assembly of various nanoelements at high-rate. These efforts have resulted in over 80 patent applications (20 granted to date). CHN has created processes to print arrays of nanoparticles, conducting polymers, polymer blends, 2D materials and SWNTs into various structures including 3D architectures at multiple length scales. Printed devices include transistors, inverters, diodes, chemical and biosensors, and interconnects using a variety of nanomaterials including 2D materials. Some of the printed applications include Nano LEDs, Print QDs for display, wearable electronics, micro wearable biosensors for detecting lactate and glucose in Sweat, chemical sensors, etc. We unveiled the world’s first Nanoscale fully-automated offset printing system (NanoOPS) prototype with built-in alignment and registration in 2014. This system is designed to print devices and products down to 20 nm or smaller.

Biography

Dr. Ahmed A. Busnaina, is the William Lincoln Smith Chair Professor and Director of NSF Nanoscale Science and Engineering Center for High-Rate Nanomanufacturing and the NSF Center for Nano and Micro contamination Control at Northeastern University, Boston, MA. He specializes in Nanoscale defects removal, mitigation and characterization, chemical and particulate contamination in semiconductor processes and in the fabrication of micro and nanoscale structures. He authored more than 420 papers in journals, proceedings, and conferences. He serves on the editorial advisory board of the Semiconductor International Magazine, the Journal of Particulate Science and Technology and the Journal of Environmental Sciences. He is a fellow of the American Society of Mechanical Engineers, and the Adhesion Society, a Fulbright Senior Scholar in addition to numerous listings in Who’s Who (in the World, in America, in science and engineering, etc.).

Love or Hate Water?

Li Qiu Wang
Department of Mechanical Engineering, The University of Hong Kong, Hong Kong

Abstract

This talk is on three techniques recently developed at HKU that use bioinspired microstructures to precisely manipulate liquids: water collecting, liquid repelling, and droplet capturing / releasing.
Unique structural and topological features of spider-silks and their web enable them being a super water collector witnessed by a large number of water droplets handing on them in the early morning. With the microfluidic technology, we have precisely fabricated robust microfibers with spindle cavity-knots and different topological fiber-networks in mimicking these features. These microfibers are endowed with unique surface roughness, mechanical strength, and long-term durability, thus enabling a super performance in collecting water. The maximum water volume collected on a single knot is almost 495 times the knot volume; the water collection is even more efficient and scalable with their networks. These light-weighted yet tough, low-cost microfibers offer promising opportunities for large-scale water collection in water-deficient areas.

Liquid-repellent surfaces repel liquids instead of allowing droplets to adhere. These surfaces are important in many fields including self-cleaning clothes and kitchenware, enhanced heat transfer, and anti-fouling, anti-corrosive and drag reduction coatings. The dream of research and development on liquid-repellents is a structure that has robust liquid repellency, strong mechanical stability, and is inexpensive to produce on a commercial scale. However, the functional outcomes of existing liquid-repellent surfaces have not been satisfactory, because of inadequacies of conventional structural design and fabrication approaches in engineering microstructures and properties of such surfaces. We developed a low-cost scalable approach for the fabrication of well-defined porous surfaces with robust liquid repellency and strong mechanical stability. The design of the liquid-repellent surfaces is inspired by structures on springtail cuticles, which can effectively resolve the longstanding conflict between the liquid repellency and the mechanical stability. Springtails are soil-dwelling arthropods whose habitats often experience rain and flooding. As a consequence, springtails have evolved cuticles with strong mechanical durability and robust liquid repellency to resist friction from soil particles and to survive in watery environments. We design the porous surfaces to be composed of interconnected honeycomb-like microwaxies with a re-entrant profile: the interconnectivity ensures mechanical stability and the re-entrant structure yields robust liquid repellency. The cuticle-like porous surfaces are fabricated by self-assembly using microfluidic droplets, which takes full advantage of the capabilities of microfluidics in terms of scalability and precise-handling of small fluid volumes. The generation of these cuticle-like porous surfaces using microfluidics has led to precise, controllable, scalable, and inexpensive fabrication.

Some semiaquatic insects can readily walk on water and climb up menisci slope due to the dense hair mat and retractable claws of complementary wettability on their tarsi. Inspired by this, we created a mechano-regulated surface whose adhesive force to liquid droplets can be simply switched through mechanical regulation. The mechano-regulated surface functions as a “magic hand” that can capture and release multiple tiny droplets precisely in a loss-free manner and works for both water and oil droplets down to nano-litre scale. These surfaces are relevant and crucial in various high-precision fields such as medical diagnosis and drug discovery where the precise transferring of tiny liquid is a must.

Learning from nature paves the way for creating nano/microstructures with unique features to interact with liquids on-demand. Small yet powerful, these structures can manipulate liquids effectively and precisely. With these techniques, water may be gathered directly from the air in deserts, no more laundry may become true, and liquids can be conveniently handled like solids.

Biography

Dr. L. Q. “Rick” Wang is currently a Professor in the Department of Mechanical Engineering, the University of Hong Kong (HKU). He also serves as the Director and the Chief Scientist for the Laboratory for Nanofluids and Thermal Engineering at the Zhejiang Institute of Research and Innovation (HKU-ZIRI), the University of Hong Kong. Dr. Wang has over 20 years of university experience in transport phenomena, materials, nanotechnology, biotechnology, energy and environment, thermal and power engineering, and mathematics, and 2 years of industry experience in technology and IP development/management/transfer as the Chief Scientist and the Global CTO. In addition to 6 authored scholarly monographs/books, 4 edited scholarly monographs, 8 book chapters, 63 keynote lectures at international conferences and over 120 invited lectures in universities/industries/organizations, Dr. Wang has published 200+ papers in various prestigious Journals, many of which have been widely used by researchers all over the world. He has also filed 30+ patents/software copyrights, and developed, with an international team consisting of about 100 scientists and engineers, a state-of-the-art thermal control system for the Alpha Magnetic Spectrometer (AMS) on the International Space Station (ISS).

Dr. Wang’s work has received recognition through several awards, including the 2018 TechConnect Global Innovation Award, the 2018 Silver Medal of the International Exhibition of Inventions of Geneva, the 2017 OSA Innovation Award, and the 2016 First Outstanding Achievement Award of Hangzhou Oversea Scholars, among others. His research has been widely featured by local, national and international media.
Energy-Saving and Comfortable Clothes from Recycled Plastic Bags

Svetlana V. Boriskina
Mechanical Engineering Department, Massachusetts Institute of Technology, MA

Abstract

Wearable fabrics technology provides local thermoregulation with zero carbon footprint via passive control of thermal radiation from the human skin. This control makes possible both cooling without breaking a sweat and heating without adding uncomfortable metal layers to the wearables. The technology offers a unique solution to achieve passive thermoregulation as well as significant energy savings in the buildings heating and cooling by using a cheap, abundant, and lightweight material - polyethylene. The micro-scale fiber structure or polyethylene fabrics also provides high level of comfort, breathability, and excellent sweat wicking functionalities. The fabrics can be manufactured via standard industrial processes, and can find use in everyday clothes, headwear, and athletic apparel as well as in tents, vehicle covers, bandages, gloves and face masks. Last but not least, the use of polyethylene offers opportunities for easy recycling of fabrics through well-established industrial processes as well as their fabrication from recycled materials, including colored plastics frequently discarded from the recycling pipeline.

Biography

Dr. Svetlana V. Boriskina is a research scientist in the Department of Mechanical Engineering at the Massachusetts Institute of Technology. She received her Ph.D. degree in physics and mathematics from Kharkiv National University, Ukraine. She previously worked at the University of Nottingham, UK, and Boston University. Her research focuses on the development of smart fabrics for thermal comfort, new metamaterials to manipulate light in unusual ways, and solar-harvesting platforms to provide clean energy and fresh water to off-grid and disaster-stricken communities. Boriskina has authored over 110 publications, served as the Principal Investigator (PI) or co-PI on multiple U.S. Department of Defense, U.S. Department of Energy, and NATO-funded projects, holds many patents on sensor, energy-conversion, and desalination systems. Svetlana received a Joint Award of the International Commission for Optics and the A. Salam International Centre for Theoretical Physics, a NATO-UK Royal Society Fellowship, and a SUMMA Graduate Fellowship in Electromagnetics. She is a Director-at-Large at the Optical Society (OSA), and an associate editor of Optics Express and Journal of Optics.

Porosome: Cells Secretory Nanomachine

Bhanu P. Jena
Department of Physiology, School of Medicine, Wayne State University, MI
Co-Founder and President, QPathology, MA

Abstract

Secretion is a fundamental cellular process in living organisms, from yeast to cells in humans. Since the 1950’s, it was believed that secretory vesicles completely merge with the cell plasma membrane during secretion, resulting in the diffusing out of intravesicular contents. However, the observation of partially empty vesicles in cells following secretion suggested the presence of transient or so called ‘kiss-and-run’ mechanism that allows fractional discharge of intra-vesicular contents during secretion. This proposed mechanism is mediated by a nanoscale supramolecular cup-shaped lipoprotein structure at the cell plasma membrane called porosome. Porosomes range in size from 15 nm in neurons and astrocytes, to 180 nm in endocrine and exocrine cells. Neuronal porosomes are composed of nearly 40 proteins compared to the 120 nm nuclear pore composed of nearly 1,000 protein molecules. Porosome structure, its chemical composition, and functional reconstitution into artificial lipid membrane and in live cells, and the molecular assembly of membrane-associated t-SNARE and v-SNARE proteins in a ring or rosette complex to establish the fusion pore at the porosome base, and the molecular mechanism of secretory vesicle volume increase required for intravesicular content expulsion with great precision, collectively provide a molecular understanding of cell secretion, resulting in a paradigm-shift in our understanding of the process.

Biography

Dr. Bhanu P. Jena is the George E. Palade University Professor and Distinguished Professor of Physiology at WSU School of Medicine, and former Assistant Professor at the Yale University School of Medicine. Among his many contributions is the
discovery of the porosome, the cellular nanomachine involved in cell secretion. Among the honors and awards he has received for his scientific contributions, are 6 honorary doctorates, Fellow AAAS; Foreign Member of the Academy of Science of the European Union; Foreign Member of the Georgian National Academy of Science; the Swebeibus Cancer Research Award; Sir. Aaron Klug Award; ASAS Basic Biological Science Award; Ranbaxy Basic Research in Medical Sciences Award; Foreign Member of the Korea Academy of Science and Technology; Foreign Member of the National Academy of Medicine, Romania; and the George E. Palade Medal.

Development of Nanocomposites for Energy Storage and Photocatalysis

Jae-Jin Shim*, Amr Hussein Mady, Debananda Mohapatra, Marjorie Baynosa and Ganesh Dhakal
Yeungnam University, South Korea

Abstract

Due to the increase in the use of renewable energy which has unsteady supply, energy storage has been an important issue worldwide. In addition, due to the increase in the environmental pollution, decomposition technique and efficient catalysts are required to solve the problems. Materials based on carbon materials such as graphene, carbon nanotubes, and carbon fibers have been studied for capacitive energy storage purposes. On the other hand, materials based on metal oxides or sulfides have been studied as catalysts and photocatalysts. Because their performances are limited, many attempts have been made to enhance their electrochemical properties by combining carbon materials with metal oxides or sulfides for both supercapacitors and catalysts applications. Due to their large surface area and high electrical conductivity, synergistic effects of excellent conductivities of graphene and high electrochemical properties of metal oxides or sulfides have improved the overall electrochemical performances tremendously. These composites show good electrochemical performances especially they are reduced to nano-size.

In this study, carbonaceous materials such as graphene, carbon nanotubes, carbon nano-onions and various mono-, binary-, and ternary-metal oxides or sulfides have been combined to make nanocomposites. Doping of sulfur or nitrogen has also been investigated to get higher performances.

Biography

Dr. Jae-Jin Shim received his BS degree from Seoul National University in 1980, MS degree from KAIST in 1982, Ph.D. degree from the University of Texas at Austin in 1990. He has been a Professor in Yeungnam University since 1994 and served as School Chairman and Vice-Dean of Engineering. He served as the President of the Korean Society of Clean Technology and Vice President of the Korean Society of Engineering Education. He is the Director of the Institute of Clean Technology and the Clean Energy Priority Research Center. He has published more than 170 papers in reputed journals and served as the Chief Editor of “Clean Technology”.

Physicochemical Characterization of Nano Bio-Hydroxyapatite Obtained by Thermal Annealing

Mario E. Rodriguez-Garcia1*, Sandra Milena-Londono-Retrepo1,2 and Gilberto Lopez-Chavez3
1Department of Nanotechnology, UNAM Center for Applied Physics and Advanced Technology, Mexico
2Center for Applied Physics and Advanced Technology, National Autonomous University of Mexico, Mexico
3Advanced Human Bioengineering, Mexico

Abstract

This paper focuses on the study of the cortical and trabecular bones of human, bovine, and porcine bones that are used in guided bone regeneration. The effect of the change of the crystal size on the shape and width of the X-ray diffraction patterns IR and Raman spectra for defatted and deproteinized bones as well as incinerated biogenic hydroxyapatite obtained from bovine, porcine, and human bones are analyzed. Inductively Couple Plasma showed the presence of some ions such as Mg, K, Al, Fe, Zn, and Na for all samples. The nanometric size of the crystals was determined through High Resolution Transmission Electron Microscopy in which ordered crystals were found. The calcination of raw clean bones at 720°C produced a transition of crystal size from nano to micro due to a coalescence phenomenon, this was accompanied by a decrease of the peak width of the X-ray...
diffraction patterns due to the decrease of the inelastic scattering contribution from the microcrystals. A simulation of the effect of the crystallite size on the shape and width of the X-ray patterns was done using PDF-4 software which confirmed that raw ordered bone crystals produce broad peaks which so far have been erroneously assigned to polycrystalline hydroxyapatite with low crystalline quality.

**Biography**

Dr. Mario Rodriguez is Full researcher from National Autonomous University of Mexico, Campus Juriquilla. His research fields are Bioceramics, Semiconductor materials, Guided bone regeneration, Structural and Optical Properties of Nanomaterials. He has published 190 international papers in these areas, and written a book related to food science. He is a referee of several international journals and he is the chairman of the Bioceramic Laboratories at Center for Applied Physics and Advanced Technology in Queretaro, Mexico.

**Clinical Applications of Nano-Hydroxyapatite**

**Gilberto Lopez-Chavez**

*BHA INSTITUTE, Advanced Human Bioengineering, Mexico*

*University Boulevard Juriquilla Queretaro, Mexico*

**Abstract**

The new technological era allows us to improve the processes of tissue regeneration in the medical area, in the case of bone regeneration the use of Nano-Hydroxyapatite thermo-treated bovine origin, allows us to regenerate bone segments in reconstructive surgery of the head and neck, very predictable thanks to its high purity characteristics, as well as its excellent physicochemical qualities. In this segment, the clinical application of this biomaterial and its excellent clinical results in the regeneration of bone tissues will be presented.

Note: The conference presents graphic images of surgical procedures.

**Biography**

Dr. Chavez is a Medical Surgeon Dentist from the Quetzalcoatl University of Irapuato, Guanajuato, Generation 1997-2002. He is a specialist in Oral Rehabilitation, from the Latin American University in Mexico City, Generation 2004-2006. He is also the Legal Representative of the Advanced Human Bioengineering Foundation for Latin America AC (BHA Foundation). Dr. Chavez is the collaborator and founder of the RITMAQ Medical Technology and Surgical Materials Innovation Network. He is the author of the books “Back of Oral and Craniofacial Reconstruction” and “Operative Manual for the Application of Biomaterials in Oral and Craniofacial Reconstruction”. In 2015 Dr. Chavez started the first jobs in 3D printing on titanium in Mexico. He is also the Technical advisor for Anteo Implants USA and is a Specialist in the DIO NAVI system (computer-guided surgery).
Recent Advance in Phosphorus Nanomaterials

Hai-Feng JI
Drexel University, PA

Abstract

We present the growth of ultra-long 1D red phosphorus nanowires (>1mm) and semiconductive amorphous red phosphorus films. Raman spectra and XRD were used to characterize the allotropes of the red phosphorus. The potential applications of the materials will also be discussed.

Biography

Dr. Ji is currently a Professor of Department of Chemistry, Drexel University. His research interests focus on MEMS devices, hydrogels, nanomaterials for energy and environmental applications, drug discovery, and surface chemistry. He is currently a co-author of over 160 peer-viewed journal articles and book chapters. He has co-authored 6 US patents, two of which have been licensed to companies. He has an H-index of 30. He is an editorial board member of several chemistry journals.

Nanostructured Materials for Energy Generation and Storage

Camila Zequine¹, Sanket Bhoyate¹, Fangzhou Wang², Xianglin Li³, Khamis Siam¹, P. K. Kahol³ and Ram K. Gupta¹,4*
¹Department of Chemistry, Pittsburg State University, Pittsburg, KS
²Department of Mechanical Engineering, University of Kansas, KS
³Department of Physics, Pittsburg State University, Pittsburg, KS
⁴Kansas Polymer Research Center, Pittsburg State University, Pittsburg, KS

Abstract

U.S. Energy Information Administration (EIA) estimates 28% growth in total world energy consumption from 2015 to 2040. Increasing global population has caused increased use of energy in household appliances, portable electronic devices, automobiles, aerospace vehicles and industrial equipment’s creating an urgent need for clean renewable energy generation and storage devices. Fuel cells and supercapacitors are among widely used energy conversion and storage devices. The properties of these devices largely depend on the morphology and structure of the active materials used. Tailoring the nanomorphology of electrochemically active materials could significantly affect their resultant catalytic and charge storage performance. The nanostructured morphology of multinary CuCo₂O₄ and CuCo₂S₄ was tuned using a different volume concentration of water and ethanol resulting in different nanoshapes maintaining similar crystal structure. The electrocatalytic performance was observed to largely depend on the morphology of the synthesized samples. For example, CuCo₂S₄ sample synthesized using ethanol required a low overpotential of 158 mV to reach 10 mA/cm² and 290 mV to achieve 20 mA/cm² for hydrogen evolution (HER) and oxygen evolution reactions (OER). An electrolyzer using symmetrical electrodes required a low overall cell potential of 1.66 V to achieve a current density of 10 mA/cm² and maintained stable performance for over 24 h, suggesting a promising bifunctional catalytic behavior. Furthermore, the synthesized samples were studied as electrodes for high-performance energy storage systems. The details will be presented at the conference.

Biography

Dr. Ram Gupta is an Associate Professor of Chemistry at Pittsburg State University, USA. Dr. Gupta’s research focuses on green energy production and storage using carbon, conducting polymers and composites, nanomaterials, optoelectronics and photovoltaics devices, organic-inorganic hetero-junctions for sensors, nanomagnetism, bio-based polymers, bio-compatible nanofibers for tissue regeneration, scaffold and antibacterial applications, bio-degradable metallic implants. Dr. Gupta published
From Nano to Emerging Technologies: Lessons Learned from Risk Assessment and Management

Igor Linkov\textsuperscript{1,2*} and Ben Trump\textsuperscript{2}
\textsuperscript{1}Adjunct Professor, Carnegie Mellon University, PA
\textsuperscript{2}Risk and Decision Science Team, US Army Engineer Research and Development Center, MS

Abstract

Emerging technologies research often covers various perspectives in disciplines and research areas ranging from hard sciences, engineering, policymaking, and sociology. This presentation will focus on lessons learned from 15 years of application of risk assessment and management in the field of nanotechnology and its relevance to other emerging technologies, like synthetic biology and advanced materials. Risk assessment is connected to both physical and social science, however, the interrelationship between these different disciplinary domains often occurs many years after a technology has matured and moved towards commercialization. This was the case of nanotechnology, but many emerging fields, like synthetic biology may serve an exception to this idea, where, since 2000, the physical and the social sciences communities have increasingly framed their research in response to various perspectives in biological engineering, risk assessment needs, governance challenges, and the social implications that the technology may incur. This presentation will highlight challenges in risk assessment and management experienced in the field of nanotechnology, current solution and will provide perspectives for newly emerging fields.

Biography

Dr. Linkov has a B.S. and M.Sc. in Physics and Mathematics (Polytechnic Institute) and a Ph.D. in Radiation, Environmental and Occupational Health (University of Pittsburgh). He completed his postdoctoral training in Risk Assessment and Toxicology at Harvard University. Dr. Linkov has managed multiple risk assessment and risk management projects in the areas of radiation health, risk assessment, risk management and decision analysis, supply chain management and cybersecurity.

Dr. Linkov has published widely on environmental policy, modeling, and risk analysis, including fourteen books and over 250 peer-reviewed papers and book chapters. Dr. Linkov has organized more than twenty national and international conferences. Dr. Linkov has served on many review and advisory panels for EPA, FDA, DOD, DHS, NSF, EU and other US and international agencies. Before joining DoD, he served as EPA SAB committee member. The Governor of Massachusetts has appointed Dr. Linkov to serve as a Scientific Advisor to the Toxic Use Reduction Institute. Dr. Linkov has received two Army medals for outstanding civilian service. He is the recipient of the 2014 Outstanding Practitioner and 2005 Chauncey Starr Award for exceptional contribution to Risk Analysis from the Society for Risk Analysis (SRA). He is SRA Fellow and was elected as Fellow at American Association for Advancement of Science (AAAS) in 2016.

Waterborne 3D Graphene Based Self-Assembly Materials for CO\textsubscript{2} Capture

Radmila Tomovska\textsuperscript{1,2*}, Nikolaos Politakos\textsuperscript{1} and Iranzu Barbarin\textsuperscript{1}
\textsuperscript{1}Institute for Polymer Materials - POLYMAT, University of the Basque Country UPV/EHU, Spain
\textsuperscript{2}IKERBASQUE, Basque Foundation for Science, Spain

Abstract

While recognizing the recent tremendous interest in 2D structures, one cannot disregard the importance of self-organized graphene based 3D macro-porous structures that are increasingly catching the attention of the materials scientists, due to the significant increase of active material per area and huge possibility of different applications (gas storage and separation, controlled release of drugs, supports for catalysts, sensors or biomolecules, cell scaffolds, membranes, chromatography, energy storage, optical devices etc.). In this work the synthesis of this type of materials using the advantage of hybrid water-borne polymer dispersions as matrix for reaction induced self-assembly of graphene/polymer hybrid platelets is presented. The
The proposed technique is quite versatile and by appropriate selection of polymers and the conditions of synthesis a portfolio of different 3D materials with very good chemical, thermal and mechanical stability was prepared. This allowed elucidating the mechanism of the hierarchical assembly of the platelets into the complex porous 3D materials.

The obtained 3D materials were evaluated as solid sorbents for CO\(_2\) capture. They have shown relatively high CO\(_2\) adsorption capacity (up to 4 mmol/g), depending on the porous structure, morphology and BET surface area but as well on the chemistry introduced by the selected polymers. The presence of polymer decreased their capacity for CO\(_2\) capture, but improved importantly the mechanical resistance and the stability during the processing cycles. The amount of polymer was optimized towards balance between the properties improvement at relatively high CO\(_2\) capturing performance.

**Biography**

Dr. Radmila Tomovska is a chemical engineer and Dr. Sc. (1999) from the University St. Cyril and Methodius, Macedonia. She works as Ikerbasque Researcher Professor at POLYMAT Institute, University of the Basque Country, Spain, in the area of (photo) polymerization in dispersed media, synthesis of waterborne polymeric and composite nanoparticles, and 3D graphene porous materials for various applications. Her research is supported by regional, national and EU funds, but as well by industry. She is author/co-author of more than 50 publications, from them 5 are chapters of book and one review article.

**Nanoparticle Synthesis of Titanium Compounds via the Flow-Levitation Method, Applications and Characterization**

G. Fred Lopez\(^2\), A. Zhigach\(^1\), I. Leipunsky\(^1\), N. Berezkina\(^1\), M. Kuskov\(^1\), E. Afanasenkova\(^1\) and O. Safronova\(^1\)

\(^1\)Institute for Energy problems of Chemical Physics of the Russian Academy of Science, Moscow, Russian Federation

\(^2\)Northeastern University, Boston, MA

**Abstract**

Nanoparticles of titanium compounds are desirable in a wide variety of applications. Titanium-Hydride nanopowders, for example, are an ideal alternative for storage, transportation and recovery of Hydrogen in energy applications. Titanium oxide and nitride nanoparticles are in demand as catalysts, and in photosensitive material for solar power applications. Titanium carbide nanoparticulate are desirable as high-hardness abrasives to substitute more expensive tungsten carbide compounds. They are also in demand for manufacturing high-temperature-resistance coatings, optical ceramics, and high-strength composites. Even so, producing nano-scaled particles of titanium compounds presents a significant number of challenges.

However, synthesis of nanoparticles via flow-levitation (FL) method, an innovative technique developed at the Institute for Energy Problems of Chemical Physics of the Russian Academy of Science addresses those challenges effectively. The method is highly versatile and capable of synthesizing nanoparticles of a wide variety of metals, alloys and metal compounds. The FL method allows full control of parameters and conditions to customize the chemical composition, thermo-physical properties, size and structure of nanoparticles. The technique, for example, is capable to synthesize pure stoichiometric titanium hydride (TiH\(_2\)) nanoparticles which have excellent characteristics for storage and recovery of hydrogen as demonstrated by meticulous characterization. The method also allows the controlled synthesis of customized core-shell nanoparticles where the core can be designed to be a purely crystalline phase of a metal or metal compound, such as crystalline titanium or crystalline titanium carbide or hydride (Figure 1), or nitride compounds, coated with one or two ultra-thin layers of either amorphous or crystalline material.

Characterization of titanium carbide, hydride, oxide, and nitride nanoparticulate obtained via the FL method demonstrates the technique's versatility and capability to obtain titanium compounds with the stipulated chemical composition, structure, thermo-physical properties and size.

![Figure 1. HRTEM of Titanium-compound nanoparticles synthesized via the FL method.](image)
Biography

Dr. Fred is a Faculty Member of the College of Professional Studies at Northeastern University, Boston, MA. He is also an alumnus of Northeastern University, and holds BS, MS and Ph.D. Degrees in Mechanical Engineering and Engineering Science with major in Thermo-fluids Engineering, and minor in Industrial Engineering.

His research interests and expertise include conventional and alternative energy conversion and power generation, nanomaterials synthesis, characterization and application in the aerospace and automotive industries, non-destructive testing, and evaluation of engineering materials. He has worked with scientists at NASA’s John Glenn Research Center in Cleveland, OH, in the development of Solar Dynamic Power for the international space station. He is currently working in cooperation with scientists of the Russian Academy of Sciences in research areas of Nanotechnology including synthesis and customization of nanomaterials. He has been Company Representative for the Society of Automotive Engineers (SAE), and member of Grant Review Panels for NASA, NSF, and DOD.

Why Nano Matters for Completion: From Monitoring to Healing of Smart Cement

Simone Musso
Aramco Services Company: Aramco Research Center - Houston, TX

Abstract

For several industries, nanoscale technology has finally moved from science fiction into reality. However, nanotechnology hasn’t been successfully applied yet in the petroleum industry, particularly in upstream exploration and production. Several technological advancements are necessary to successfully face new technical challenges: the industry is striving to improve productivity, oil recovery and safety of operations, while tapping into new reservoirs (unconventional resources) is becoming more difficult.

Even though research investments have been somehow difficult to justify during periods in which crude oil price is low, numerous works have shown promising applications of nanoparticles in several areas such as, hydraulic fracturing, Enhanced Oil Recovery (EOR), and monitoring of the reservoir.

This presentation aims to provide an overview of the application of nanoparticles during completion, and in particular to reinforce, monitor, and heal the cement used for zonal isolation.

Cementing the annulus between the casing and rock formation is responsible for isolating different areas of the wellbore and to provide structural support to the wellbore.

However, after the cement sets and hardens, several factors can cause the formation of cracks or microannulus at the interface of the casing and rock formation, with resulting catastrophic consequences (e.g. Macondo accident).

Conductive piezoresistive nanoparticles can be used to monitor, real time and in-situ, the performance of the cement. At the same time, the same particles can be used to trigger chemo-mechanical changes in the cement, preventing or healing any crack or debonding of the cement from the casing or rock formation.

Biography

Dr. Simone Musso is Senior Scientist at the Aramco research center. He uses his expertise in synthesis and application of nanomaterials and nanocomposites to improve drilling and completion practices, for a more efficient/safe upstream petroleum industry. He has led several successful industry-academia collaborations and his expertise is well represented by 61 papers, several patents, and products. He has been invited to become a scientific reviewer for the Kazakhstani National Center of Science and Technology, scientific advisor for Enhanced Nano Composites Inc., and he was awarded the Honorary Fellowship of the Australian Institute of High Energetic Materials.
Silicon-Organic Nanocomposites as Chemical Sensors for Explosive Trace Detection

I.A. Levitsky
Emitech Inc., MA

Abstract

We present a short review of our research and development in the field of fluorescent and conductive sensors for explosive trace detection. Sensory materials include small molecules and polymers infiltrated inside nanoporous silicon (NPSi) one dimension photonic crystals, which are specific to the presence of explosive vapors and particulates (nitro- and peroxide-based compounds). NPSi multilayer structure provides the photon confinement resulting in fluorescence band narrowing. Such approach allows improve detector selectivity and sensitivity with respect to conventional sensors (sensory material deposited on the flat substrate). Special attention is paid to multi-parametric sensing and sensor array platform as effective trends for the improvement of analyte classification and quantification. Mechanisms of molecular physical and chemical sorption inside pores of NPSi composite are discussed.

Biography

Dr. Igor A. Levitsky has over 20 years of experience in technology development, experimental and theoretical study of physical/chemical properties of organic and composite materials including nanocarbons (carbon nanotubes, fullerenes, graphene), organic-inorganic nanocomposite, ionomeric polymers, liquid crystals, and molecular aggregates. Dr. Levitsky has a Ph.D. in Physics (1995), from the Institute for Low Temperature Physics and Engineering, Kharkov, Ukraine, and an M.S. in Physical Optics in 1991 from the Department of Physics, Kharkov State University, Kharkov, Ukraine. He had postdoctoral appointment at the Chemistry Department at Massachusetts Institute of Technology (1997-1999). He is also the founder and Vice President of Emitech, Inc. (www.emitechinc.com), and Corish, Inc. (subsidiary of Emitech) high tech companies in the field of material science and nanotechnology.

Polydiacetylene (PDA)-TTA Vesicles –Nanostructure Arrays: A Potential Tool for Radionuclide Sensing

Ofra Paz-Tal3*, Reut Israel1,2 and Raz Jelinek1,2
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2Ilse Katz Institute for Nanotechnology, Ben Gurion University of the Negev, Israel
3Chemistry Department, Nuclear Research Center-Negev, Israel

Abstract

While laboratory assays e.g., mass-spectrometry-based techniques are currently available for radionuclide detection, simple, inexpensive, and easily-applicable field devices for on-site radionuclide detection have not yet introduced. Accordingly, development of an on-site sensing platform for radionuclides would have significant practical benefits.

The aim of this work was to develop a new radionuclide sensor assembly based upon polydiacetylene (PDA) - a unique conjugated polymer which exhibits interesting structural and photophysical properties, specifically visible color and fluorescence transformations that can be induced by varied target analytes and environmental conditions. We prepared PDA nano-vesicles comprising phospholipids and embedded thenoyl trifluoroacetone (TTA) which exhibits high affinity to lanthanide and actinide ions. This array served as an effective guest/host system, providing a vehicle for radionuclide (e.g., $\text{UO}_2^{2+}$, $\text{Eu}^{3+}$) detection (Figure 1).
Figure 1: Radionuclide detection schemes. A. Induction of color by capture of radionuclides; B. Blue-red transitions induced by ion binding and perturbation of PDA framework.

We present a new nanostructure which the colorimetric/fluorescence transitions can be generated through binding of the ions upon the PDA surface. The presence of TTA ligand in the PDA vesicles enhance the fluorescence of lanthanide and actinide ions especially for Eu$^{3+}$ and Cd$^{2+}$ (Figure 2) and could be effectively used as a platform for detection and speciation of lanthanide and actinide metal ions.

![Figure 2](image_url)

Figure 2: PDA nanostructure vesicles embedded with 50mM TTA in the presence of 1000ppm of each metal ions.

Biography

Dr. Ofra Paz Tal is the Head of the Organic group in the Applied Chemistry Laboratory at NRCN, Israel since 2010. He obtained his Ph.D. degree from the Department of Chemistry, Faculty of Natural Sciences, Ben-Gurion University of the Negev, Israel in the year 2000. The title of his Ph.D. Thesis was “New pyridinium substituted TTF derivatives: A route towards single component conducting molecular compounds and LB films with nonlinear optic (NLO) behavior” and his advisors were Prof. James Becker and Prof. Vladimir Khodorkovsky. His research mainly revolves around Synthesis and characterization of new organic compounds and polymers, Fluorescence Nano-Structures and Sensors. Currently he has received the Pazy Foundation Grant (2017-2021) and is working on “Molecular design and self-assembly of polydiacetylene(PDA)-ligand arrays: A potential tool for radionuclide sensing” along with his Co-PI Prof. Raz Jelinek.

Applications of Nanodiamond Colloids in Industry

Ethan Languri
Tennessee Tech University, TN

Abstract

Diamond is a well-known allotrope of carbon that has unique properties such as exceptional hardness, thermal conductivity, electrical resistivity, and refractive index. The strong covalent bonding of diamond makes it a worthy conductor of heat and excellent electrical insulator. The major traditional industrial applications of diamond are for cutting and polishing tools thanks to diamonds hardness. However, nanodiamond, nanometer-sized crystal structure of diamond, has the unique properties of diamond that can be artificially manufactured with huge potentials to be used in industry as an additive.

Particulate nanodiamond has huge potentials to be utilized as an additive to liquid and solid systems to enhance their properties, such as thermal conductivity. It is crucial to de-aggregate the nanodiamond particles effectively and then functionalized selectively to the host medium for their effective utility. This proper de-aggregation and functionalization shown to improve the heat carrying capacity extraordinary at the same pumping power. In this talk, various applications of effective nanodiamond colloids will be explained in industry. The potential applications in industry will include as enhanced coolants in electronic thermal management applications, HVAC and any closed-loop heat transfer systems, automotive applications as coolants or lubricants, power plants and utility systems and more. The opportunities in energy saving, maintenance saving and other value proposition will be explained in details and quantified.
Biography

Dr. Ethan Languri is an Assistant Professor of Mechanical Engineering and serves as the Associate Director of the Industrial Assessment Center at Tennessee Tech University. He is a registered Professional Engineer (PE) in the State of Tennessee. He received his Mechanical Engineering Ph.D. in 2011 from University of Wisconsin-Milwaukee followed by two Postdoctoral Fellow appointments at the University of Wisconsin-Milwaukee and Texas A&M University. Later, he worked as a Senior Mechanical Engineer at Applied Research Associates for about three years. Dr. Languri has been awarded several times including Kinslow Research Award by TTU and Chancellor’s Award by University of Wisconsin.

Accelerating Your Research Using Nature Research Group’s AI Powered Nanotechnology Platform

Prathik Roy1*, Pranoti Kshirsagar2 and Bettina Goerner2

1Database Research Group, Nanoscience and Technology, Springer Nature, NY
2DRG, Springer Nature Heidelberg, Germany

Abstract

Growing public and private investment into nanotechnology has led to a significant rise in nanotechnology data generated, with increasing research output and patents over the last decade. Nanotechnology has made a significant impact on a wide range of industries from medicine to aerospace – in developing new products and applications. However, utilizing this rapidly growing data remains a critical challenge. The increasing diversity of nanomaterials leads to a gap between data generation and data access. Nano.nature.com known as Nano is an artificial intelligence powered research solution under the Nature Research portfolio that aims to provide highly indexed and structured information related to nanomaterials derived from peer-reviewed journals across all major publishers and over 22 million patents with nano-imprint. These include composition, synthesis, properties, characterization methods and application information. This talk will illustrate on the impact of nanoscience around the world and how Nano can aid nanotechnology research communities to obtain fast and precise insight into the wealth of nanotechnology based scholarly knowledge.

Figure 1: Curated Nanomaterial data on Nano – a Nature research solution

Biography

Dr. Prathik Roy is the Product manager for Nanoscience and Technology at Springer Nature, New York. He is a former MacDiarmid Postdoctoral fellow from University of Canterbury, New Zealand where he developed photodetectors and solar cells. He was also a Post-doctoral fellow in National Taiwan University where he worked on graphene-based solar cells, LEDs and photocatalytic materials. He obtained his Ph.D. from NTU where his thesis focused on the synthesis of nanomaterials for biosensing. During his academic career, Prathik has published 30+ peer-reviewed research articles in addition to being the recipient of 6+ international research scholarship awards.
**Nano-Engineering the Wetting, Optical and Adhesion Property Glass Surface and its Applications**

**Prantik Mazumder**  
*Corning Research and Development Corporation (CRDC), NY*

**Abstract**

In this talk we will review recent work in CRDC aimed at manipulating the wetting, optical and adhesion properties of glass surface via surface chemistry and nano-texturing. One part of the talk will entail the fabrication of a multifunctional nanostructured surface on Corning® Gorilla® Glass that combines a wide range of optical, wetting and durability properties, including low omnidirectional reflectivity, low haze, high transmission, superhydrophobicity, oleophobicity and adequate mechanical resistance. The other half will cover novel surface treatment processes (molecular scale to few nanometer) that offer tunability of surface free energy and adhesion property of glass surface which was exploited in developing temporary bonding solutions for various applications related to semiconductor and flat panel display processing.

**Biography**

Dr. Mazumder joined Corning Incorporated in 1999 and worked on and led wide-ranging interdisciplinary research and development projects at the intersections of chemical engineering, materials science, surface and intermolecular phenomena, nanotechnology, mathematical modeling and numerical simulation. A few examples include: Plasma chemical vapor deposition system for optical fiber manufacturing, characterization and development of low-loss optical waveguides, capacitive de-ionization for water desalination, free standing silicon wafer processing for low cost photovoltaic, chemical fining of glass melt, fluorescence-independent optical sensor for high throughput screening of drugs, temporary bonding and debonding technologies for silicon or glass based devices, anti-smudge and anti-reflection surfaces, and metallization of glass and other dielectrics. He is recognized as an expert in surface and interfacial sciences, especially related to inorganic substrates such as glass. He currently leads various projects related to surface modification via chemistry and nano-engineering to achieve unique combinations of wetting, adhesion, chemical, optical, electrical and tribological properties and conductive metallization of glass. In 2017, Dr. Mazumder has been awarded the prestigious Annual Stookey Award which is Corning’s highest award for exploratory research.

**Quantized Dislocations**

**Mingda Li**  
*Department of Nuclear Science and Engineering, MIT, MA*

**Abstract**

A dislocation, just like a phonon, is a type of atomic lattice displacement but subject to an extra topological constraint. However, unlike the phonon which has been quantized for decades, the dislocation has long remained classical. This presentation is a pedagogical introduction on our recent theoretical effort of quantized dislocation, aka the “dislon” theory, with a focus on new phenomena and predictive power. By establishing a central equation “dislocation=quantum field”, the influence of dislocations to materials functionalities - such as electrical, optical, magnetic and thermal properties - can be computed in a unified manner at a full quantum many-body level.

**Biography**

Dr. Mingda Li completed his B.S. in Engineering Physics from Tsinghua University in 2009, and his Ph.D. in Nuclear Science and Engineering from MIT in 2015. Before joining the department as a faculty, he carried out research as a postdoc associate at Mechanical Engineering Department of MIT. His research is defect engineering, to develop quantum defect theories, to develop novel methods for defect characterization, and to use defects to tailor materials functionalities and quantum ordering.
Fast and Efficient Oil/Water Separation with ZnO Nanorods/Carbon Microfiber Composite Membranes

Zhaoyang Liu
Qatar Environment and Energy Research Institute, Hamad Bin Khalifa University, Qatar Foundation, Qatar

Abstract

Large quantity of oily waste water is generated from various industries, including oil exploration and oil refinery. Fast and efficient separation of oil from these waste waters is challenging due to the small size of emulsified oil droplets. Membrane filtration has the great potential for separating oil-water emulsions, due to membrane’s size sieving effect. Here, a new micro-nanostructured membrane was reported for fast and efficient oil/water separation. This membrane is made of ZnO nanorods (NR) grown on carbon microfiber (CC) substrate. Due to its high hydrophilicity and oleophobicity of ZnO nanorods, this membrane exhibits excellent antifouling property, with the oil foulants on membrane surfaces easily washed away by simple physical cleaning without chemical additives. This membrane can achieve high water permeation flux (20933.4 L m\(^{-2}\) h\(^{-1}\)) and high oil separation efficiency (over 99%), purely driven by gravity. Moreover, the facile fabrication process and inexpensive materials of this membrane provide great potential for its industrial application. This study shows a new method for fast and efficient oil/water separation with nanorods/microfiber composite membranes.

Fig. 1. (a) FESEM image of ZnO-NRs/CC membrane with ZnO-NRs grown on CC membrane. Images inserted are water contact angle and oil contact angle on the membrane, respectively, suggesting highly hydrophilic can oleo-phobic properties for the membrane. (b) Enlarged FESEM image of the ZnO-NRs/CC membrane.

Fig. 2. (a) Water permeation fluxes and oil separation rates of the gravity-driven separation process using ZnO-NRs/CC membrane for oil-in-water emulsions. (b) Microscopic image of oil/water emulsion before membrane filtration, and (c) Microscopic image of oil/water emulsion after membrane filtration, and there is no visible oil drop.
Biography

Dr. Zhaoyang Liu is a Senior Scientist in Water Group of Qatar Environment and Energy Research Institute, Hamad Bin Khalifa University, Qatar. His expertise involves the development of advanced materials and processes for water treatment. As part of Water Security Research Portfolio, Dr. Liu has been coordinating the pillar of Process Development and Optimization, which focuses on addressing the stakeholders’ issues in seawater desalination and wastewater treatment. He holds several international patents for water treatment, and some of which have been successfully licensed to commercial enterprise. He also serves as Editorial Board Member of Scientific Reports.

Constructing of Ultrathin 2D Material for Highly Efficiency Electrocatalysis

Guangtong Hai and Ge Wang
University of Science and Technology Beijing, China

Abstract

Two dimensional materials possess inherent advantages to improve electrocatalytic performance. First, two dimensional nanosheets have large surface–volume ratio, which can promote the adsorption of substrates and provide high specific surface area for electrocatalytic reactions. Moreover, the 2D nature of the nanosheets indicates short diffusion distance for electrons, which causes faster charge transfer rate and better turnover frequency. Therefore, constructing of 2D ultrathin nanosheets is an effective strategy to achieve high electrocatalytic performance.

Our group recently reported a series of 2D ultrathin materials: (1) Bimetal ultrathin metal-organic frameworks (MOFs) nanosheets were successfully prepared through a simple ultrasonic oscillation method. Due to the ultrathin feature, the surface metal atoms are highly coordinated unsaturated, which greatly benefit the adsorption process, thus offering outstanding performance. Besides, two kinds of metal atoms could generate the coupling pair, which could effectively promote the charge transfer. (2) On the basis of ultrathin nanosheets, novel 3D flower-like Ni$_2$P were synthesized through the self-assembly of ultrathin Ni$_2$P nanosheets, which retain the 2D structural advantages and offer faster electrons transfer compared with dispersed unassembled 2D nanosheets (3) To further optimized the catalytic performance, 3D porous core-shell ultrathin nanosheets were prepared via a facile stepwise hydrothermal method. The ingenious architecture possesses numerous channels for the diffusion of substrates, ideal pathway for electron transfer and larger area for adsorption compared with imporous nanosheets. Collectively, our constructing strategy provided a successful practice to prepare a series of high-efficient catalysts.

Preparation and Characterization of Alkaline Metals Doped Zinc Oxide Particles and their Adsorption Behavior

Peter Baumli$^1$, Nithyapriya Manivannan$^1$, Anna Sycheva$^{1,2}$, Ferenc Kristaly$^3$ and Gabor Muranszky$^4$

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$^2$MTA-ME Materials Science Research Group, Hungary
$^3$Institute of Mineralogy and Geology, University of Miskolc, Hungary
$^4$Institute of Chemistry, University of Miskolc, Hungary

Abstract

In the present study, undoped and doped with K+, Rb+ and Cs+ zinc oxide (ZnO) nanoparticles were prepared using solvo-thermal method. The activity of the samples towards different metal ions and the structural change in the samples based on
the doped material before and after heat treatment at 400°C were studied. The adsorption studies of the prepared samples in different concentration of the Ni ion solution were performed and the adsorbed Ni amount was measured using Atomic Absorption Spectrometry (AAS). The compositional and structural analysis of the samples were carried out using X-Ray powder diffraction (XRD). According to Scanning Electron Microscopy (SEM) measurements the morphology of ZnO has been changed from flower-like to rod-like as the effect of doping by alkaline cations. The amorphous content in the as-prepared samples was increasing from 2 to 10 wt% with increase of atomic radius of dopant.

Biography

Dr. Peter Baumli is an Associate Professor at the Institute of Physical Metallurgy, Metal forming and Nanotechnology at the University of Miskolc, Hungary. His research activities included development of nanocomposites, nanoparticles, and investigation of the wettability, grain boundary wetting.

Green Synthesis of Nano Particles from Agricultural Waste for Treatment of Oil Contaminated Water

Evidence Ahayere1,3, Doga Kavaz2,3* and Edidiong A. Essien1,3
1Department of Environmental Science, Cyprus International University, Turkey
2Department of Bioengineering, Cyprus International University, Turkey
3Environmental Research Centre, Cyprus International University, Turkey

Abstract

Around the world there is a general increase in water contamination problems, specifically caused by oily products, such as petroleum products, food products, greasy products, paints, and oily chemical products. This can also be attributed to the fact that these oily products are unavoidably used daily. This risk leads to this present study which involves the synthesis of silica Nano particles from agricultural waste (barley husk) and the treatment of contaminated water from oily substances using Nano silica synthesized from barley waste. Because of the Nano scale dimension, that Nano particles poses, agriculturally synthesized Nano particles possess large surface area (250mg/g) this results in high uptake of oily contaminants as compared to other sorbents. High uptake efficiency of 80% was recorded at pH 7. Equilibrium studies were investigated, using the UV-Vis spectroscopy and the obtained results were processed so as to produce relevant parameters. Nano particles obtained from agricultural waste proved to be an easy and cost-effective treatment for contaminated water.

Biography

Dr. Doga Kavaz is a full-time Lecturer and Associate Professor in the Cyprus international university. She has over 20 publications in many international journals, she is also the rector’s coordinator of same university.

Cu-O-Ce Solid Solutions and CuO/CeO2 Nanorods Catalysts for the Application of CO Oxidation

Shaikh Tofazzel Hossain1,2, Elizaveta Azeeva3, Kefu Zhang4, Elizabeth T. Zell,2 David T. Bernard3, Snjezana Balaz5 and Ruigang Wang6
1Department of Physics and Astronomy, State University of New York, NY
2Materials Science and Engineering Program, Youngstown State University, OH
3Department of Human Ecology, Youngstown State University, OH
4Department of Chemistry, Huazhong Agricultural University, China
5Department of Physics and Astronomy, Youngstown State University, OH
6Department of Metallurgical and Materials Engineering, The University of Alabama, AL

Abstract

An attempt to advance our understanding of the role of copper species (α, β, and γ) distribution and thermal cycling treatments on low-temperature CO oxidation was conducted by synthesizing of Cu-O-Ce solid solutions and CuO impregnated on CeO2 nanorods catalyst (CuO/CeO2) using hydrothermal and thermal decomposition methods. In this comparison study, X-ray diffraction (XRD) and Raman Spectroscopy confirmed the incorporation of copper ions into CeO2 lattice. Transmission
Electron Microscopy (TEM) images showed the evidence of shape and size of the catalysts. With the assistance of H₂ temperature programmed reduction and CO oxidation fixed-bed reactor, the catalytic behavior of the catalysts was explained; it was observed that CuO/CeO₂ nanorods catalysts exhibited an improved low-temperature catalytic performance due to strong CuO-CeO₂ interfacial interaction and the formation of oxygen vacancies. The temperature programmed reduction-temperature programmed oxidation (TPR-TPO) thermal cycling study suggested a change in oxygen vacancy concentration after each cycle, indicating an improved low-temperature reducibility.

Biography

Dr. Hossain received his Ph.D. in Materials Science and Engineering from Youngstown State University in 2018. He recently joined as an Assistant Professor in the Department of Physics and Astronomy at State University of New York at Oneonta.

A Three-Electrode EPD System for the Deposition of Carbon Nanotubes onto Silicon

Pei Zhao*, Lauren J. LeSergent, Yiqi Zhang and John Z. Wen
Department of Mechanical and Mechatronics Engineering, University of Waterloo, Canada

Abstract

This three-electrode EPD system does the deposition of CNTs onto a semiconducting silicon substrate. It is a development on the conventional two-electrode EPD system that fails in coating CNT thin films onto silicon. The three electrodes include one silicon substrate to be coated and two steel electrodes. The silicon substrate is attached to one steel electrode by using a clip, but partially separated from the steel by a piece of filter paper, to form the coupled electrodes. The steel side of the coupled electrodes is against the edge of the vessel containing the CNT solution. The silicon side of the coupled electrodes is facing the CNT solution. The second free steel electrode is placed at a certain distance from the coupled electrodes, in the CNT solution, to from the three-electrode EPD system. The coupled silicon and steel electrodes act as the anode, and the free steel acts as the cathode in this set-up. CNT films of varying qualities on silicon have been achieved with applying varying CNT suspensions (water-based and ethanol-based), voltages (30-60 V), deposition times (10-120 minutes) and separation distances between the coupled electrodes and the free steel electrode (0.6-1.6 cm). The coated CNTs have formed an entangled configuration. We believe that uses of the three-electrode EPD set-up can be extended to deposition of various particles beyond CNTs onto semiconducting or nonconducting substrates other than silicon.

Biography

Dr. Pei Zhao received her BASc and Ph.D. in Materials Science and Engineering at Tongji University in 2009 and at University of Chinese Academy of Sciences in 2014, respectively. Pei joined University of Waterloo as a postdoc in 2015 and was promoted to a research assistant professor in 2018. She has participated in various materials projects, e.g. modification of nylon for oil/water separation, ZnO nanorods for photocatalytic water purification by using a microfluidic reactor and W/Cu functionally graded materials used in fusion reactors. Pei’s current research interests focus on materials engineering and its applications in new energy resources and environmental treatments or detection.

Adaptive Finite Element Analysis for Multistage Fracturing of Rock

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Abstract

Compared with conventional water-based fracturing, the supercritical CO₂ (SC-CO₂) fracturing technology can potentially improve the fracturing effect and gas production in unconventional tight reservoirs. To comprehend the key mechanical mechanism of this technology, some governing issues, such as the heat transfer between the injected SC-CO₂ and rock matrix, multistage fracturing, pre-existing fractures, and fracturing-induced damaged, and contact slip events, need to be properly simulated via numerical approaches. However, the challenge of characterizing the complex structure of natural fractures and the physical properties of SC-CO₂ that significantly affect fracturing and heat transfer in porous rock matrix have not been
satisfactorily solved. To overcome the shortcomings of the conventional finite element methods that impede the automatic remeshing to fit the simulation of fracture propagation, in this study, we introduce an adaptive finite element–discrete element method and local remeshing strategy to simulate the propagation of fracturing fractures. The proposed numerical model involves the crucial governing issues of a multistage SC-CO$_2$ fracturing, such as heat transfer, thermal-hydro-mechanical coupling, the interaction between the fracturing fractures and the embedded pre-existing fractures, leak-off of fracturing fluid, proppant transport, and gas production prediction. Based on the changes of the computed stresses, the distribution and magnitudes of microseismic damaged and contact slip events can be identified, allowing us to predict the microseism caused by fracturing. The fracture network and consequent heat transfer and fluid flow induced by slick water and SC-CO$_2$ fracturing in engineering-scale unfractured and naturally fractured models are compared in the same manner to evaluate the influence of SC-CO$_2$ on multistage fracturing behavior, thermal effects, gas production, and microseismic effects. Numerical results show that SC-CO$_2$ fracturing can improve the fracturing effect as well as increase the production rates but may not simultaneously induce additional microseismic events.

Alzheimer’s Disease Neuropathology is Exacerbated Following Traumatic Brain Injury: Neuroprotection by Co-Administration of Nanowired Mesenchymal Stem Cells and Cerebrolysin

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9Drug Development and Discovery, Ever Neuro Pharma, Austria
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11Pathology, University of Maryland, MD

Abstract

Military personnel are often prone to traumatic brain injury (TBI) that enhances the possibility of Alzheimer’s disease (AD) at a later stage. Since TBI leads to breakdown of the blood-brain barrier (BBB) and extravasation of serum proteins into the brain fluid compartment, it is quite likely that plasma amyloid beta protein (AbP) may enter into the brain after TBI leading to development of AD. Thus, there is a need to understand the role of TBI in AD. AD like brain pathology was induced by intracerebroventricular (i.c.v.) administration of soluble form of AbP 200 ng/30 µl per day into the left lateral ventricle for 4 weeks in a rat model. This treatment resulted in AD like pathology e.g., deposit of AbP in the brain as well as BBB breakdown, edema formation and neuronal, glial and axonal injuries. In order to find out role of TBI in AD development, rats were subjected to mild concussive head injury (CHI) by dropping a weight of 114.6 g over the exposed parietal skull bone from a 20 cm height through a guide tube. This adjustment resulted in an impact of 0.224 N over the skull surface. In these CHI inflicted animals AbP was infused in identical conditions starting from 1 week after injury for 4 weeks. Our observations show that AbP infusion in CHI rats exacerbated BBB breakdown to serum proteins by 2-4 fold, edema formation by 1.5 to 2 fold and marked increase in neuronal, glial or axonal injuries as compared to AbP treatment in normal animals. Immunohistochemical examination revealed enhanced deposits of AbP in the brain in CHI group after AbP infusion. The glial reactions and myelin damages were also much more aggravated. Extravasation of albumin was also increased in several brain regions in CHI group after AbP infusion as
compared to normal animals. Administration of mesenchymal stem cells (MSCs, ca. 1 million, i.c.v.) 1 week after AbP infusion resulted in marked neuroprotection as seen by reduced BBB leakage, AbP deposits and brain pathology in normal animals. Likewise i.c.v. administration of 50 µl cerebrolysin daily for 3 weeks starting from 1 week after AbP infusion was neuroprotective in normal animals. However, in CHI group these treatments either alone or in combination were ineffective. Interestingly when TiO2 nanowired MSCs and cerebrolysin administered together in identical conations, significant neuroprotection was achieved in AD cases in CHI group. Taken together, our observations are the first to point out that co-administration of MSCs and cerebrolysin using nanowired delivery has far more superior neuroprotective effects in AD model in CHI, not reported earlier.

Biography

Dr. Hari Shanker Sharma, Director of Research (International Experimental Central Nervous System Injury and Repair, IECNSIR), University Hospital, Uppsala University is Professor of Neurobiology (MRC), Docent in Neuroanatomy (UU) and is currently affiliated with Department of Surgical Sciences, Division of Anesthesiology and Intensive Care Medicine, Uppsala University, Sweden. Dr. Sharma received the prestigious Distinguished International Scientists Collaboration Award (DISCA) by National Institute on Drug Abuse (NIDA), Baltimore, MD (2006–2008). His research on nanoparticles in Neurodegeneration and Neuroprotection is supported by US Air Force Research and Development, Dayton, OH, USA. Dr. Sharma published over 400 peer reviewed research papers (H-index 41).

Integrative Chemistry toward “Out of the Box” Heterogeneous Catalysis

Renal Backov

University of Bordeaux, France

Abstract

We will show how, when combining chemistry and the physical chemistry of complex fluids, we can trigger the design of highly efficient heterogeneous catalysts. We will thus focus the topic on 3D-macrocellular monolithic foams bearing hierarchical porosities and applications thereof toward heterogeneous catalysis where both activities and mass transport are enhanced. We will first depict the overall synthetic path, focusing on concentrated emulsions and lyotrope mesophases, acting as soft templates at various length scales. We will see how we can design cellular materials being either, inorganic, carbonaceous, hybridized or living ones where heterogeneous catalysis applications are addressed while considering respectively acidic, metallic, enzymatic or bacterial processes. Along, we will demonstrate how the fluid hydrodynamic, the low molecular hindrance and the easiest accessibility occurring within these foams are offering advanced “out of the box” heterogeneous catalysis whatever acting in batch, on-line or when dedicated toward cascade-type chemical reactions. Finally, we will depict the first CO₂ photo-reduction process acting in volume and not on surface anymore, enhancing electronic density, minimizing both foot-print penalty and back-reactions.

Biography

Dr. Renal Backov is Professor at the University of Bordeaux since 2010. His current research is performed at the French Centre de Recherche Paul Pascal-CRPP (CNRS) UPR 8641. His main subject of research is the rational design of advanced functional materials through combining the physical chemistry of complex fluids and chemistry. As the synthetic paths employed is pleading for a strong interdisciplinary approach of chemical science, he formalized the concept of Integrative Chemistry in 2006. He was Laureate of the solid-state chemistry division of the French chemical society in 2013 while being currently invited Professor at the MIT, Cambridge, MA.

Bioinspired Wettability Surfaces: Development in Micro- and Nanostructures

Yongmei Zheng

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Abstract

Biological surfaces create the enigmatical reality to be contributed to learning of human beings. They run cooperate between
of endlessly arranged various-style gradient micro- and nanostructures (MN) that greatly provide with excellent functions via natural evolvement. As known, a combination of multiple gradients in a periodic spindle-knot structure take on surface of spider silk after wet-rebuilding process in mist. This structure drives tiny water droplets directionally toward the spindle-knots for highly efficient water collection. Inspired by the roles of gradient MNs in spider silk, a series of functional fibers with unique wettability has been designed by various improved techniques such as dip-coating, fluid-coating, to combine the Rayleigh instability theory. The geometrically-engineered thin fibers display a strong water capturing ability than previously thought. The bead-on-string hetero-structured fibers are capable of intelligently responding to environmental changes in humidity. Also a long-range gradient-step spindle-knotted fiber can be driven droplet directionally in a long range. Besides, inspired by gradient effects on butterfly wing and lotus leaves, the surfaces with ratchet MN, flexible lotus-like MN are fabricated successfully by improved methods, which demonstrate that the gradient MN effect rises up distinctly anti-icing, ice-phobic and de-ice abilities. These multifunctional materials can be designed and fabricated for promising applications such as water-collecting, anti-icing, anti-frosting, or anti-fogging properties for practical applications in aerospace, industry and so on.

Biography

Dr. Yongmei Zheng is a Professor at School of Chemistry, Beihang University. Research interests are focused on bioinspired surfaces with gradient micro- and nanostructures to control dynamic wettability, and develop the surfaces with characteristics of water repellency, anti-icing, or fog-harvesting, tiny droplet transport, and so on. Publications are more than 100 SCI papers included in Nature, Adv. Mater., etc., with 12 Cover stories, and a book “bioinspired wettability surfaces: Development in micro- and nanostructures” by Pan Standard Publishing, USA. Her work was highlight as scientist on News of Royal Society of Chemistry, ChemistryWorld in 2014. She is a member of Chinese Composite Materials Society (CSCM), American Chemistry Society (ACS), International Society of Bionic Engineering (ISBE), and International Association of Advanced Materials (IAAM). She wins an ISBE outstanding contribution award in 2016 by ISBE. Her homepage: http://www.zhengyongmei.polymer.cn.

Current Progress in Nanocarrier Design for the Treatment of Lung and Metabolic Diseases

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Abstract

Nanoparticulate delivery system receives a widespread interest for use to deliver therapeutics to treat lung diseases such as cancer and tuberculosis, and metabolic disease such as diabetes. With reference to lung diseases, pulmonary delivery of nanoparticles is challenged by exhalation. Several approaches have been developed to form nanoparticles with suitable aerodynamic diameters for lung delivery, namely nano-agglomeration, nanocomposite formation and microencapsulation. The current approaches require meticulous formulation efforts and the particles are poorly dispersed. The microencapsulated dosage forms run the risks of inadequate nanoparticle release and have nanoparticle size altered with loss of size-dependent biological performances. This presentation highlights physical blending of microscale lactose particles with nanoparticles (nanoparticles-on-microparticles system) as the alternative approach to deliver drugs via the pulmonary route. The critical nanoparticulate physicochemical parameters that are required for pulmonary inhalation are identified. In the case of diabetes, oral insulin delivery is met with physical, chemical and enzymatic barriers which negate drug bioavailability. The use of nanoparticulate system is challenged by premature drug release and degradation, and ineffective transmucosal transport. This presentation summarizes current advancements in oral insulin nanocarrier designs and intends to address the possible success of oral insulin as the replacement delivery strategy of injectable and inhaled insulin.

Biography

Dr. Wong Tin Wui obtained his Ph.D. degree from National University of Singapore in 1999. He is presently the Lecturer and Researcher at Universiti Teknologi MARA. His research areas focus on targeted drug delivery. He has published over 110 peer reviewed articles. He is the editorial board member of Asian Journal of Pharmaceutical Sciences, associate editor of Drug Design, Development and Therapy, regional editor of Current Drug Delivery, co-Editor-in-Chief of Recent Patents on Drug Delivery and Formulation. Dr. Wong is the working committee for National Nanotechnology Directorate/Centre, Ministry of Science, Technology and Innovation Malaysia, and research grant assessor for European funding organization (Belgium and Czech Republic) as well as Ministry of Energy, Science, Technology, Environment and Climate Change and Ministry of Higher Education Malaysia.
Nano Surgery

Huanchen Li
NanoSurgery Inc., MA

Abstract

We use Diamagnetic Nanoparticles to do surgeries. It can do everything conventional surgeries do, but without incision. With external magnets, we manipulate in vivo diamagnetic nanoparticles in a 3D manner into targets such as a tumor, and then heat the nanoparticles to destroy the targets. Patent Number: 9833415, issue date: 12/05/2017, title: “3D tumor targeting with diamagnetic repulsion”.

Brain Injury Exacerbates Neuropathology of Sleep Deprivation: Superior Neuroprotection By Co-Administration of TiO2 Nanowired with Alpha-MSH and Cerebrolysin

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10Drug Development and Discovery, Ever Neuro Pharma, Austria

Abstract

Sleep deprivation (SD) is common in military personnel engaged in combat operations. Our previous reports show that 12 h SD alone induces brain pathology and continued until 72 h in a progressive manner. However, these military personnel with SD are also prone to traumatic brain injury (TBI). Thus, a possibility exists that TBI could further exacerbate SD induced brain pathology. Several lines of evidences suggest that both in TBI and in SD a decrease in alpha-melanocyte stimulating hormone (MSH) and brain derived neurotrophic factor (BDNF) levels occur in plasma as well as in the brain. This could be one of the leading causes of brain pathology in SD or in TBI. Thus, exogenous supplement of alpha-MSH and/or BDNF could induce neuroprotection in SD or TBI. In present investigation effect of concussive head injury (CHI) in SD induced brain pathology and effects of alpha-MSH and neurotrophic factors treatment leading to neuroprotection in a rat model was examined. SD was induced in rats using the inverted flowerpot methods surrounded by water level 1 cm below the platform (6.5 cm in diameter) that allow free movement but continuously sleep leads to fell down in water disturbing the sleep process. SD was induced in healthy rats as well as in rats that were subjected to CHI by dropping a weight of 114.6 g over the skull causing an impact of 0.224 N on the brain without skull fracture. Rats subjected to 48 h SD in CHI (24 h after insult) exhibited greater brain pathology e.g., higher leakage of Evans blue albumin and radioiodine ([131]-I) by 3-to 4 fold as compared to naïve rats subjected to identical SD. Neuronal, glial and axonal damages using histopathological techniques were also exacerbated by several fold in CHI after SD. Plasma alpha-MSH and BDNF level shows significant reduction (alpha-MSH 8.34±0.23 vs. Control 20.34±0.12 pg/ml; BDNF 8.23±0.11 vs. control 22.34±0.21 pg/ml) in SD group after CHI as compared to SD group alone (alpha-MSH 15.13±0.12 pg/ml; BDNF 14.23±0.08 pg/ml). Intravenous administration of alpha-MSH (100 µg/kg) together with cerebrolysin (a balanced composition of several neurotrophic factors and active peptide fragments 5 ml/kg) significantly induced neuroprotection in CHI or SD groups alone. However, TiO2 nanowired delivery of alpha-MSH and cerebrolysin is needed to induce neuroprotection in SD rats after CHI. The levels of alpha-MSH and BDNF were also retired by this treatment in SD rats after CHI (alpha MSH 22.34±0.12 pg/ml; BDNF 23.34±0.17 pg/ml). Taken together our results are the first to point out that TiO2 nanowired administration of alpha-MSH and cerebrolysin induces superior neuroprotective effects following SD in CHI, not reported earlier.
Chronic Exposure to Graphene Oxide can Influence on Life Expectancy and DNA Stability in Acheta domesticus

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Department of Animal Physiology and Ecotoxicology, University of Silesia in Katowice, Poland

Abstract

Nanoparticles, including graphene oxide (GO), can cause adverse effects in organisms. Like in the case of other xenobiotics, GO toxicity depends on concentration, time of exposure, co-occurrence of other compounds, the condition of an organism and many other factors.

The aim of the study was to check how chronic GO administration at low doses (concentrations: 0.2, 2 and 20 µg/g of food), lasting for three generations, can affect the survival and the level of DNA damage in hemocytes of house cricket (Acheta domesticus). Kaplan-Meyer survival analysis and log-rank test (STATISTICA® 11 PL, StatSoft Inc.) were applied to assess the effects of GO on cricket mortality during their lifespan. For assessment of DNA damage the Comet assay was used.

Administration of GO at concentration of 0.2 and 20 µg/g of food (groups GO0.2 and GO20, respectively) slightly shortened life of the first generation. Meanwhile, lifespan of insects which consumed food spiked with GO at concentration of 2 µg/g (group GO2) were the same as in control group. In the first and second generation, regardless of the dose, GO did not increase the DNA damage or even decreased its level. In the third generation, a tendency to increase GO-induced DNA damage was observed, especially in the GO20 group.

At doses used in the experiment (0.2-20 µg/g of food), GO does not significantly affect stability of DNA. Unfavorable changes may, however, appear in subsequent generations subjected to chronic exposition. Adverse effects of GO can be reduced by vitamin C supplementation.

Acknowledgement: The research was supported by the National Science Centre (NCN) based on Agreement No. UMO-2016/23/N/NZ7/01977.

Biography

Dr. Maria Augustyniak is a Professor of biology working in the Department of Animal Physiology and Ecotoxicology. The most important areas of her interest are studies of the impact of environmental stress on organisms, phenomena of adaptation, phenotypic plasticity and cross tolerance in animals exposed to xenobiotics, including nanoparticles. Her scientific work includes experiments on invertebrates, often carried out at various levels of the biological organization - from molecular to population level. Dr. Maria Augustyniak paid a lot of attention to the study of DNA damage, using the comet assay, in invertebrates under various types of stress.
A Chip-Based Nano-Optic-Fluidic Biosensor for Protein Detection

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University of North Carolina at Greensboro, NC

Abstract

There is an unmet need of point-of-care (POC) biosensor technology for decentralized laboratory testing, especially for protein biomarker measurements in blood samples. The challenge of whole blood assay is the complexity such as the cells interference. Herein we report our progress of a chip-based biosensor that incorporate an optical transmission sensing scheme with an automated size-dependent sample delivery function in a single nanoscale unit. Combining computational tools for structure optimization and experimental validation, a novel ledged nanoslit array at gold thin film has been developed to provide high sensitivity in surface plasmon resonance (SPR) induced transmission wave shift and delivery of protein biomarkers for optical sensing.

A specific application of the biosensor is focused on a rapid early diagnosis of heart failure, especially myocardial infarction, by monitoring cardiac biomarkers. We account a device with a micro-structured fluidic, flow-over dam with the nanoledge array (stair-step) features milled into the top of the dam. Fluorescent microspheres, whose size is similar to blood cells, are shown to hang up on flow-over dams with undercut sidewall angles and pass over top of the dams with overcut sidewall angles. Arrays of nanoledge structures are functionalized a DNA aptamer and used in the detection of Troponin T, one of the biomarkers for acute myocardial infarction (MI) or a heart attack. Testing of real blood samples is underway. This research offer promise for a complete lab-on-chip biosensor combining on-chip/in-line blood sample handling integrated with a simple, label-free, optical detection system.

Biography

Dr. Jianjun Wei is an Associate Professor of Nanoscience at the Joint school of Nanoscience and Nanoengineering (JSNN), the University of North Carolina at Greensboro. Prior to joining JSNN, he had worked in CFD Research Corporation in Huntsville, AL, from 2006 to 2013, and led as a Principal Scientist (PI and co-PI) for a number of BAA, SBIR/STTR Phase I, II, and III US government contracts, primarily through NIH, NASA and DOD research grants. He obtained his Ph.D. in chemistry in 2004 at the University of Pittsburgh, followed with one-year postdoctoral fellowship at the same university.

A Versatile Platform for Adding Functional Properties to Amyloid Fibrils

Charles E. Jakobsche
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Abstract

The overall objective of this work is to develop a general method for manipulating the functional properties of amyloid fibril structures. The approach is to design and synthesize a family of molecular tools that can be used to localize new functional units onto the fibrils and thereby modify their properties by adding new functions at the molecular level. The presentation will show some prototype members of this family of molecular tools and show that they not only can bind to a various amyloid fibril but can also endow those fibrils with new functional properties. These results set the stage for future applications of this strategy, which could include 1) manipulating the properties of disease-relevant fibrils, 2) creating functional nanomaterials on fibrillar scaffolds, or 3) studying the structures of the fibrils themselves.

Biography

After receiving his undergraduate education at Williams College, Dr. Jakobsche received his Ph.D. in organic chemistry from Yale University in 2009 under the direction of Scott Miller. As a postdoc in David Spiegel's group he studied chemical biology by designing bifunctional organic molecules that can direct immune responses against cancer cells. At Clark University Dr. Jakobsche maintains has a wide range of interest that span the interface of organic chemistry, chemical biology, and medicine, and that often focus on the concept of “function-oriented” organic synthesis.
Production of Nanoparticles Based on Supercritical CO2 Antisolvent Nanotechnology and its Application in Food and Pharmaceutics

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Abstract

Nanoparticles have attracted more and more attention in the food and pharmacy industries. Encapsulation of active components by biodegradable polymers provides a way to control the release of drugs and bioactive ingredients and to protect the material from light or oxygen damage. Also, active-ingredient loaded nanoparticles have been designed as an efficient drug delivery carrier to improve the bioavailability of the drug. Supercritical CO2 anti-solvent (SAS) nanotechnology has become a very attractive alternative to many conventional approaches to produce solvent-free and uniformly distributed nanoparticles because it has many advantages, such as non-toxic, environment-friendly, inflammable, low viscose, low cost, and a moderate critical pressure and temperature. Compared with most traditional processes, such as milling, spray-drying, recrystallization using solvent evaporation and liquid antisolvents, the SAS technique has lower residual solvents, simpler steps, and mild operation temperatures. In this paper, the production of nanoparticles used in the pharmaceutics and food fields using SAS are presented. The advanced fabrication processes based on supercritical CO2 antisolvent are investigated in terms of morphology and size, yield, and loading. The model substances, such as curcumin, thalidomide, hydroxypropyl methylcellulose phthalate, and the composite of the PLGA–HPMC, 5-Aminosalicylic Acid-Eudragit S100, PLA-PEG, Lutein-Zein, Curcumin–PLGA, Melatonin-Zein were selected for producing nanoparticles. The effects of operating parameters on the particle size and yielding are investigated and discussed, such as pressure, temperature, solution flow rate and solvent nature. Also, the mechanism of forming nanoparticles in modified SAS process is explained.

Biography

Dr. Yaping Zhao is a Professor of Chemistry and Chemical Engineering, Shanghai Jiao Tong University, obtaining Ph.D. from Jiangsu University in 1997 and a visiting scholar at Stanford University in 2009. His professional field is Chemistry and Process Engineering in Supercritical Fluid; Preparation of organic and inorganic nanomaterial based on supercritical CO2 and H2O, respectively; Exfoliation of graphite into graphene and its application. He has carried out more than 20 items of the project coming from the National Natural Science Foundation, and industry funding. He has published more than 120 articles and hold more than 20 patents.

Nanomedicine in Parkinson’s and Alzheimer’s Disease

Rajnish Kumar Chaturvedi
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Academy of Scientific and Innovative Research, CSIR-IITR Campus, India

Abstract

Parkinson’s disease (PD) and Alzheimer’s disease (AD) are two slow, chronic and progressive neurodegenerative disorder, which are characterized by loss of dopaminergic and cholinergic neurons respectively. Existing drug therapy in Parkinson’s disease such as dopamine precursor L-DOPA only provides symptomatic relief with several side effects. The neurotransmitter dopamine is not able to cross the BBB, and direct delivery of dopamine into the brain is not possible in PD patients. Therefore, constant and safe delivery of dopamine beyond the blood brain barrier (BBB) is a major setback in PD therapy. Similarly, process of generation of new neurons (neurogenesis) is reduced in AD, and activation of this process by targeting endogenous neural stem cells (NSC) could be a potential therapeutic regenerative approach. Curcumin, a neuroprotective agent, has poor brain bioavailability, thus we formulated dopamine-loaded PLGA nanoparticles (DA NPs) and curcumin-PLGA nanoparticles (Cur-PLGA-NPs) to deliver dopamine and curcumin in the brain of animal model of PD and AD respectively.

We found following intravenous delivery, DA NPs crossed the BBB and slowly and constantly released dopamine in the different brain regions such as substantia nigra and striatum of a 6-hydroxydopamine (6-OHDA)-induced rat model of PD. DA NPs also prevented DA auto-oxidation mediated neurotoxicity as compared to bulk dopamine. Systemic administration of DA
NPs caused significantly increased levels of neurotransmitter dopamine and reduced DA-D2 receptors super-sensitivity in the striatum of parkinsonian rats. DA NPs significantly recovered neurobehavioral abnormalities in parkinsonian rats. Interestingly, DA NPs did not show DA mediated peripheral toxicity (1).

We also found that curcumin-encapsulated PLGA nanoparticles (Cur-PLGA-NPs) induce NSC proliferation and neuronal differentiation in vitro and in the hippocampus of adult rats, as compared to bulk curcumin. Cur-PLGA-NPs significantly increased expression of neurogenic and Wnt pathway genes. Cur-PLGA-NPs increase neuronal differentiation by activating the Wnt/β-catenin pathway. Inhibition of the Wnt pathway blocked neurogenesis-stimulating effects of curcumin. These nanoparticles reversed learning and memory impairments in an amyloid beta induced rat model of AD-like phenotypes, by inducing neurogenesis (2).

References:

Biography
Dr. Chaturvedi is working as Senior Scientist at CSIR-IITR, Lucknow, India. His group is trying to understand how environmental toxicants affect key events of neurogenesis including regulatory cell signaling pathways. They are also involved to assess the molecular and/or cellular events that are target(s) for inhibition of neurogenesis. In other project they are involved in identification of molecules which can induce “Brain Self Repair” by activating resident Neural Stem Cell Population. His research work has been published in prestigious international journals like ACS Nano, Journal of Biological Chemistry, Nature Medicine, EMBO Molecular Medicine, Human Molecular Genetics etc.

Highly Sensitive Near-Infrared (GdNd)₂O₃ Nanothermometers Operating in the Biological Windows

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Abstract
Non-contact, self-referenced and near-infrared luminescent nanothermometers have been recognized as emerging tools in the fields of nanomedicine and nanotechnology due to their great capability of precise temperature readout at the nanoscale and real-time deep-tissue imaging (1,2). However, the development of multifunctional and biocompatible luminescent nanothermometers operating within the optically transparent biological windows with high thermal sensitivity (>2.0%·K⁻¹) remains challenging. Here, we report supersensitive nanothermometers effectively operative within the optically transparent biological windows based on (Gd₀.⁹₈Nd₀.₀₂)₂O₃ spherical particles under laser diode excitation at 808 nm in the physiological temperature range (298–338 K) (3). The thermometric parameters were evaluated and compared for powder samples and colloidal nanoparticles in a cell culture medium using the integrated intensity ratio between the emissions originated from the ⁴F₃/₂ Stark sublevels (R1 and R₂) to the ⁴I₉/₂, ⁴I₁₁/₂ and ⁴I₁₃/₂ multiplets. The temperature sensitivity is highly dependent on the medium, and a high sensitivity of 2.18%·K⁻¹ at 298 K is achieved for the colloidal nanoparticles in the 800–965 nm range, which is the highest known temperature sensitivity for colloidal nanoparticles working in this spectral window. The nanothermometers are biocompatible with human MNT-1 melanoma cells, showing their potential for applications in nanomedicine, e.g., intracellular imaging and temperature mapping.

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FEDER-016687) is acknowledged. MLD and HO thank FCT for the post-doctoral grants (SFRH/BPD/93884/2013 and SFRH/BPD/111736/2015, respectively).

References:

Biography
Dr. Mengistie Debasu is a Researcher at the University of Aveiro (UA), Portugal. He received his B.Ed. degree in physics from Bahir Dar University in Ethiopia (2004) and joint M.Sc. in Materials Science from UA, Aalborg University and Hamburg-Harburg University of Technology (2009). He concluded his Ph.D. study in Materials Science and Engineering at UA in 2013. From 2014–2018, he was a postdoctoral researcher at UA. Recently, he has been awarded a competitive national (FCT) project grant (221k €). His current research interests include the study, design and development of multifunctional nanoplatforms for emerging applications in the fields of nanomedicine and nanotechnology, e.g., hyperthermia, bioimaging and temperature sensing at the nanoscale.

Mesenchymal Stem Cell Engineering using Ferrimagnetic Nanocube for an Improved Ischemic Stroke Treatment

Tianyuan Zhang*, Qianhao Xu, Daishun Ling and Jianqing Gao
Zhejiang University, China

Abstract
Ischemic stroke is a nasty disease with high morbidity and mortality worldwide, though desperately needed, there are thus far no pharmacological treatments available for the efficient recovery post ischemic stroke. Recently, the emerging of stem cell therapy opened a novel avenue for post-stroke treatments. However, their therapeutic efficiency is largely restricted by the lack of an effective and biocompatible approach to produce genetically engineered stem cells, as well as the poor homing of stem cells to ischemic cerebrum. To overcome the current limitation, herein, we report a nonviral “ferrimagnetofection” approach, using magnetosome-like ferrimagnetic iron oxide nanochains (MFIONs), to engineer MSCs for highly efficient post-stroke recovery. These one-dimensional MFIONs demonstrated highly efficient cellular internalization, which resulted in an efficient genetic engineering of mesenchymal stem cells (MSCs) to overexpress brain-derived neurotrophic factor (BDNF) for treating ischemic cerebrum. Moreover, the internalized MFIONs also up-regulated the expression level of CXCR4 in the MSCs, thus significantly improved the homing of MSCs to ischemic cerebrum. Consequently, a dramatic recovery from ischemic stroke, such as amelioration in the mortality, reduction in infarct volume and recovery of neural functions, could be achieved by using robust “ferrimagnetofection” strategy in a mouse middle cerebral artery occlusion (MCAo) model in vivo.

Biography
Dr. Tianyuan Zhang is currently a postdoctoral fellow at both College of Pharmaceutical Sciences, Zhejiang University and Dr. Li Dak Sum and Yip Yio Chin Center for Stem Cell and Regenerative Medicine, Zhejiang University. He obtained his B.S. from Zhejiang University City College, China (2010), and Ph.D. from College of Pharmaceutical Sciences, Zhejiang University, China (2016). He has a broad training in drug delivery, gene therapy, stem cells therapy and magnetic nanomaterials. His recent research is focused on the applying of engineered stem cells with nanomaterials as living vectors for potential target drug/gene delivery.
Abstract

The bottom-up growth of silver nanowires (Ag NWs) in solid state is studied under the influence of different conditions including oxidative etching, sodium chloride (NaCl) concentrations and time of growth. Through investigation of direct relation of NaCl concentration to the formation of silver chloride (AgCl) Nano cubes in the synthesis process embedded in chitosan polymer is presented. These AgCl Nano cubes further acts as nucleation points, pushing the growth of Ag NWs from the polymer substrates. From no NaCl inclusion to 100mM concentration of NaCl addition, a total of six different concentrations are investigated for the growth of wires. Understanding the role of oxygen blocking in Ag NWs growth is presented. Analytical characterizations X-ray diffraction (XRD), UV-Vis spectroscopy and FTIR analysis combinedly proves the formation of AgCl cubes in solution phase of reaction system itself. Morphological and chemical characterizations scanning electron microscopy (SEM) and electron dispersion spectroscopy (EDS) presents at what concentration of NaCl, AgCl nanoparticles are capable to promote the growth of Ag NWs from the polymer film.

This Ag NWs polymer substrate is subjected to surface enhanced Raman scattering (SERS) activity for detection of Rhodamine 6G (R6G) to as low concentration as $10^{-7}$M, with detection sensitivity recorded of $R^2 0.9875$. We further investigated successful antibacterial efficiency of the Ag NWs polymer substrate towards E-coli bacteria. This platform is unique and proved for its capability to branch into different fields like biosensors and biomedical.

Biography

Chevva Harish is currently working as Graduate research assistant at Joint School of Nanoscience and Nanoengineering, UNCG, as a part of his four-year Ph.D. degree. He has completed his master's degree in Nanotechnology at VIT university, India. Including his masters research project and his Ph.D. thesis project, he has experience in efficiently handling wide range of Nano characterization tools. Additionally, he has thorough understanding in synthetic ways for Nanomaterial synthesis, Nanocomposites, 2D materials like Graphene and MoS$_2$, and in fabrication of plasmonic nanostructures for biosensing applications. Currently he has four first author publications under his name, including many co-author publications.

Targeted Chemotherapy Approach Based on Iron-Releasing Nanoparticle Conjugates for Triggered Metastatic Melanoma Therapy in vitro

Khalaf Jasim$^{1,2,5}$ and Andre Gesquiere$^{1,3,4}$

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$^2$Department of Chemistry, University of Central Florida, FL
$^3$Department of Materials Science and Engineering, University of Central Florida, FL
$^4$The College of Optics and Photonics (CREOL), University of Central Florida, FL
$^5$Department of Chemistry, College of Science, Tikrit University, Iraq
Abstract

Melanoma represents one of the most aggressive and lethal forms of skin cancer, with annually rising incidence throughout the world. Although chemotherapy modalities remain the mainstay of treatment, however, the therapeutic potential of chemotherapy against cancer, in general, is restricted and seriously dissatisfactory due to low topical drug concentration, multidrug resistance (MDR), the nonspecific drug distribution, and the heterogeneity of cancer. In order to surmount such limitations a new nano-formulation of polymeric nanoparticles - loaded iron (Fe\(^{3+}\)) - functionalized polypeptide endothelin-3 human, rat was fabricated by a nanoprecipitation method. It might represent an adjuvant treatment \textit{in vivo}, since this strategy can selectively deliver high concentrations of iron to the tumor area, because NPs can encapsulate iron, target the tumor area by passive and active targeting mechanisms, and release the iron inside the cancer cells. As a result, triggering programmed cell death known as ferroptosis occurred via intracellular iron-mediated Fenton reaction without the need for external light or laser input using cells’ own H\(_2\)O\(_2\). Resulting \(\cdot\)OH can rapidly oxidize any surrounding bio-macromolecules within the biological system and cause damage to DNA chains, proteins, and fatty acids in lipids in cell membranes of the cancer cells.

With our study we prepared CPNPs via reprecipitation method and modified their surface with the functional group polypeptide endothelin-3 (EDN3). The resulting EDN3-CPNPs show specific targeting ability to tumor cells that overexpress endothelin B Receptor (EDNRB) and show promise as therapeutic targets for metastatic melanoma.

Biography

Mr. Jasim is a lecturer and researcher at the Chemistry Department, Tikrit University, Iraq since 2006. Currently he is a MOHESR Scholar at the Department of Chemistry and the NanoScience Technology Center at University of Central Florida, USA. He completed his B.Sc. (2002-2006) and MSc (2006-2009) at Tikrit University with specialized emphasis on synthesis of polymeric azo dyes. Major focus of his current work at the University of Central Florida is on studying perspective and potential application of nanotechnology in targeted and effective combination therapy for the novel treatment of metastatic melanoma.

Evaluation of Selected Biological Parameters in \textit{Acheta domesticus} after Long-Lasting Exposure to Graphene Oxide Nanoparticles in Food

Marta Dziewiecka*, Barbara Flasz, Andrzej Kedzierski and Maria Augustyniak

Department of Animal Physiology and Ecotoxicology, University of Silesia in Katowice, Poland

Abstract

The popularity of nanotechnology in the world is not diminishing, that’s why the toxicity and behavior of nanoparticles, such as graphene oxide (GO) in biological systems are important fundamental issues that require significant attention. The behavior of GO in various biological systems is very complexed and difficult to predict, especially in terms of multi-generational exposure of organisms. Prolonged oxidative stress can damage to cellular structures, including genetic material and may adversely affect subsequent generations.

The main objective of our study was to check whether symptoms of oxidative stress after exposure to low doses of GO in food (concentrations: 0.2, 2 and 20 µg/g of food) appear in three-generations of \textit{Acheta domesticus}.

In the 1\textsuperscript{st} and 2\textsuperscript{nd} generation of insects we found significant increase in the level of reactive oxygen species, the number of apoptotic cells as well as decrease in cell viability in group which consumed food spiked with GO at concentration of 2 µg/g. In the 3\textsuperscript{rd} generation mentioned above parameters had the same level as in control group. Interestingly, increasing the HSP70 protein levels both in 1\textsuperscript{st} (hemolymph) and 3\textsuperscript{rd} (gut) generation were observed. Result might suggest the higher turnover of proteins after prolonged contact with nanoparticles, especially in 1\textsuperscript{st} generation. Also, parental effects including epigenetic mechanisms can be responsible for observed changes, mainly in 3\textsuperscript{rd} generation.

Acknowledgment: The research was supported by the National Science Centre (NCN) on the basis of Agreement No. UMO-2016/23/N/NZ7/01977.

Biography

Dr. Marta Dziewiecka is an Assistant Professor in Department of Animal Physiology and Ecotoxicology at University of
In vitro Investigation into the Genotoxic Effects of Graphene Oxide on Human DNA before and after Exposure to Human Whole Blood from Healthy Individuals and Pulmonary Disease Patients: Asthma, COPD and Lung Cancer Patients

Emmanuel Eni Amadi\textsuperscript{1*}, Mojgan Najafzadeh\textsuperscript{1}, Adi Baumgartner\textsuperscript{2}, Badie K Jacob\textsuperscript{3} and Diana Anderson\textsuperscript{1}

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\textsuperscript{2}School of Health Sciences, York St John University, UK
\textsuperscript{3}Bradford Royal Infirmary, Bradford, UK

Abstract

Graphene nanoparticles are increasingly becoming popular in the past few decades due to their unique properties such as mechanical, chemical and electronic properties. The proposed application of the water-soluble derivative, Graphene Oxide, in biomedical sciences as a nano carrier in cancer therapeutics and nanomedical devices had led scientists to increase research in this nanomaterial. Despite their intended nanomedical applications, there are concerns about their potential toxicity in human DNA as the nanoparticles enter human whole blood. To our knowledge, this is the first research on in-vitro studies of genotoxic potential of the 2D nanomaterials in human whole blood from real-life patients clinically diagnosed with asthma, COPD and lung cancer by a Consultant Physician. In this study, we used a total of 105 different blood samples, consisting of 30 healthy individuals, 25 asthma patients, 25 COPD patients and 25 lung cancer patients. Whole blood samples were treated with four different concentrations of Graphene oxide (10, 20, 50 and 100 µg/mL) and genotoxicity assays (Comet and cytokinesis-blocked micronucleus (CBMN)) performed. Quantification of DNA damage parameters (% Tail DNA and Olive Tail Moment) and MNi induction showed concentration-dependent increase in DNA damage in each of the treated samples. However, pulmonary diseases patients (lung cancer, COPD and asthma) showed more DNA damage than healthy individuals. These findings are clear indications that low concentrations of GO used in this study were genotoxic to human DNA. Therefore, more caution is required when formulating Graphene Oxide as a nano carrier in drug delivery or in nanomedical sciences.

Biography

Emmanuel Eni Amadi is a Ph.D. Candidate in Biomedical Sciences, under Professor Diana Anderson, Faculty of Life Sciences, University of Bradford, UK. He holds an Executive MBA from Lancaster University Management School, UK (2009-2011); PG. Diploma in Pharmacy, University of Brighton, UK (2005-2006); MSc in Analytical and Pharmaceutical Sciences, Loughborough University, UK (2002-2003) and a Bachelor of Pharmacy degree from the University of Nigeria, Nsukka. He was the Founder, CEO and Superintendent Pharmacist for EE AMADI LTD t/a Drugs4U Pharmacy Manchester, UK (2011-2018). Currently, he sits on the Board as a Non-Executive Director / Member of Trustee to a Multi-Academy Trust in Bury, Greater Manchester, UK. His Scientific Fields, expertise and interests are on Pulmonary Nanotoxicology and Genotoxicology of Graphene Oxide nanoparticles in drug delivery; nanomedicines/nanomedical devices in the treatment of asthma, COPD and lung cancer patients; mainly on molecular DNA damage mechanisms of 2D Graphene Oxide nanoparticles in human whole blood before and after exposure to the genotoxic agent. He is interested in a Postdoctoral Fellowship in the United States.

Fatty Acid Conjugated Pyridinium Cationic Amphiphiles as Antibacterial Agents and Self-Assembling Nano Carriers

Pavan Walvekar\textsuperscript{2}, Ramesh Gannimani, Sanjeev Rambharose, Chunderika Mocktar, and Thirumala Govender

Discipline of Pharmaceutical Sciences, School of Health Sciences, University of KwaZulu-Natal, South Africa

Abstract

Most of the bacteria are on the verge of becoming resistant to available potential antibiotics. Novel approaches to combat these drug resistant bacteria are becoming crucial. This study aimed to synthesize novel fatty acid based cationic amphiphiles
(FCA) that would serve as nano-drug carrier having intrinsic antibacterial activity. Three fatty acids oleic, linoleic and linolenic acid based cationic amphiphiles were synthesized and evaluated for antibacterial activity. The application of vancomycin (VCM) delivery was demonstrated using oleic based cationic amphiphilic (OCA). OCA was self-assembled in aqueous media to prepare VCM loaded OCA vesicles. The particle size, polydispersity index, zeta potential and entrapment efficiency were found to be 132.9±2.5 nm, 0.167±0.02, 18.9±1.2 mV and 61.24±1.8% respectively. The microscopy images revealed that the vesicles were spherical and bilayered. The release of VCM from OCA vesicles was sustained throughout the studied period of 72h. From in vitro studies, a significant antibacterial activity was observed for all three FCAs, and it was found that, VCM loaded OCA vesicles displayed indifference and synergism against Gram positive methicillin susceptible and resistant Staphylococcus aureus (MRSA) respectively. In contrast to antibacterial activity of VCM against Gram negative Escherichia coli and Pseudomonas aeruginosa, FCAs were more potent, further there was no synergism observed against either of the strains when VCM was encapsulated in OCA vesicles. The synergism against MRSA was further confirmed in in vivo studies using mouse infection model. These findings therefore suggest that, FCAs can make promising nano-carrier systems for the delivery of antibiotics to treat bacterial infections.

Biography

Mr. Pavan Walvekar completed his master’s degree in Pharmaceutics in 2015. Currently, he is pursuing Ph.D. under the supervision of Prof. Thirumala Govender at University of KwaZulu natal, South Africa. His research interests include development of targeted and stimuli responsive nano drug delivery systems to fight infections and other diseases.

Tailoring Cellulose Nanocrystals by Food Grade Cationic Surfactant (Lauric Arginate) for Stabilizing Edible Pickering Oil-in-Water Emulsion

Thamonwan Angkuratipakorn†, Jirada Singkhonrat† and Eric A. Decker‡

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‡Department of Food Science, University of Massachusetts, Massachusetts, MA

Abstract

The development of bio-based materials has been of interest for a few decades. Cellulose nanocrystals (CNCs) are sustainable nanoparticles that are known to be efficient interfacial stabilizers. The modification of CNCs surface has been applied for improving their ability to stabilize emulsions. However, how the CNCs are modified can becomes the limitation in food applications. Here, we investigated interactions between CNCs and lauric arginate (LAE), a food-grade cationic surfactant. The complexes of CNCs and LAE (CNCs/LAE) were formed by the electrostatic interaction and absorbed to the oil-water interface. The interaction between CNCs and LAE was observed by isothermal titration calorimetry (ITC) and zeta potential. Furthermore, the oxidative stability is also required to study the ability of complexes to inhibit the lipid oxidation which is a major challenge in food industry. We found that 0.02% CNCs and 0.1% LAE complexes could produce stable Pickering emulsions resisting the coalescence of low polydisperse droplets. The CNCs/LAE-stabilized emulsion also had relatively low lipid oxidation rates by presenting lower primary (lipid hydroperoxides) and secondary oxidation products (headspace hexanal) formation compared to emulsions stabilized by LAE alone. The lag phase of CNCs/LAE-stabilized emulsions is also longer than LAE-stabilized emulsions which means that the present of CNCs could retard the lipid oxidation in the emulsion. This study provided an alternative strategy for food Pickering emulsions where CNCs play a crucial role when complexed to LAE.

Biography

Thamonwan Angkuratipakorn, received the bachelor’s degree in chemistry and is currently undertaking Ph.D. research with scholarship from Thailand Research Fund (TRF) at department of chemistry, Thammasat University, Thailand. Recently she is a visiting researcher under exchange program at Department of Food Science, University of Massachusetts, Amherst, USA. Her research focuses on cellulose nanomaterials and its application.
Growth of Nitrogen-Incorporated Ultra-Nano Crystalline Diamond with Acicular-Shaped Grains Using Si$_3$N$_4$ as Interface Layer and Study its Application in Biosensor

Ching Chang*, Chi-Young Lee and Nyan-Hwa Tai
Department of Materials Science and Engineering, National Tsing Hua University, Taiwan

Abstract

This study focuses on the study of Nitrogen-Incorporated Ultra-Nano Crystalline Diamond (N-UNCD) growth process through the Microwave Plasma Enhanced Chemical Vapor Deposition (MPECVD) process on a patterned silicon substrate by adopting Si$_3$N$_4$ as a growth interface layer. The N-UNCD-based biosensor having the patterned N-UNCD structure possesses high sensitivity, great selectivity, and excellent detection limits for dopamine detection. For better understanding the synthesizing mechanism of the patterned N-UNCD, influence of Si$_3$N$_4$ on induced interference is investigated and the grain growth of the N-UNCD with time is studied.

N-UNCD electrode is a potential candidate of sensitive biosensor for dopamine. It can directly sense a dopamine solution containing ascorbic and uric acids without catalyst or medium. In this work, N-UNCD grew on a patterned silicon substrate can improve the sensitivity and selectivity due to its high surface area. The CV plots of the patterned N-UNCD electrodes show better sensitivity and selectivity than those of the flat N-UNCD in the mixed dopamine electrolyte. The performance of the patterned N-UNCD electrode is almost two times higher than that of the flat one. Furthermore, we also found that before CN molecules attached onto the silicon substrate, growth of the acicular N-UNCD (1 0 0) facet structure was induced by a thin needle-like Si$_3$N$_4$ interlayer.

Additionally, the Si$_3$N$_4$ signal decreases and the hydrophilicity increases, which was evidenced from the decrease of the contact angle from 70° to 15°. All these facts will lead to the high sensitivity of the synthesized N-UNCD film for dopamine biosensor.

Biography

Mr. Ching Chang received his master’s degree from National Chiao Tung University in 2017. The thesis focused on the mechanism of interface between oxide and nitride during nitriding process. Presently, he joined in Materials Science and Engineering from the National Tsing Hua University (Hsinchu, Taiwan). His current research interests are biosensors by using different kinds of carbon nanomaterials as a based material, including dopamine sensing, saliva glucose sensing, and human CO$_2$ exhaled sensing. On the other hand, he is majoring in Transmission Electron Microscopy (TEM) and Scanning Transmission Electron Microscopy (STEM) for analyzing material properties.

Intracellularly-Actuated Nanoparticle-Drug Bioconjugates for Overcoming Multidrug Resistance in Cancer Cells

Ajmeeta Sangtani$^{1,2}$, Eleonara Petryayeva$^3$, Kimihiro Susumu$^{1,4}$, Eunkeu Oh$^{1,4}$, Alan L. Huston$^1$, Igor L. Medintz$^1$, Walter R. Algar$^4$, and James B. Delehanty$^4$
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$^2$Fischell Department of Bioengineering, University of Maryland, MD
$^3$Department of Chemistry, University of British Columbia, Canada
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Abstract

The development of multidrug resistance (MDR) in a wide range of cancers known to be a major factor in the failure of chemotherapeutics due to the presence of membrane-associated transporters that actively pump drugs out of the cell, resulting in minimal cell death. While nanoparticle (NP)-mediated drug delivery has emerged as a mechanism for overcoming MDR, they often rely on co-delivery with multiple chemotherapeutics, nucleic acid hybrids, or MDR pump inhibiting drugs. While effective, these strategies require genetic transfection or result in off-target toxicity, limiting their overall efficacy. Here we describe a novel NP-peptide-drug bioconjugate that achieves augmented cell killing in MDR cancer cells without the use of additional therapeutics. In this bioconjugate, a quantum dot (QD) serves as a central scaffold scaffold onto which is appended
two species of peptide; a cell-uptake peptide that mediates endocytic internalization and a display peptide conjugated to a drug that is cleavable by esterases found within the endolysosomal pathway. Herein we control drug release both spatially, where endosomes circulate the drug away from MDR pumps that reside on the membrane and temporally, where release is perinuclear. Cellular uptake studies demonstrated high internalization of the QD-drug bioconjugate and nuclear localization of the drug after 48 h in MDR cells. Additionally, cellular viability assays showed a significant increase in cell death for the NP-drug bioconjugate compared to free drug, confirming the utility of this system in overcoming MDR in cancer cells.

Biography

Ms. Ajmeeta Sangtani is a graduate student in a federal lab over the last four years. Her thesis work has been focused on using quantum dots (QDs) as a prototypical nanoparticle (NP) to further explore targeted delivery, internalization, and active actuation of hard NPs. This work led to two first author publications. Through her work, she has gained extensive experience with NP surface modification/characterization, cellular culture techniques, and confocal imaging. She is now working on use of these system for other purposes, such as photodynamic therapy. Additionally, she has published comprehensive first author reviews, including one featured on the journal cover. In the future, she would like to apply the knowledge for translational therapeutic purposes.

Development of High-Performance Ionization Sensors

Yong Zhang
State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, China

Abstract

There are several ionization sensors using micro-nano materials as cathode or anode to detect gas, temperature, haze or electromagnetic fields. Unfortunately, they are greatly limited by their multi-valued sensitivity, low sensitivity, low integration, only one parameter detectable, and yet susceptible to interference. Our group has developed high-performance ionization sensors using carbon nanotubes, which are comprised of carbon nanotube cathode, extracting electrode and collecting electrode, and worked at the non-self-sustaining discharge state. Since discharge current depends on the concentration of material in electrode gap, temperature, and electromagnetic field strength, the ionization sensors are capable of detecting gas and haze concentrations, temperature and electromagnetic fields. In addition, exponential dependence of interelectrode separation on discharge current enable the ionization sensors identifying different measured parameters with various electrode gaps at the same time. And more importantly, the ionization mechanism based sensors are distinct with other sensors on their inherent sensitivity to ultramicro-concentration materials such as ppt (10^{-12} L/L) order gases and 0.1 µg/m^3 haze. The capacitive structure sensors as well as exhibits the ability of anti-interference due to their structure advantage, sensor array with various electrode gaps and artificial intelligence (AI) based multi-information fusion. The ionization sensors and array demonstrate high performance like high integration and sensitivity as well as micro size, in comparison with other sensing technology. The ionization sensors show the expected potential applications on gas and haze concentration as well as temperature monitoring fields, and also on the measurement of electromagnetic field vectors.

Biography

Dr. Y. Zhang received her Bachelor’s degree, Master’s Degree and Doctorate Degree in 1990, 1993 and 2004 from Xi’an Jiaotong University, respectively. She is a Professor of Xi’an Jiaotong University, a fixed member of the State Key Lab of Electrical Institute and Power Equipment of Xi’an Jiaotong University, and a senior member of the Institute of Electrical and Electronics Engineers (IEEE), as well as the expert committee members of Energy Equipment of China and Beijing Energy Societies, respectively. Her research fields are focused on micro and nano electromechanical systems-based sensors and artificial intelligence (AI) based detection technology.
Nanodesign of the Magneto-Optical Materials

Yukiko Yasukawa
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Abstract

Magneto-optical (MO) characteristics are interactions between the magnetism and light. In this study, we present strategies of artificial controls of MO characteristics of materials for the application of ultrahigh-/fast sensitive sensors that detect “objectives” by means of the changes in MO characteristics of the materials. To realize this issue, the control and enhancement of MO characteristics of the materials are essential. Therefore, we attempted two different approaches to solve this issue in the present study; (1) combination of nano-structuring of MO materials and localized-surface plasmon resonance (hereafter, we denoted as “plasmons”), and (2) nanoscale-design of MO materials.

In the case of (1), we selected TbFeCo thin films as MO materials, while self-organized Au nanoparticles were used as the source of plasmons. By utilizing self-organized Au nanoparticles, we expected to induce the couplings of plasmons between the particles to generate homogeneous and enhanced-electric field, i.e., “hot spots” in the vicinity of the particles. As a consequence, the controlling and enhancement of MO characteristics of TbFeCo could be possible by the assistance of “hot spots”. In the latter case, the layered structures of FeCo/Pd thin films were used as MO materials. By changing the layered structures, e.g., thickness of thin films and order of layers, we attempted to optimize the MO characteristics of the specimens.

The MO characteristics were sufficiently controlled and enhanced by two different approaches; we revealed that tailoring the MO materials in nanoscale is important to attain improved-MO rotation angles for both cases.

Biography

Dr. Yukiko Yasukawa, Doctor of Engineering, now is an Associate Professor of Department of Electrical and Electronic Engineering, Faculty of Engineering, Chiba Institute of Technology, Japan. She got a Doctorate degree in functional-oxide materials, i.e., magnetic- and superconducting-oxide materials, from Tokyo Institute of Technology. After she received the Ph.D., she learned nanofabrication techniques. She established her own laboratory in 2014 in Chiba Institute of Technology. Her current interests are magneto-optical materials as well as iron oxides that can be applicable in RF region. Her research group is getting bigger year by year and has active collaborations in domestic and abroad.

Irradiation-Induced Metal-Insulator Transition in Monolayer Graphene

Issai Shlimak
Bar Ilan University, Israel

Abstract

Metal-insulator transition was studied in a series of monolayer graphene (MG) samples gradually disordered by means of ion irradiation. Degree of disorder was controlled using measurements of the Raman scattering spectra. It was shown that disorder introduced by irradiation with different dose $D$ of different ions can be unified by using such a parameter as the density of structural defects $N_D = kD$, where coefficient $k$ depends on the mass $M$ and energy $E$ of the impact ion. Dependence $k(M,E)$ is shown.

For slightly disordered samples, the temperature dependences of conductivity and magnetoresistance show that the mechanism of conductivity is determined by the regime of weak localization and antilocalization due to chirality of charge carriers in MG. Further increase of disorder leads to strong localization, when conductivity is described by the variable-range-hopping (VRH) mechanism. A transition from the “Mott regime” to the “Efros-Shklovskii regime” of VRH was observed with decreasing temperature.

Magnetoresistance (MR) of strongly disordered samples with VRH mechanism of conductivity showed different behavior: in perpendicular magnetic fields resistance decreases (negative MR, NMR), while parallel magnetic fields lead to positive MR (PMR). The NMR is explained by the “orbital” mechanism based on the interference of many paths through the intermediate sites in the probability of the long-distance tunneling. The PMR in parallel fields was explained by suppression the hopping transitions via double occupied states due to spin polarization in strong magnetic fields. Localization radius of charge carriers for samples with different degree of disorder was determined.
Biography

Dr. Issai Shlimak got Ph.D. and D.Sc. at the Ioffe Physical-Technical Institute in Saint-Petersburg in Russia (former USSR). Since 1990, he is Professor of Physics in the Resnick Institute of Advanced Technology, Department of Physics, Bar-Ilan University, Ramat Gan, Israel, head of the Samson Chair of semiconductor technology. He was awarded by the prize of the Council of Ministers of the USSR with gold medal and Diploma, Bareha Fellowship in Israel consigned for outstanding immigrant scientists. He is the author of more than 200 publications including a book, articles in scientific journals and patents.

Computational Study on Binding of Histidine and Proline with Graphene in Gas and Aqueous Phases

Tandabany Dinadayalane*, Dalia Daggag and Taylor Dorlus
Department of Chemistry, Clark Atlanta University, GA

Abstract

Density functional theory (DFT) level calculations were performed to investigate the interactions of two amino acids (histidine and proline) with two finite-sized graphene sheets (C_{62}H_{20} and C_{186}H_{36}). The conformational analysis was done for both proline and histidine using MMFF force field as implemented in Spartan ’16. From the conformers generated, few low energy and one high energy conformers were chosen for proline and histidine to build the complexes with graphene. In case of forming the complexes, various possible orientations were considered for each of the conformers. This study aims is to understand the influence of conformers of histidine and proline on binding with graphene in the gas and aqueous phases, and the effect of varying the graphene sheet on their binding affinities. The conformer and orientation of histidine and proline on the surface of graphene play an important role in determining the stabilities of complexes. Histidine generally exhibits higher binding affinity than proline. This could be attributed to the presence of π-electrons and two nitrogen atoms in the five-membered ring of histidine. Graphene size effect is negligible for the binding affinities of both amino acids. Inclusion of solvent (water) reduces the binding energy but the trend is retained. HOMO-LUMO energy gaps were calculated at the TPSSh/6-31G(d)//M06-2X/6-31G(d) level. Binding of proline or histidine does not change the band gap of graphene.

Acknowledgment: TD acknowledges the NSF HBCU-UP RIA (Grant number 1601071).

Biography

Dr. Dinadayalane Tandabany is an Associate Professor of Chemistry at Clark Atlanta University (CAU). He directs the research lab of “Computational Chemistry and Nanomaterials Lab” (CCNL) at CAU. He serves as a PI or Co-PI of numerous federally funded grants. His research contributions and interests are exploration of structures and reactivities of small molecules, nanomaterials particularly, carbon-based hybrid nanomaterials and their applications in energy, electronics, chemical and biosensors. He co-authored more than fifty (50) publications that received approximately 1700 citations with an h-index of 24. Most recently, Dr. Tandabany received the 2019 BEYA STEM Innovator Award.

Nano Catalysis for Sustainable Energy and Environment

Chuan-Jian Zhong
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Abstract

Nanoscale metal/alloy catalysts exhibit unique catalytic and electrocatalytic properties for many types of reactions, including fuel cell and emission control reactions. The highly-dynamic nature of the catalysts in catalytic and electrocatalytic reactions requires the abilities not only to prepare the nanoscale metals/alloys with controllable size, shape, composition and surface properties, but also the abilities to probe the detailed structures of the catalysts as prepared and under the reaction conditions. This presentation will discuss some of the recent results of our studies of metal/alloy nanoparticles and nanowires in the catalytic oxidation of carbon monoxide and hydrocarbons and the electrocatalytic oxygen reduction.
Biography

Dr. Chuan-Jian Zhong, Professor of Chemistry and Materials Science at State University of New York (SUNY) at Binghamton, USA, was a Max-Planck-Society postdoctoral scientist at Fritz-Haber Institute, postdoctoral fellow at University of Minnesota, and associate scientist at Iowa State University and Department of Energy’s Ames Laboratory, received National Science Foundation Career Award, SUNY Chancellor’s Award for Excellence in Scholarship and Creative Activities, 3M Faculty Research Award, and Japan Society for the Promotion of Science Invitation Fellowship. He authored/co-authored about 645 papers and about 15 US patents, and was selected by Shanghai-Elsevier Global Ranking of Academic Subjects 2016 as one of the Most Cited Researchers.

Hybrid Graphene-Perovskite Quantum Dot Phototransistor with High Responsivity

Basudev Pradhan1,3*, Sonali Das1, Farzana Chowdhury1, Jayesh Cherusseri1 and Jayan Thomas1,2
1NanoScience Technology Center, University of Central Florida, Orlando, FL
2CREOL, University of Central Florida, Orlando, FL
3Department of Energy Engineering, Central University of Jharkhand, India

Abstract

Organic-inorganic halide perovskite quantum dots (QDs) are attractive materials for optoelectronic device applications, such as light emitting diodes, displays, sensors, detectors, energy storage devices, solar cells, etc due to their bandgap tunability across the visible spectrum of the light as well as high photoluminescence quantum yield and narrow emission spectrum. But the charge transports properties of QDs are inherently low because of the inclusion of spacer molecules during their synthesis limits their best performance in many optoelectronic applications. On the other hand, the graphene shows excellent electrical conductivity and mobility (electron mobility>15,000 cm²V⁻¹s⁻¹), good stability and flexibility for stretchable and wearable electronics. However, the light absorption rate of a single layer graphene is only 2.3% of the incident visible light, which has limited the responsivity of the graphene based photodetector to 10⁻² A/W, makes inferior to many photonic devices. We report here graphene-QDs based hybrid phototransistor with very high responsivity (~10⁶ A/W) at 437 nm wavelength by taking the advantages of both materials. In this phototransistor, graphene is a carrier transport channel with high mobility, while QDs act as strong light absorbing materials. Our phototransistor demonstrated superior performance to what has been achieved previously with the individual materials.

Biography

Dr. Basudev Pradhan is an Assistant Professor, Department of Energy Engineering, at Central University of Jharkhand, India and presently visiting University of Central Florida under BASE fellowship funded by IUSSTF. He received his Ph.D. from Indian Association for the Cultivation of Science (IACS) and Jadavpur University, India. He was Alexander von Humboldt research fellow in Germany. His research interests focus on perovskite solar cell, organic solar cell, phototransistor etc. He has published 22 high quality research papers in the reputed international journals. He is one of the associate editors in Applied Physics A, Springer Nature journal.

Application of One-Dimensional GeSn, CuO and Bi₂Se₃ Nanomaterials in Nanoelectromechanical Switches

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2Department of Chemistry, Tyndall National Institute, University College Cork, Ireland

Abstract

Nanoelectromechanical systems (NEMS) are a class of devices utilizing mechanical and electrical functionality of nanostructures for sensors, resonators and switches. In a nanoelectromechanical (NEM) switch, mechanical deflection of a nanostructure is used to connect electrodes, and transduce electric signal, for example, for memory and logic applications. One-dimensional nanomaterials, such as nanowires and nanoribbons, are desired components for building NEM switches thanks to
low mass, tunable composition, shape, mechanical and electrical durability.

One of the major challenges for implementation of NEM switch devices is that the mechanical and electrical reliability and reproducibility of individual nanowires may change. These properties must be examined prior to fabrication of real devices, requiring ultimate resolution of the dimensions, forces and electric signals at nanowire-electrode interface. Development of nanowire-based NEM switch technology demands using a combination of methods for precise manipulation of the nanowires to achieve scalable production of the nanodevices.

In this work, we investigate the electrical and mechanical properties of semiconductor copper oxide (CuO), bismuth selenide \((\text{Bi}_2\text{Se}_3)\) and germanium tin alloy (GeSn) nanowires and their NEM switching. Electrical I-V and mechanical resonance tests along with nanomanipulation by in-situ scanning electron microscopy (SEM), suggest suitability of these nanomaterials for building NEM switches. Next, we demonstrate approach for fabrication of single-nanowire NEM switch devices on chip, combining top-down lithography with bottom-up dielectrophoretic alignment and nanomanipulations. Finally, we discuss the working parameters of the implemented devices towards the creation of NEM switches with improved reliability.

**Biography**

Dr. Jelena Kosmaca is a leading Researcher at the University of Latvia Institute of Chemical Physics. She received a doctoral degree in Materials Physics from University of Latvia in Riga, Latvia. Her current research is synthesis, characterization and application of one-dimensional nanomaterials in NEMS.

**Non-Volatile, Reversible Metal Insulator Switching in Oxide Interfaces Controlled by Gate Voltage and Light**

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**Abstract**

The field-effect-induced modulation of transport properties of 2-dimensional electron gases residing at the LaAlO\(_{3}\)/SrTiO\(_3\) and LaGaO\(_{3}\)/SrTiO\(_3\) interfaces has been investigated in a back-gate configuration. Both samples with crystalline and with amorphous overlayers have been considered. We show that the “naïve” standard scenario, in which the back electrode and the 2-dimensional electron gas are simply modeled as capacitor plates, dramatically fails in describing the observed phenomenology. Anomalies appearing after the first low-temperature application of a positive gate bias causing a non-volatile perturbation of sample properties. Such anomalies are shown to drive low-carrier density samples to a persistent insulating state. Recovery of the pristine metallic state can be either obtained by a long room-temperature field annealing, or, instantaneously, by a relatively modest dose of visible-range photons. Illumination causes a collapse of the electron system back to the metallic ground state, with a resistivity drop exceeding four orders of magnitude. The samples can be repeatedly switched between the conducting and insulating state by the alternated application of suitably tailored back-gate voltage pulses and light pulses. The possibility to stabilize intermediate resistance states, to be employed for the implementation of a multilevel, electro-optically controlled, resistive memory system was also investigated. A model is proposed to discuss and interpret the data on the base of the analogy with floating-gate MOSFET devices, which sheds a new light on the effects of back-gating on oxide-based 2-dimensional electron gases.

**Biography**

Dr. Mian Akif Safeen did M. Phil in Solid State Physics in 2011 from University of Punjab, Pakistan and Ph.D. in Applied Physics in 2016 from University of Naples “Federico II”, Naples, Italy. His research interests include fabrication of nano-materials, renewable energy materials and oxide electronics. He has published more than 10 articles in international journals with cumulative Impact factor and citations around 36.5 and 70 respectively. He presented his work at different conferences in Rome (Italy), Cargese (France), E-MRS Warsaw (Poland), Warwick (UK) and MRS Boston (USA). Currently, he is working as an Assistant Professor in Physics University of Poonch, Rawalakot.
Room-Temperature Self-Powered Energy Photodetector Based on Optically-Induced Seebeck Effect in Cd$_3$As$_2$

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$^2$Department of Physics, Santa Clara University, CA

Abstract

Cd$_3$As$_2$ is a newly rediscovered 3D Dirac semimetal that shares many advanced characteristics. Unlike to graphene, this bulk compound is highly stable, and its electronic configurations are protected against environmental fluctuations. As the carrier back-scattering suppressed, the electrical transport is primarily controlled by high-energy electrons. As a result, Cd$_3$As$_2$ possesses one of the largest free-carrier mobility of $\sim 10^7$ cm$^2$V$^{-1}$s$^{-1}$, exceeding that of graphene. Combined with its strong absorption of infrared light, low thermal conductivity and large thermopower of $\sim 600$ $\mu$V/K at temperature range of $\sim 300$-$400$ K, Cd$_3$As$_2$ is a strong contender for the development of a new class of photo-sensors, photo-transistors and optical switches based on photo-induced Seebeck effect, in short, a photo-thermo-voltaic (PTV) effect.

In this work we have synthesized electronic-grade Cd$_3$As$_2$ crystals using a hot-wall, horizontally-oriented atmospheric pressure CVD reactor. The samples exhibit 2D-shape and microscopically flat mirror-like top surfaces. Room temperature FTIR absorption measurements were done in the energy range of $\sim 0.1$-$0.5$ eV, with the results to be presented and discussed. More importantly, 2-terminal infrared PTV-photosensors were engineered and their photo-response was tested at the light modulations done at 50 Hz- 6 kHz frequency range. The PTV photodetector remains robust, requires no bias and its light responsivity approaches 0.27mA/W. Among other findings, the generated photocurrent is shown to be position dependent and change with both the modulation frequency and optical powers. Our study indicates that Cd$_3$As$_2$ is a next generation solid state material for application in high-bandwidth and spectrally broad photo-sensing, imaging, and communication.

Biography

Ms. Niloufar Yavarishad received her bachelor’s degree in physics from K. N. Toosi University of Technology, Tehran, Iran in 2013. She is currently a Ph.D. student working in the field of electrical engineering-nanotechnology in the Nanotechnology Research Laboratory at the University of Wisconsin-Milwaukee, USA. Her areas of interests include controlled CVD-based synthesis of advanced nano-semiconductors, investigation of arrayed semiconductors produced by self-assembly techniques, study of the physical mechanisms controlling properties of nano-electronic materials, use of spectroscopic, transport and photo-conduction techniques for materials properties characterizations. She also works on engineering of novel solid-state nano-photo-sensing and energy conversion materials and devices based on bulk Cd$_3$As$_2$ and their-based nano-heterojunction synthesis by CVD.

Free-Standing Two-Dimensional Alumina Grown by Graphene-Assisted Atomic Layer Deposition

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Abstract

We present a two-step synthesis and characterization of free-standing 2D nanosheet Al$_2$O$_3$ network synthesized by atomic layer deposition (ALD). The approach takes advantage of interconnected 3D network of graphene as a growth scaffold that can be readily removed during annealing. The 2D nanosheet network annealed in air at $\sim 800$ $^\circ$C demonstrate polycrystalline order and exhibit a medium-strength defect-assisted light emission in the ultraviolet range. HRTEM and SAED analysis illustrates cubic crystal structure with a small tetragonal distortion for Alumina 2D nanosheet stacks with average crystal sizes of $\sim 10.67\times7.32$ nm$^2$. The varying range of the crystal size and small distortions in the analyzed structures shows the transition phase Alumina in the selected annealing temperature. Shape-wise, the flakes closely resemble graphene that served as the deposition substrate. Yet, unlike graphene the surface of the alumina is not atomically smooth and exhibit characteristic ripples likely formed as a result of the strain relaxation. According to current-voltage measurements the flake network is electrically interconnected with
the charge transport being Ohmic at the room temperature with an activation energy of \( \sim 0.33 \text{ eV} \) and threshold temperature of \( \sim 145 \text{ K} \). A small percentage of sodium is detected by EDX as a remnant of the graphene scaffold which contributes to the conductivity of the 2D nanosheets network as dopants and not the crystalline and stoichiometry of the structure. This work opens a door to a facile low-cost synthesis of device-quality 2D nano-ceramic networks for applications in electronics, gas sensing and environmental cleaning.

**Biography**

Ms. Elaheh Kheirandish is a Ph.D. candidate at the Electrical Engineering department of the University of Wisconsin-Milwaukee. She is currently research assistant at the Nanotechnology Research Laboratory, Doctoral Intern at the SafeLi LLC, and the vice president for student section of Applied Spectroscopy Society at UWM. Her background is in electronic material characterization, spectroscopy and microscopy. She has received multiple awards including Graduate Student Excellence Fellowship Award and Chancellor’s Award. She has published 3 papers on photoluminescence and charge transport of nano-columnar \( \text{TiO}_2 \), light emission of nanoporous \( \text{GaN} \) and \( \text{Cd}_3\text{As}_2 \) optically induced Seebeck effect photodetector.

**Development of \( \text{Fe}_2\text{O}_3 \) Hollow Microspheres-Incorporated rGO Sponge for Effective Electromagnetic Wave Absorption**

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*Department of Materials Science and Engineering, National Tsing Hua University, Taiwan*

**Abstract**

Owing to the rapid development of various electronic devices and wireless networks, electromagnetic (EM) pollution has been increasing at a noticeable rate. Radiating EM waves not only reduce performance of exposed devices but also pose a hazard to human beings. As a result, designing effective electromagnetic absorption materials to minimize the electromagnetic interference (EMI) is exceedingly imperative.

In this work, we develop a porous composite via coating polyurethane (PU) sponge with reduced graphene oxide (rGO) and hematite (\( \text{Fe}_3\text{O}_4 \)) hollow microspheres. Compared with impermeable shielding materials, porous materials are endowed with advantages such as lower density and stronger EM wave-absorption capacities. Through adhering rGO onto the skeleton of PU sponge, the composites could perform EM waves absorption property which originates from residual defects and functional groups on the surface of the rGO sheets which could arise polarization of defects and dipoles. Based on large band gap, \( \text{Fe}_3\text{O}_4 \) was selected to reduce dielectric value of rGO, therefore, lead to moderate permittivity value of the sponge composites. Besides, hollow structure of the \( \text{Fe}_3\text{O}_4 \) microspheres could further provide internal multiple scattering and reflection of EM waves. Consequently, when EM waves impinge on porous composite, it will undergo multiple reflection on the myriad rGO interfaces within the interconnecting pores. The addition of \( \text{Fe}_2\text{O}_3 \) hollow microspheres provide hierarchical structure within the composites, which could enhance the overall attenuation of incident EM waves effectively. Due to the low density and outstanding shielding effectiveness performance, our study demonstrates a promising approach of preparing absorption type EMI shielding materials.

**Biography**

Ms. Kuan-Yu Chen received her Bachelor’s degree in chemistry, and she is now pursuing Master’s degree in the Department of Materials Science and Engineering in National Tsing Hua University. Currently, she joined Advanced Carbon Nano-Materials Lab under the supervision of Professor Tai. Her research interest is designing functionalized nanomaterials with carbonaceous inclusions and their multifarious applications. Presently, her work focuses on the fabrication of lightweight composite with rGO and multi-layered microspheres for EMI shielding application.

**Non-Conventional Ratiometric Up-conversion Luminescence Remote Thermometry Based on Non-Thermally Coupled Levels of Er in High Temperature Cubic Phase \( \text{NaYF}_4 : \text{Yb, Er} \)**

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**NANO Boston Conference | April 22-24, 2019 | Boston, MA**
Abstract

High temperature cubic phase NaYF₄:Yb, Er explored as promising for optical remote sensor for harsh environment. Ratiometric up-conversion luminescence of non-thermally coupled levels i.e. green (¹H₁₁/₂ → ¹S₃/₂) and red (⁴F₉/₂ → ¹I₁₅/₂) bands of HT cubic phase NaYF₄:Yb, Er has been calculated. Temperature dependent up-conversion emission spectra of HT cubic phase up to 973K shows that two bands have different dependence upon temperature and hence suitable for optical thermal sensing. The maximum sensitivity is measured to be 3.5 % K⁻¹ at 833 K. The CIE chromaticity diagram shows that the color point moves from deep red (0.6357, 0.3501) to yellow region (0.4379, 0.475) and then to the green region (0.318, 0.669) with increasing temperature. X-ray diffraction with temperature are showing the shifting of pattern peaks towards lower 2 theta. This shifting implies the expansion of unit cell. The lattice expansion in HT cubic phase alters the crystal symmetry around the activator ion which increases the green to red emission ratio.

High Color Purity Red Emitting Phosphors Na₃.₆Y₁.₈(PO₄)₃:Pr³⁺ for Blue LED

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Abstract

Pr³⁺-doped Na₃.₆Y₁.₈(PO₄)₃ phosphors in pure phase were synthesized via conventional solid-state reaction in air. Photoluminescence properties of those phosphors were investigated in detail. High color-purity red emission originated from the ¹D₂ → ³H₄ transition was observed in Pr³⁺-doped Na₃.₆Y₁.₈(PO₄)₃ under 450 nm excitation. Fluorescence concentration quenching in Pr²⁺-doped Na₃.₆Y₁.₈(PO₄)₃ could be attributed to phonon-assisted cross-relaxation energy transfer between the Pr³⁺ ions. The Commission International de L’Eclairage (CIE) chromaticity coordinates of 1 at% Pr³⁺ doped Na₃.₆Y₁.₈(PO₄)₃ was observed to be (0.5957, 0.3988). In addition, thermal stability of the samples has been also investigated elaborately. By integrating this phosphor with commercial Ce³⁺:YAG and a 450 nm blue chip, a white LED is fabricated. The present work suggests that Pr³⁺-doped Na₃.₆Y₁.₈(PO₄)₃ as pure red phosphors have a potential application in the blue-chip WLEDs.

Synthesis of Methacrylic Acid from Biomass Derived Itaconic Acid over High Surface Area Nano-Catalysts

Ashish Bohre¹, Kalpana Avasthi, and Blaz Likozar

Department of Catalysis and Chemical Reaction Engineering, National Institute of Chemistry, Slovenia

Abstract

Conversion of biomass derived substrate to monomer is an increasingly important topic. We herein reported a bio-based route to methacrylic acid (MAA) via decarboxylation of itaconic acid over solid base catalysts. High selectivity of MAA (50 %) was achieved under relatively mild reaction condition. The reported MAA yields is the highest ever achieved with alkaline base free and noble metal free heterogeneous catalyst for decarboxylation of itaconic acid. The effect of temperature, catalyst mass, pressure, substrate concentration, on itaconic acid conversion and methacrylic acid yield was determined. The fresh and used catalysts are characterized by XRD, N₂ physisorption, CO₂ TPD, CO-Chemisorption, XPS and SEM-EDX. The selectivity of MAA was higher for solid base catalyst with compared to other commercial catalysts such as Pd/C, Pd/Al₂O₃, BaO and Zeolite-Y under similar reaction conditions. In the end, an overall reaction pathway for the conversion of the itaconic acid to methacrylic acid via decarboxylation reaction is proposed.
Biography

Dr. Ashish Bohre is currently leading a project as a Principal Investigator at Department of Catalysis and Chemical Reaction Engineering, National Institute of Chemistry (NIC), Ljubljana, Slovenia. Prior to his association with NIC, he serves as postdoctoral fellow in the research group of Dr. Basudeb Saha at Department of Chemistry, University of Delhi. He received his Ph. D. in Chemistry from Dr. Harisingh Gour Central University, studying the immobilization of nuclear waste in ceramic matrix. His current research is focused on heterogeneous catalysis including catalyst synthesis, characterization and application in sustainable monomer production.

Synthesis of Styrene from Biomass-Derived Feedstocks Over Nano Material Based Heterogeneous Catalysts

Kalpana Avasthi*, Ashish Bohre and Blaz Likozar
Department of Catalysis and Chemical Reaction Engineering, National Institute of Chemistry, Slovenia

Abstract

Styrene is an important aromatic compound, which is applied in polystyrene plastic materials, polyesters, various protective coatings, resins, rubbers and other common copolymers. Currently, the majority of styrene is industrially produced by multiple-step and energy-intensive chemical processes from petroleum-derived ethylbenzene precursor. Besides the use of a non-renewable feedstock itself, these synthesis processes produce styrene with a low conversion selectivity. Thus, there is a need to develop novel sustainable processes for styrene building-block production from renewable carbon-containing resources, such as biomass-derived lignin residues. The current bio-refinery processes draw value from carbohydrates, leaving lignin as a waste. However, lignin represents a potentially valuable source of renewable aromatic/phenolic compounds for diverse chemical industries. Therefore, the valorization of bio-based feedstocks to styrene is contributing to emerging resource sustainability and to making the second- and third-generation bio-refining processes profitable. We have developed unique and sustainable catalytic processes to produce styrene by the C-H bond activation of benzene.

Biography

Dr. Kalpana Awasthi received her Ph.D. in 2017 from Dr. H. S. Gour Central University, India. Currently, she is working as a visiting researcher at the Department of Catalysis and Chemical Reaction Engineering, National institute of chemistry, Ljubljana. The focuses of her research are catalytic conversion of lignocellulosic biomass into next generation biofuels and fine chemicals.
Novel Antimicrobial Nanostructures with Different Morphologies Obtained by Atomic Layer Deposition Processes Over Electrospun Matrices

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1Food Packaging Laboratory (Laben-Chile), Dept. of Science and Food Technology, Faculty of Technology, Universidad de Santiago (USACH), Chile
2Center for the Development of Nanoscience and Nanotechnology (CEDENNA), Chile
3Department of Physics, Universidad de Santiago de Chile (USACH), Chile

Abstract

The need and interest to search for new substances with high antimicrobial activity has greatly increased due to the enhancement of food borne diseases, nosocomial infections during hospitalization and the great resistance that microorganisms have developed towards certain known antibiotics. In this line, nanotechnology is a useful tool in the development of substances with high antimicrobial activities. Thus, this study proposes the combination of atomic layer deposition (ALD) and electrospinning (EP) technologies to develop nanotubes and nanospheres of titanium dioxide, metal oxide with photocatalytic and antimicrobial properties. First, polyvinyl alcohol (PVOH) nanofibers and polyvinylpyrrolidone (PVP) capsules were obtained using electrospinning equipment, from the variation of the parameters such as height (distance between the tip of the capillary and collector), injection flow and polymeric solution concentrations. Subsequently, the electro spun nanostructures were used as a mold for the deposition of titanium dioxide by ALD. Deposition of this metal oxide were done at 200 °C using 300 cycles of deposition. Subsequently, nanostructures were exposed at calcination temperatures in order to remove polymers and obtain hollow nanostructures with enhanced specific area. Thermal and morphological analysis by SEM and TEM microscopies revealed the maintenance of morphology. X-ray analysis revealed the change of titanium dioxide crystallographic structure from amorphous to anatase crystalline structure after calcination. These new nanostructures presented interesting antimicrobial activities against Gram-positive and Gram-negative bacteria.

Biography

Dr. Dicastillo works as an Associate Researcher in the Food Packaging Laboratory, in the University of Santiago de Chile. She is a chemist and her Ph.D. and post doctorate were focused on Food and Materials Science. Her Ph.D. was done in the Institute of Agro-chemistry and Food Technology (IATA-CSIC) in Valencia and it was based in the research of the development of hydrophilic active materials, mainly focused on antioxidant releasing systems. Nowadays, new topics have joined her work, such as nanotechnology, electrospinning, biodegradable materials and search of natural compounds with antioxidant and antimicrobial from plant extracts.

The Effect of Oxygen Pressure on the Magnetic and Transport Properties of Ultra-Thin Magnetite Films

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2Department of Physics, University of Connecticut, CT
3Condensed Matter Physics and Materials Science Department, Brookhaven National Lab, NY

Abstract

In this study, the effect of oxygen stoichiometry on the transport and magnetic properties of the epitaxial magnetite (Fe₃O₄) ultrathin films was extensively investigated. Fe₃O₄ ultra-thin films with thicknesses varying from 20 nm to 3 nm were grown using molecular beam epitaxy under different oxygen pressures. The quality of epitaxial Fe₃O₄ thin films as judged by observation of the Verwey transition and corroborated by X-ray photoemission spectroscopy. The Verwey transition has been investigated using both transport and magnetization measurements. The magnitude of the Verwey transition was observed to
be sensitive to the oxygen pressure during film growth. Furthermore, the magnetization studies of the high quality epitaxial ultrathin Fe$_3$O$_4$ film showed that the films are ferrimagnetic and their magnetic moments are much greater than that of bulk magnetite, particularly at the thickness of 10 nm and 5 nm. In addition, a strong influence on the Fe$_3$O$_4$ film structure was observed when changing oxygen deposition. Therefore, that would be important for the design of a spintronic device since the magnetic and transport properties of Fe$_3$O$_4$ are strongly correlated with its crystal structure.

**Biography**

Dr. Shoroog Alraddadi, received his Ph.D. in Physics from University of Connecticut in 2016. Currently, he is an Assistant Professor in the Department of Physics at Umm Al-Qura University. His research interests focus on Thin Films and Physics of Nanostructures, Magnetic Oxide, Surface and Structure Properties, Transport and Magnetic Measurement. The application of experimental techniques such as Molecular beam epitaxy (MBE), X-ray photoelectron spectroscopy (XPS), Low energy electron diffraction (LEED), Physical Property Measurement System (PPMS), Displex Closed - Cycle Refrigeration (CCR) System, X-Ray diffraction (XRD) in the study of a wide variety of condensed matter systems.

**Graphene-Si Field Effect Photodetector**

Siwapon Srisonphan* and Khomsan Ruangwong  
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**Abstract**

We herein demonstrate a graphene/SiO$_2$/p-Si heterostructure with an embedded nanoscale mesa structure forming GOS-Mesa field-effect photodetector. The measured internal quantum efficiency of a proposed photodetector is ~190% and ~135% under of Ultraviolet and Visible illumination, respectively. The numerical simulation suggests that the photon excited carrier can enhance the multi-excitons via impact ionization in a quantum confined two-Dimensional Electron Gas (2DEG) region forming at SiO$_2$/Si interface. A 2DEG quantum well confined at the adjacent to Si/SiO$_2$ interface does not only play an important role for photo-excited electron emission from the p-Si edge, but also allows very high localized electric field (~10$^6$ V/cm) in 2DEG region. This paper presents photo-generated carriers, enhancing the impact ionization process in an inversion layer induced in graphene field-effect based device, resulting in the increasing of carrier multiplication factor (M). The integration of well-designed nanoscale structure and novel nanomaterials can establish new principles and approaches to nano-electronic and nanophotonic devices.

**Biography**

Dr. Khomsan Ruangwong is currently a Master student in Electrical Engineering at Kasetsart University. His main research interests are modeling and simulation and dielectric and insulation including plasma technology.

**Catalytic Reduction of 4-Nitrophenol by Magnetically Recoverable Silver Metal Nano-Composite**

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Department of Convergence Technology Engineering, Chonbuk National University, Republic of Korea

**Abstract**

We study the catalytic reduction of 4-nitrophenol (Nip) to 4-aminophenol (Amp) by sodium borohydride (BH$_4^-$) in the presence of silver nano-composite in aqueous solution. A novel magnetically recoverable silver loaded Fe$_3$O$_4$ and antimony doped tin oxide (ATO) nano-composite was successfully synthesized by simple one-pot hydrothermal process. The as-synthesized nano-composite was characterized by FE-SEM, HRTEM, XRD, FT-IR techniques. The UV-Visible spectroscopy was used to monitor the catalytic reduction of 4-nitrophenol. This catalytic reduction proceeds via the intermediate 4-hydroxylaminophenol which has been used abundantly as a model reaction to check the catalytic activity of metallic nanoparticles. Furthermore, silver nano-composite showed high performance in the catalytic reduction of 4-nitrophenol and could be easily recycled by applying an external magnetic field while maintaining the catalytic activity without significant decrease even after several times.
Biography

Ms. Laxmi Kafle received her master’s degree from Tribhuvan University, Kathmandu, Nepal in 2013. In Sept. 2017, she joined Convergence Technology Laboratory of Prof. Han Joo Kim in Chonbuk National University, South Korea, as a master student investigating the nanomaterial synthesis applied in environmental remediation.

Neutral High-Generation Phosphorus Dendrimers Inhibit Macrophage-Mediated Inflammatory Response \textit{in vitro} and \textit{in vivo}

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Abstract

Introduction: Inflammation is a physiological response of the organism aimed to defend itself from several insults. However, inflammation can also participate in the pathogenesis of central nervous diseases such as multiple sclerosis, Alzheimer disease or Parkinson diseases. Mononuclear phagocytes, including monocytes and macrophages, play a central role in innate immunity as a first line of defense and ensure the delayed adaptive immune response (1).

To explore new approaches to combat against the negative aspects of inflammation, we have used neutral high-generation phosphorus dendrimers bearing 48 (G3) or 96 (G4) bisphosphonate groups on their surface (2).

Results: G3 and G4 phosphorus dendrimers show no toxicity and have good solubility and chemical stability in aqueous solutions. Here, we present data showing neutral phosphorus dendrimers show remarkable anti-inflammatory activities both \textit{in vitro} and \textit{in vivo}. In \textit{vitro}, G3 and G4 reduced the secretion of proinflammatory cytokines from mice and human monocyte-derived macrophages. In \textit{vivo}, these molecules present efficient anti-inflammatory activity in a mouse model of subchronic inflammation, the mouse air pouch injected with zymosan.

Conclusions: Taken together, these data suggest that neutral G3-G4 phosphorus dendrimers have strong potential applications in the therapy of inflammation and, likely, of autoimmune diseases.

References:


Biography

In 2015, Romero-Castillo L. obtained the Degree in Pharmacy and she started her doctoral thesis in the research group Neurodeath Associated Unit CSIC-UCLM of the Department of Medical Sciences of the University of Castilla La Mancha. She is in her last year of doctorate. In February, she will start her 3-month predoctoral stay in the Evergrande Center for Immunologic Diseases at Harvard Medical School and Brigham and Women’s Hospital with the aim of completing her studies of multiple sclerosis. During this period, two scientific publications, one chapter of book and 5 presentations in congresses (3 international and 2 national) have been accomplished.
Effect of Surfactants on the Ni-P Bath and on the Formation of Electroless Ni-P -TiC Nanocomposite Coatings

Mate Czagany* and Peter Baumli
University of Miskolc, Hungary

Abstract

The effect of three different types of surfactants (anionic: SDBS, cationic: CTAB, and non-ionic: PVP) was studied systematically on the behavior of electroless Ni-P baths containing TiC nanoparticles, and on the formation of Ni-P-TiC composite coatings. The surfactants mostly affect the interfacial phenomena, i.e. wetting and electro-kinetic behavior during the formation of the coating. Sessile drop method was applied to investigate the wetting properties of the coating, which revealed the wetting improvement on all three substrates (W302 steel, TiC, Ni-P coating substrates) in the case of the anionic and cationic surfactant. Electro-kinetic stability was investigated by Zeta potential measurement, that showed a stability decrease in Ni-P bath compared to the distilled water medium, which led to the agglomeration of the TiC particles. TiC agglomerate size below 100 nm was achieved by all three types of surfactant (1 g/L) in distilled water; however, only larger agglomerates were measured in the Ni-P bath. Finally, the Ni-P-TiC composite coatings on steel substrate were created. Cross-section investigation of the coatings revealed that, the highest amount of TiC (0.53 w% and 0.52 w%) was incorporated in the Ni-P matrix with the use of 0.1 g/L CTAB and 0.1 g/L PVP respectively, although these particles formed larger agglomerates.

Biography

Mr. Mate Czagany is a Ph.D. student and assistant research fellow at the University of Miskolc. He received bachelor’s degree in Materials Engineering and master’s degree in Metallurgical Engineering. His research activities included development of lead-free solder alloys by investigating their wetting properties, and development of electroless Ni-P alloy and composite coatings. Currently, his Ph.D. study focuses on the investigation of the effect of melting point depression in nano-multilayered systems under the supervision of Prof. George Kaptay and Dr. Peter Baumli.

Effect of Alloying Elements on the Steel-Cu Joint Microstructure at Smaller Holding Time

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‡Bay Zoltan Applied Research Nonprofit Kft, Hungary

Abstract

Structural steels and their application in the fabrication of various structures is well known in the engineering field. Besides these steels are used in HVAC domain for fabrication of reliable heat exchanger joints. The joining of these steel systems also opens up exciting opportunities in the space and construction engineering. Most of these joints we talk about come from the interaction of molten copper as the joining material, obtaining kind of brazed joints between steels to keep check. However, the problem with these steels is that they contain various alloying elements which dictate the joint morphology and efficiency. Although most of the research in alloyed steels like AISI 304 have been conducted with copper and its alloys as joining material, basic behavior of these alloying elements and how they affect the joint microstructure is still needs to answered. The following research from us tries to answer this problem. We look at evolution of microstructure of steel-Cu joints as function of alloying element concentration. The elements in our study are Cr, Mn and S and how they affect the microstructure of the joint with copper at a fixed holding time of less than 5 minutes and the whole experimental setup was carried under inert gas (Ar) environment.

Biography

Dheeraj Varanasi is an Indian student pursuing Ph.D. in the department of material science engineering, Institute of Metal Forming, Physical Metallurgy and Nanotechnology, University of Miskolc, Miskolc, Hungary.
Synthesis and Investigation of Nickel and Copper Nanoparticles

Laszlo Somlyai-Sipos*, Peter Baumli and Dora Janovszky
University of Miskolc, Hungary

Abstract

The melting point is one of the most important thermodynamic properties of all metal materials. The melting point, what characteristic of the bulk materials is independent of the size in the microscopic range, but it will be size-dependent in the nano range. The reason of this phenomenon is the high surface volume ratio because it greatly affects the chemical and physical properties of the surface atoms. One of our objectives in our research was to create nickel and copper nanoparticles using aqueous medium technology. The analysis of the produced particles was performed by X-ray diffraction (XRD) analysis, scanning (SEM) and transmission (TEM) electron microscopies. The other objective of this work was to determine the size dependence of the melting point of the produced nickel and copper nanoparticles by differential scanning calorimeter (DSC).

Biography

Laszlo Somlyai-Sipos is a first year Ph.D. student and an assistant research fellow in part-time in the Institute of Physical Metallurgy, Metal forming and Nanotechnology at the University of Miskolc, Hungary. His research focuses on nanotechnology. His current research is the development of metal matrix composite, investigation of wetting and synthesis of nanoparticles.

Characterization of the Titanium Dioxide Nanoparticles

Weam Sidahmed* and Awadalla Sidahmed
University of Khartoum, Sudan

Abstract

This research aims to study an effect of annealing nanosize titanium dioxide (Ti), Titanium dioxide (Ti) is a wide gap oxide semiconductor is an n-type due to oxygen deficiency. It has three phases of the crystal structures including anatase, brookite, and rutile, where the band gap is 3.2 eV for brookite, 3.2 eV for anatase, and 3.0 eV for rutile. The most stable forms and the principal sources of (Ti) are rutile. The metastable anatase and brookite will transform to the thermodynamically stable rutile upon calcination at temperatures exceeding 600°C.

In all three forms, titanium (Ti) atoms are coordinated to six oxygen (O) atoms, forming (Ti) octahedra.

Utilize six grams of (Ti) material beige color was tope down divided for two parts one was annealed to 600°C for 4 hours and another let without annealing.

The as-prepared samples were further characterized using devices studying (Ti) properties, X-Ray Diffraction (XRD), Fourier Transformation Infrared Red (FTIR) and USB Spectrometer.

As 0.25g from both samples was taken and put in (FTIR) to reading transmission and absorption properties, 0.5g was taken for two samples put in (XRD), and 0.25g from both samples was taken and used UV-Visible Spectroscopy (USB) to take the readings.

After the properties of the annealed sample were studied and compared to the raw (control powder), these properties were found that the color of the Titanium Dioxide has changed from beige into white as the last one showed fewer impurities and formed Ti-O-Ti vibrational mood which was absent in the control sample.

The band gap was recorded and found to be 2.567 eV and 2.568 eV for control and annealed samples respectively.
**pH-Responsive Lipid Hybrid-Dendrimer Nanoparticles to Combat Anti-Bacterial Drug Resistance**

**Ruma Maji**, Calvin A Omolo and Thirumala Govender  
*Department of Pharmaceutical Sciences, College of Health Sciences, University of KwaZulu-Natal, South Africa*

**Abstract**

Emergence of antimicrobial drug resistance is currently a major health concern globally. Advanced approaches to delivering existing antibiotics are essential to combat drug resistance. pH-responsive nanoparticles can play a significant role in delivering the antibiotics directly to the acidic environment of bacterial infection site, thereby enhancing drug safety, efficacy and decreasing the development of drug resistance.

The aim of this study was to develop and evaluate novel pH-responsive lipid-hybrid dendrimer nanoparticles (LH-DNPs) to deliver Vancomycin (VCM) to the bacterial infection site.

LH-DNPs were prepared by emulsification solvent evaporation method and characterized by particle size, polydispersity index (PDI), surface charge or Zeta-potential, drug entrapment efficiency, surface morphology and by various *in vitro* characterization studies such as drug release, antibacterial activity, and intracellular activity.

Prepared LH-DNPs were nano-size range with narrow-range of size distribution pattern supported by the PDI value 0.28±0.05, with 82.70±4.09% drug entrapment efficiency. pH-responsive behaviour of the nano-formulations was confirmed by changes in size from 124.4±2.01 to 173.9±13.38 at different pHs of 7.4, 6.0 respectively, as well as from the shifting of surface charge from negative to towards positive in response to acidic pHs. In *in vitro*, drug release data showed, VCM released from LH-DNPs faster at pH 6.0 than 7.4. In *in vitro* antibacterial activity against *Staphylococcus aureus* (SA) and *Methicillin-resistant Staphylococcus aureus* (MRSA) showed lower minimum inhibitory concentrations (MICs) for LH-DNPs as compared to bare VCM. LH-DNPs showed 2-fold and 0.5-fold lower MIC at pH 7.4 and 2-fold and 8-fold lower at pH 6.0 against both SA and MRSA compared to the bare VCM. LH-DNPs also showed significant (p< 0.0001) antibacterial efficacy towards the intracellular bacteria.

This study confirmed LH-DNPs would be a promising nano-carrier system for antibiotics with enhanced antibacterial efficacy against gram-positive bacteria i.e. SA and MRSA which could improve the patient’s life.

**Biography**

Dr. Ruma Maji has her expertise in the field of formulation and development of nano-drug delivery systems. Her pharmaceutical background has given her the extra freedom to think, correlate and understand both biological and chemical aspects of the work. Currently she is working on stimuli-responsive nano-drug delivery systems, transferosomes etc. In this research work she has formulated pH-responsive nano-carrier and evaluated their potential to combat the anti-bacterial drug resistance. This delivery systems would be a promising new pharmaceutical delivery system which will improve patient’s life, and it can also be contributed a newer approach and knowledge to the drug delivery research.

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**Vitellogenin Expression after Graphene Oxide Intoxication and Therapeutic Effect of Ascorbic Acid in *Acheta domesticus***

**Barbara Flasz**, Marta Dziewiecka, Andrzej Kedziorski and Maria Augustyniak  
*Department of Animal Physiology and Ecotoxicology, University of Silesia in Katowice, Poland*

**Abstract**

The release of graphene oxide (GO) into ecosystem during its production, processing, and application undoubtedly increases environmental risk. Any disturbances during the production of reproductive cells can lead to serious consequences, including extinction of the species. In order to better understand the risks of GO, and to give environmentally responsible advice on its future applications, studies on its adverse effects on reproduction are important. It is also relevant to find possible treatment to avoid or decrease possible adverse effects of GO on organisms.

The main goal of the project is investigation of graphene oxide impact on reproduction potential of *Acheta domesticus*, with particular focus on Vitellogenin (Vg) expression measured at molecular level, as well as estimating potentially protective effect
of vitamin C supplementation on improving the condition of the organism of the house cricket subject to GO.

We have intoxicated crickets with GO-contaminated food during whole life cycle. Next, we replaced GO food with ascorbic acid food for 15 days in the 10th day of adultness. Lastly, we have collected fat body to estimate level of Vitellogenin by Western Blot method.

Long-term GO intoxication in low concentrations leads to disturbance of reproduction potential. The GO treatment alters Vg precursor expression pattern, that may be hazardous for embryo development. The negative GO effect is stronger in groups consuming food with higher GO concentration. Fortunately, ascorbic acid reduces the toxicity of GO showing its therapeutic effect.

Acknowledgment: The research was supported by the National Science Centre (Agreement No. UMO-2016/23/N/NZ7/01977).

Biography

Ms. Barbara Flasz studied Plant and Microorganisms Biotechnology at University of Silesia in Katowice, Poland. She is currently a Ph.D. student at Department of Animal Physiology and Ecotoxicology at University of Silesia in Katowice. Her research activities mainly focus on Vitellogenin protein as a biomarker and graphene oxide toxicity. The impact of nanoparticles on reproduction potential, especially on molecular level of proteins and gene expression is imperative and represents a major and important part of her research.

Electrical Conduction in the Ag/Si Interface of Silicon Solar Cells

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2Department of Physics, Federico Santa Maria Technical University, Chile
3International Solar Energy Research Center Konstanz (ISC), Germany
4Department of Physics, FCFM, University of Chile, Chile
5Department of Pharmacological and Toxicological Chemistry, University of Chile, Chile

Abstract

Electrical conductivity between the photovoltaic solar cell’s carriers and the metal fingers occurs through nanometric silver crystallites grown in the silicon surface during metallization. These crystallites are not necessarily in direct contact with the bulk Ag of the paste, due to the large amount of glass frit (1). In this work we analyze the electrical conduction of two different silver pastes and their effect in cells efficiencies.

Solar cells with paste A, show an efficiency of 20.05% for samples with 1 print, which increased to 20.21% with 2 prints. Paste B achieved an efficiency of only 17.16% with 1 print but was increased to 19.32% with a second print.

Contact resistivity ($\rho_c$) of paste A, with one print, is slightly higher, probably because penetration of paste A crystallites on the silicon surface is slightly larger. While $\rho_c$ lowers with the second print of paste A, it raises with a second print of paste B. This is probably due to an increase of the oxidized silver observed for paste B. Nevertheless, the expansion of the area covered by silver crystallites in the second print of paste B seems to balance the increment of $\rho_c$.

Line resistivity of the metal fingers is one order of magnitude larger for paste B compared to paste A due to structural differences, but this difference is overcome in the second print.

Differences in efficiency between pastes seem to be mainly given by contact resistance, while the number of prints reduce line resistivity enhancing cells efficiency.

Reference:
Biography

Dr. Valeria del Campo obtained her Ph.D. from Pontifical Catholic University of Chile in 2009. Since then she is a researcher at Federico Santa Maria Technical University, Chile. Her research area is experimental condensed matter physics, in which she is mainly focused in nanoscience and nanotechnology. She has studied growth, characterization and applications of different nanostructures like graphene, metallic ultrathin films and self-assembled monolayers. In the last four years she has been studying photovoltaic solar energy and the application of nanomaterials for efficiency and robustness improvements.

Binding Affinities of Selected Aliphatic α-Amino Acids with Graphene: A Computational Study

Jovian Lazare* and Tandabany Dinadayalane
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Abstract

Density functional theory (DFT) calculations were performed to understand the binding of eight aliphatic amino acids (glycine, alanine, valine, leucine, cysteine, methionine, aspartic acid, and glutamic acid) individually with two finite size graphene sheets. After performing conformational analysis for these eight amino acids using Merck Molecular Force Field (MMFF) implemented in Spartan ’18 software package, geometries of all the conformers were refined first at the HF/6-31G(d) level and then at the M06-2X/6-31G(d) level. The most stable conformer obtained at the M06-2X/6-31G(d) level was used to build complexes with graphene by considering different possible binding modes. All the complexes were fully optimized using M06-2X/6-31G(d) level. Binding energies with and without basis set superposition error (BSSE) correction were calculated and analyzed. Our study reveals that multiple C-H...pi and N-H...pi interactions contribute for stabilization of the complexes. The data obtained from our computational study may be helpful for force field development and for future experiments on non-covalent interactions of amino acids with graphene. Our findings would provide insights for experimentalists exploring graphene nanomaterials for potential applications in drug delivery, biomedical implants (or biocompatible materials), biomedical imaging, protein sequencing, and biosensor devices. Our goal is to understand the relationship between the binding affinities of various complexes and structural features including the orientation of amino acid adsorbed on varying sizes of graphene surface.

Biography

Jovian is currently a Ph.D. student in chemistry at Clark Atlanta University (CAU). He earned his B.S. in chemistry from Savannah State University. While attending CAU, he achieved several prestigious awards such as Extreme Science and Engineering Discovery Environment (XSEDE) Scholar in 2016, XSEDE travel award for PEARC17 conference and Mickey Leland Energy Fellowship (MLEF)-U.S. Department of Energy (DOE) in summer of 2018. Some of his research interests are computational design of materials, nanomaterials-based alternative energy, solar energy harvesting, utilization of electrochemistry for conversion of environmental gases. After graduation, he plans to take a postdoc position preferably at a national lab.

Functional Inorganic Nanomaterial Aerogels for Chemical Sensor Applications

Sung Mi Jung
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Abstract

Creating 3D porous inorganic nanowire aerogels using various materials and inexpensive means remains an outstanding challenge despite their importance for many applications. Here, we present a facile methodology to enable highly porous and ultralight inorganic nanowire aerogel production on a large scale and at low cost. The inorganic nanowire aerogels are obtained from formation of a cross-linking network during one-step inorganic nanowire synthesis process without any specific crosslinking reaction and template fabrication process. Inorganic nanowires start to grow from precursor suspension and the length and concentration of the grown nanowires increase with growth time and then the ultralong nanowires are interconnected with each other to form a continuous nanowire gel network at the gel formation concentration. Such a method not only offers great simplicity but also allows the interconnected nanowires to have much longer length. The longer length offers aerogels with remarkable porosity and surface area, extremely low densities, excellent mechanical and electrical properties by tuning the
synthesis conditions. Superior properties such as high porosity, high electrical conductivities, and mechanical robustness allow these aerogels to be used in many areas, such as sensing, catalysis, absorption, water/air purification filters.

Biography

Ms. Sung Mi Jung received Ph.D. in Chemistry from Seoul National University, South Korea in 2008. During 2010-2016, she has worked at Prof. Jing Kong’s group as postdoctoral associate and research scientist in the Electrical Engineering and Computer Science Department, MIT. She is currently a senior research scientist at Korea Institute of Toxicology. She is an expert in the field of synthesis of 3D aerogels from 1D and 2D nanostructure materials such as carbon-based materials, and inorganic materials and their sensing, energy storage, environment, and bio-tissue engineering applications. Her research interests are sensing toxic materials, gas sensors, and biosensors.

Characterization of Aerosolized Particles from Nanoclay Composites during Manipulation Processes

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2Korea Occupational Safety and Health Agency, South Korea
3West Chester University, PA
4RJ Lee Group, PA

Abstract

The objective of this study was to characterize the particles generated during industrial sanding of nanoclay-embedded polypropylene composites. Two types of nanoclay, Cloisite 25A and Cloisite 93A at 1% and 4% of concentration by weight, were embedded into polypropylene. A sanding apparatus was used to levigate virgin and nanoclay-embedded polypropylene blocks. Two types of zirconium aluminum oxide belts (P100 and P180 grits) were used. Various direct-reading instruments were used to measure particle concentrations and size distributions. A MOUDI impactor was used for gravimetric analysis. Particles released from sanding were collected with inhalable samplers loaded with polycarbonate filters for electron microscopy. Regardless of sandpaper grit sizes and materials, the results using direct-reading instruments revealed one main mode in particle distributions by number with a peak between 10 nm and 15 nm. However, the particle number concentrations of nanoclay composites differed considerably, showing number increases of 1.3-2.6 times, compared to those of virgin polypropylene. Gravimetric analysis showed that the majority of the airborne particles were inhalable. Electron microscopy analysis confirmed the direct-reading instruments’ results and revealed the presence of large-size agglomerated particles as well as small particles in the respirable fraction. Several particles have nano-features that resemble embedded nanoclay. These results indicate that the inclusion of nanoclay in polypropylene has an effect on the matrix structure and the rate of degradation of the material during sanding. Additionally, these findings may have implications on the toxicity of the particles generated as higher particle concentrations could elicit more severe adverse health effects after inhalation.

Biography

Dr. Eun Gyung Lee is an Environmental Health Scientist at the National Institute for Occupational Safety and Health. She has worked on several research studies involving exposure measurements and modelling evaluation of airborne chemicals, development of sampling pumps corresponding to human breathing rates, and comparison of sampling strategies between different sampling and analytical methodologies. She has been Secretary of ISO Technical Committee 146 on Air Quality/Sub-Committee 2 on Workplace atmosphere since 2009 and is currently a member of the editorial board of Journal of Occupational and Environmental Hygiene.

Monodispersed Functional Nanoparticles Prepared by HGRT Technology and their Applications in Transparent Polymer-Based Nanocomposites

Xiao-Fei Zeng1, Jun Bao, Jie-Xin Wang and Jian-Feng Chen
State Key Laboratory of Organic-Inorganic Composites, Beijing University of Chemical Technology, China
Abstract

How to disperse the inorganic nanomaterials mono-uniformly in the organic matrices is the key challenge of innovation of new generation of organic-inorganic nanocomposites. Many techniques have been used to fabricate the transparent nanocomposites by incorporating the mono-dispersed nanoparticles into optical polymer. However, making mono-dispersed nanoparticles requires complex processing, and it is difficult to realize large-scale production. In this paper, a simple strategic method to synthesize the mono-dispersed nanoparticles in the liquid mediums (transparent nano-dispersions) was proposed to prepare the transparent polymer-based nanocomposites. The transparent nano-dispersions with the contents higher than 50 wt% were produced by our proposed novel high-gravity reaction coupled with extraction-phase transfer (HGRT) technology. By such strategy, the various transparent nano-dispersions and their polymer-based nanocomposites with unique functions were fabricated on a large-scale, such as metal oxides nano-dispersions, nano-lubrications for high railways and nanocomposite films for glass energy-saving, where the inorganic nanoparticles were all dispersed at the nano-scale. Even if the content of nanoparticles was higher than 50 wt%, the fabricated flexible nanocomposite film also had the same visible transmittance with the unfilled film. Our HGRT technology is suitable for massive production of transparent nano-dispersions and functional optical nanocomposites, which is cost effective and the products for the custom designed nanoparticles for tailed functions.

Biography

Dr. Xiao-Fei Zeng obtained her bachelor’s degree and Ph.D. degree from Beijing University of Chemical Technology in Chemical Engineering in 1996 and 2010, respectively. She was appointed to the staff of Beijing University of Chemical Technology in 2001. Her research interests involve the preparation of nanomaterials and their transparent nano-dispersions, organic/inorganic nanocomposites. She has filed 22 national patents (16 granted) and published more than 110 peer-reviewed journal papers. As one of the principal investigators, Dr. Zeng has been granted the National Scientific and Technological Progress Award. She has also been granted two provincial awards.

Polymerization of n-Butyl Cyanoacrylate as Drug Carrier Using High Gravity Technology

Xingzheng Liu, Boting Lu, Jian-Feng Chen and Yuan Le*
State Key Laboratory of Organic-Inorganic Composites, Research Center of the Ministry of Education for High Gravity Engineering and Technology, Beijing University of Chemical Technology, China

Abstract

Poly (n-butyl cyanoacrylate) (PBCA) is a widely used drug carrier with excellent biocompatibility and biodegradability which can be sterilized by high temperature. PBCA can be prepared by anionic polymerization, which use low toxicity initiator and solvent. However, the polymerization behavior of PBCA is difficult to control and hard to reproduce. Rotating packed bed (RPB), which is prone to industrialization, has been proved as a powerful tool to produce homogeneous nanoparticles. In this work, a novel synthesis method for PBCA nanoparticles with different molecular weight was reported. The polymerization was carried out in internal circulation RPB, and the drug carrier ability was characterized using sorafenib (SFN) as model drug. Polymerization and purity were confirmed by $^1$H NMR spectra, FT-IR and thermogravimetry. Molecular weight was determined by gel permeation chromatography. The decrease of reaction time, polydispersity index and types of additives was achieved compared with conventional stirred tank reactor. SEM images shows the morphology difference between PBCA with different molecular weight. SFN was loaded in PBCA using anti-solvent method. The drug loading properties was measured by HPLC system. The in vitro drug release of different molecular weight PBCA indicates controlled and sustained release. Furthermore, in vitro cytotoxicity shows acceptable biocompatibility of PBCA and toxicity enhancement to SFN for Hep G2 cells. Cellular uptake of Nile red labelled PBCA shows efficient internalization for Hep G2 cells.

Biography

Dr. Yuan Le is a full professor of State Key Laboratory of Organic-Inorganic Composites, Research Center of the Ministry of Education for High Gravity Engineering and Technology, Beijing University of Chemical Technology. Her research interest involves nanomaterials and nano-drug delivery systems. She has filed over 40 national patents and published more than 70 peer-reviewed journal papers.
Artemisia absinthium Extract Loaded High Efficacy Double Triggered NIPAAm-VP-AA Nanoparticles for Breast Cancer Therapy

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2Department of Chemistry, School of Chemical and Life Sciences, Jamia Hamdard, India

Abstract

The side effects related to the currently available anti-breast cancer agents are the matter of concern. This can be overcome by combining two alternative approaches together i.e. herbal drugs together with the nanoparticles. Keeping in mind the tumor micro environment double triggered (temp. and pH responsive) polymeric nanoparticles (NPs) were prepared and characterized by TEM, DLS and IR. The cytotoxicity of the different part extracts of A. absinthium was evaluated on the breast cancer cell lines (MCF-7 and MDA MB-231) by MTT and LDH assay. The extract which emerges as the best was loaded on the NPs and evaluated on cell lines by various cytotoxic parameters like MTT assay, CFSE cell proliferation assay, apoptosis assay, cell cycle study and DAPI nuclear staining. Finally, the key proteins responsible for the caused cytotoxicity were identified by nano-LC-MS/MS analysis, which was validated by RT-PCR. The whole extract was the best with least IC50 value and high LDH release. Further, the encapsulation of the whole extract on the NPs enhances their cytotoxic efficacy with lesser effect on the normal cells (HEK-293 cell line). The proteome analysis by the nano-LC-MS/MS identified the key proteins that are mainly related to the proliferation, vesicular trafficking, apoptosis, and tumor suppression. The results of this study showed that encapsulation of the whole extract of A. absinthium cause apoptosis at very low concentration in breast cancer cell lines. The identified key proteins help in understanding the mechanism of caused cytotoxicity and may also be used in further targeted drug delivery.

Biography

Mr. Mohd Mughees recently submitted his Ph.D. thesis entitled “Evaluation of Therapeutic Potential of Herbal Based Nano-Formulation on Breast Cancer Cell Lines” to the Jamia Hamdard, New Delhi, India. He has published 9 research articles and one book. He has been awarded travel grant from ‘European Society of Medical Oncology’ to participate in the “TAT-2018” held at France. He has also been awarded Senior Research Fellowship from Indian Council of Medical Research and Hamdard National Fellowship from Jamia Hamdard. He has presented his work in 3 International and 5 national conferences and also participated in more than 10 workshops.

A Possible Interaction Mechanism between Arsenite Species and Fe3O4@α-FeOOH Nanoparticles in Aqueous Medium

Herlys Viltres1,2*, Oscar Odio1, Mark Biesinger4, Gala Montiel3, Raul Borja4 and R. Edilso1

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2University of Western Ontario, Canada
3University of the Salle, Mexico
4Center for Nanoscience and Micro-Nanotechnology, National Polytechnic Institute, Mexico

Abstract

Arsenic is one of the most widespread inorganic pollutants worldwide and represents a significant potential risk to human health and the biosphere. It is well known that arsenic is highly toxic and carcinogenic; at present, there are reports of diverse countries with arsenic concentrations in drinking water higher than those proposed by the World Health Organization (10 μg/L). Nanomaterials and nanotechnologies inspire new possible solutions to major environmental issues nowadays. It has been reported that adsorption strategies using iron oxide nanoparticles are very effective for the removal of arsenic in drinking waters. In this case, an inorganic hybrid material could have better application in the arsenic remove, due to a large superficial area of goethite (α-FeOOH) and the superparamagnetic properties of magnetite (Fe3O4), give a great versatility to the hybrid material for the separation process.

As-synthesized hybrid magnetic nanoparticles (Fe3O4@α-FeOOH) were put in contact with As2O3 solutions at room temperature at pH 4 and 7. The nanoparticles were characterized by DRX, FT-IR, and XPS. The presence of arsenic on particles surface was confirmed, which is more remarkable when pH= 7 condition is employed. On the other hand, when As(III) species
interact with the nanoparticle surface, oxidation to As(V) occurs, which produces the surface reduction. Besides, after adsorption experiment, it was evidenced from XPS that once arsenic species interact with the nanoparticles, they form doubly protonated monodentate and simply protonated monodentate complex of As(III) at pH = 4 and 7, respectively, and bidentate complex of As(V) after As(III) oxidation, in both conditions.

**Biography**

Ms. Herlys Viltres completed her master’s degree in the Center for Research in Applied Science and Advanced Technology (CICATA), Legaria Unit, National Polytechnic Institute, Mexico. At this moment she is a Ph.D. student at CICATA. She worked on the synthesis and characterization of iron oxide nanoparticles (magnetite, hematite, and goethite) to remove arsenic from the aqueous medium. In her doctorate, she works on different methodologies for obtaining magnetic nanoparticle platforms with dendritic architecture on the surface. Now, she is doing an internship at the University of Western Ontario under the supervision of Dr. Mark Biesinger in the field of surface characterization techniques like XPS.

**Engineering Embolic Particles from a Periodically-Pulsating Charged Liquid Meniscus**

Xiaowei Tian and Li Qiu Wang

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HKU-Zhejiang Institute of Research and Innovation (HKU-ZIRI), China*

**Abstract**

Generation of uniform and size-controlled soft microparticles in large quantity is of paramount importance for embolization therapy, a nonsurgical, minimally-invasive procedure that involves the selective occlusion of blood vessels on demand by introducing embolic agents. Here, we engineer the embolic microparticles from an electrified meniscus of the precursor alginate solution.

We have studied the micro-dripping regime of a highly conductive and viscous liquid for the purpose of generation uniform, size-controlled embolic microparticles in large scale of production. We found that the micro-dripping regime occurs in a narrow range of electric Bond number, \( B_e = 0.3^{-1} \), where the conical tip of the charged meniscus emits a single yet fine droplet, periodically. We further find the dependence of droplet size and generation frequency on the dimensionless controlling parameters in the micro-dripping regime: \( B_e \) and the dimensionless flow rate. The size of the produced droplets in this regime scales with \( q^{0.5} \), and \( B_e \) has little effect on the droplet size. The dimensionless droplet generation frequency changes with. By adopting a small value of, the periodic micro-dripping can yield uniform droplets with a high frequency and the size that is only one-tenth of the nozzle size. Therefore, the micro-dripping mode of electrospray provides uniform microdroplet templates that has a narrower size distribution than traditional “top-down” approaches such as phase separation or precipitation with standard deviations~50%, and also offers a reasonable production rate with scale-up operations. Our results can offer useful guidelines for effective production of therapeutic microparticles from precursor solution of similar physical properties on a commercial scale.

**Biography**

Dr. Xiaowei Tian received her B.S.E. degree from the University of Manchester in 2012, S.M. C and Ph.D. in Mechanical Engineering from the University of Hong Kong in 2013 and 2018, respectively. She is currently a Postdoctoral Fellow in the Department of Mechanical Engineering in the University of Hong Kong.

Her research interests include emulsions, microfluidics, emulsion-templated materials and soft matter. She also interests in thermal engineering especially in thermal dynamics and entropy generation analysis.
Investigation of $\text{BaTiO}_3$ Nanocomposite Electrodes for Energy Harvesting in Lithium Ion Batteries

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Abstract

Employing piezoelectric materials in lithium ion batteries is a promising method for energy harvesting during operation of the battery. Si and $\text{BaTiO}_3$ (BTO) nanoparticles found in the anode of a lithium ion cell work synergistically to help Li intercalation process. Expansion of Si during charging of the battery can be utilized as the mechanical strain can be used to generate electric potential in the BTO particles. With the additional electric field lithium intercalation can be enhanced due to decreasing activation over potential and increased diffusion at the solid-electrolyte interface. Piezo-effect also work in favor of deintercalation in the cathode for the same reasons. In this study, a multi physics model of a lithium ion cell consisting of Si anode and LCO cathode is developed. Piezoelectric effect is coupled with the electrochemical and mechanical phenomena occurring during various cell operating conditions. Size, and shape of the BTO particles are investigated for energy harvesting purposes.
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