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Magnesium Nanocomposites for Engineering/Biomedical Applications

Magnesium is a non-toxic, sustainable and lightest metallic element that can be used in load bearing applications. These attributes make it suitable for mitigate global warming through the use in engineering sectors (automobile, aerospace, space, sports, defense and electronics) and as a biomaterial to reduce the medical costs as the temporary medical implants made from magnesium will not need a revision surgery. One of the method to enhance practically all the properties of magnesium is through the judicious use of reinforcements at nano-length scale. Accordingly, the present talk will focus on the amazing capabilities of different types of nano-reinforcements in very small amount to enhance ambient temperature and elevated temperature mechanical properties, machining, oxidation and electrochemical response of magnesium. A brief glimpse of underlining mechanisms will be provided along with the future challenges for as materials

Biography

Dr Manoj Gupta was a former Head of Materials Division of the Mechanical Engineering Department and Director designate of Materials Science and Engineering Initiative at NUS, Singapore. He did his Ph.D. from University of California, Irvine, USA (1992), and postdoctoral research at University of Alberta, Canada (1992). In August 2017 he was highlighted among **Top 1% Scientist of the World** Position by The Universal Scientific Education and Research Network and **among 2.5%** among scientists as per ResearchGate. To his credit are: (i) Disintegrated Melt Deposition technique and (ii) Hybrid Microwave Sintering technique, an energy efficient solid-state processing method to synthesize alloys/micro/nano-composites. He has published over 585 peer reviewed journal papers and owns two US patents and one Trade Secret. His current h-index is 67, RG index is > 47 and citations are greater than 17000. He has also co-authored six books, published by John Wiley, Springer and MRF - USA. **He is Editor-in-chief/Editor of twelve international peer reviewed journals.** A multiple award winner, he actively collaborate/visit Japan, France, Saudi Arabia, Qatar, China, USA and India as a visiting researcher, professor and chair professor.

Yasuhiro Shimizu* and Takeo Hyodo**

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High CO Sensing Performance of Solid Electrolyte Gas Sensors

Detection of CO is of primary importance from the view point of safety in many industrial processes as well as our daily life. In addition, low temperature operation is one of requisites for achieving high performance of CO sensing. But, the room temperature (RT) operation of CO gas sensors in any types is usually suffered from the problem associated with the interference from water vapor. Thus, the simultaneous studies of CO gas sensing properties and cross-sensitivity to water vapor are absolutely necessary for the development of CO gas sensors capable of operating at RT.

Recently, we have found that selective CO detection could be achieved by the design of electrode materials used for solid electrolyte gas sensors at RT and/or at temperatures less than below the freezing point. The first approach is the use of an Au-loaded metal oxide as an electrode material for the potentiometric sensor fabricated with an anion-conducting polymer as an electrolyte. The important role of metal oxides, such as Bi_2O_3 and CeO_2, added to the Pt sensing and reference electrodes of a potentiometric NASICON gas sensor has been demonstrated in the second approach.

These two kinds of solid electrolyte sensors showed good CO sensing performance and then selectivity to CO against H_2 at RT even in a humid environment. The potentiometric NASICON sensor showed good CO sensing properties even at temperatures less than below the freezing point. More detailed CO sensing performance and possible CO sensing mechanism will be delivered at my presentation.

Biography

Yasuhiro Shimizu received his B. Eng. degree in applied chemistry in 1980 and Dr. Eng. degree in 1987 from Kyushu University. He has been a professor at Nagasaki University since 2005. He was a president of Japan Association of Chemical Sensors, the Electrochemical Society of Japan at 2015 and 2016, and is co-Editor-in-Chief of Sensors and Actuators B form 2018. His current research concentrates on development of gas sensors based on various kinds of sensing principles.

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Interfacial Modification in Nanocomposites to Tailor Functionalities

The talk will concentrate on various approaches being used to engineer materials at the nanoscale for diverse applications in future technologies. For instance, the case of clay, carbon nanostructures (e.g. nanotubes, graphene), metal oxides, bionanomaterials (cellulose, starch and chitin) will be used to highly-light the challenges and progress. Several polymer systems will be considered such as rubbers, thermoplastics, thermosets and their blends for the fabrication of functional polymer nanocomposites. The interfacial activity of nanomaterials in compatibilising binary polymer blends will also be considered. Various self assembled architectures of hybrid nanostructures can be made using relatively simple processes. Some of these structures offer excellent opportunity to probe novel nanoscale behavior and can impart unusual macroscopic end properties. The talk will comprise various applications of these materials, taking into account their multifunctional properties. Some of the promising applications of clay, metal oxides, nanocellulose, chitin, carbon nanomaterials and their hybrids will be reviewed. Finally the effect of dewetting upon solvent rinsing of nanoscale thin films will also be discussed.

Biography

Prof. Sabu Thomas is a highly committed teacher and a remarkably active researcher well-known nationally and internationally for his outstanding contributions in polymer science and nanotechnology. He has published over 1000 research articles in international refereed journals. and has also edited and written 140 books with an H-index of 106 and total citation of more than 53,000. He has received a large number of international and national awards and recognitions. Under the leadership of Prof. Thomas, Mahatma Gandhi University has been transformed into a top University in the country where excellent outcome-based education is imparted to the students for their holistic development.

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Topological defects in nematic liquid crystals: playground of fundamental physics

Topological defects (TDs) are an unavoidable consequence of continuous symmetry breaking phase transitions. They appear at all scales of physical systems, including particle physics, condensed matter, and cosmology. Due to their topological origin, they display several universalities that are independent of the systems' microscopic details. For example, they might even explain the stability of "fundamental particles" via topological protection if fields represent a fundamental entity of nature.

The nematic liquid crystal (NLC) phase represents an ideal playground to study TDs owing to their unique combination of optical anisotropy, fluidity, and softness. In them, various TDs could be relatively easily created, observed, and manipulated. In the lecture, our theoretical and experimental study of TDs in NLCs will be presented. We will demonstrate how a network of TDs forms due to the universal Kibble mechanism and evolves with time after LC is quenched from the isotropic (ordinary liquid) to the nematic phase. We illustrate that TDs could stabilize the glass phase in supercooled nematics. Furthermore, we will show how different "charged" and "charge-less" TDs could be stabilized in confined nematics. In particular, defect structures analogous to intriguing Majorana particles will be presented. The study of such structures might give insight into open problems in the physics of neutrinos.

Biography

Samo Kralj has completed his Ph.D. from the University of Ljubljana (Slovenia) and postdoctoral studies from the University of Southampton (UK) and JSI (Slovenia). He is the head of the Laboratory of Complex Systems and vice-head of the Department of Physics, FNM UM, and senior adviser at JSI. His research interests soft nanocomposites, biophysics, glassy systems, topological defects, and has published more than 150 papers in reputed journals. Among others, he organized and chaired the European conference on liquid crystals (2011) and ESF exploratory workshop on topological defects (2013).

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Precise ML-aided design for cemented paste backfill materials

Mine tailings are inevitable by-products of hardrock mining and its disposal is possibly the most daunting challenge faced by the mining industry. The emergence of cemented paste backfill (CPB) technology has the potential to substantially alter the way mine tailings are managed. However, the current CPB design is highly experimental-based, which is time consuming and labor intensive. Towards this end, a state-of-the-art concept for CPB design is proposed. In such a design framework, the influence of in-situ mining conditions on strength and flowability requirements of CPB will be considered promptly. Based on the strength and flowability requirements, the CPB mix design is optimized and in-situ backfill will proceed using the optimized mix design. The ongoing backfill involves the change of in-situ mining conditions, which will be considered once again. Therefore, this design framework is a 'close-loop' design system for CPB that can consider in-situ mining conditions and make corresponding optimization almost in real-time. Precise decision can be made for CPB materials considering the difference of each underground stope.

Biography

Prof. Chongchong has completed his PhD from The University of Western Australia, Australia. He has been a professor at Central South University, China, since 2019. Based on the continuous research focusing on intelligent backfill system, he has published more than 70 papers in reputed journals. Moreover, he has been serving as an editorial board member of three reputed SCI journals.

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Will nanomaterials and stem cells give hope to unmet clinical need in medicine

The world advancing rapidly in the field of technology, a simple example is our mobile phone. However, when compared to healthcare, the diagnostic and treatment of diseases are still very poor, and surgery has not changed significantly compared with 50 years ago.
There is plenty of news in academia/media that everything could be diagnosed and cured, but in reality, the invention has been tested in rodents and has not moved to human. This is due to; the complexity of the medical devices builds in a university research environment, the lack of difficulty taking devices to the clinical setting, as well as the positive outcome obtained from in vitro and rodents may not transferable to human. Therefore, need going back to the drawing table and rethink to build medical devices that; commercially feasible, reliable, sensitive, repeatable and non-toxic and biocompatible.

The potential for using smart nanomaterial and consequent research to replace damaged tissues has also seen a quantum leap in the last decade. In 2010, two scientists in the UK isolated a single layer of carbon atoms on scotch tape. Graphene considers as a wonder material, it is the strongest material on the planet, an order of 100 times stronger than steel, super-elastic and conductive. The functionalized graphene oxide (FGO) is non-toxic and antibacterial. FGO has been used for drug and gene delivery, development of biosensor or in nanocomposite materials development of human organs. In my talk, I present and discuss our work on the application of FGO in development of medical sensors, drug, gene and stem cells delivery, as well as the development of human organs with stem cells technology. The FGO based materials can be fabricated to human organs. The 3D scaffold from these materials is functionalized with bioactive molecules and stem cells technology, for the development of human organs. The data for the development of organs using these materials will be presented.

Biography

Professor Alexander Seifalian, Director of NanoRegMed Ltd, The London BioScience Innovation Centre, London. He has worked at the Royal Free Hospital and University College London for over 26 years, during this time he spent a year at Harvard Medical School looking at caused of cardiovascular diseases and at Johns Hopkins Medical School looking at the treatment of liver. He published more than 647 peer-reviewed research papers and registered 14 UK and International patents. Currently on editorial boards of 41 journals. During his career, he has led and managed many large projects with successful outcomes in terms of commercialization and translation to patients. In 2007 he was awarded the top prize in the field for the development of nanomaterials for cardiovascular implants by Medical Future Innovation, and in 2009 he received a Business Innovation Award from UK Trade & Investment. He was the European Life Science Awards' Winner of Most Innovative New Product 2012 for the "synthetic trachea". He won the Nanosmat Prize in 2013 and in 2016 he received the Distinguish Research Award in recognition of his outstanding work in regenerative medicine from Heals Healthy Life Extension Society. Currently working on the commercialization of his research. He has commercialized a novel functionalized graphene oxide (FGO) for medical and other industrial applications. He also working on the commercialization of human organs using FGO based nanocomposite materials

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Stereolithographic Additive Manufacturing of Practical Ceramic Components

Vltraviolet laser lithography was newly developed as a direct forming process of fine ceramic components with micro geometric patterns. As an additive manufacturing technique, two dimensional cross sections were created through dewaxing and sintering by UV laser drawing on spread resin paste including ceramic nanoparticles, and three dimensional composite models were sterically printed by layer laminations and interlayer joining. Ceramic particles of barium titanate or titanium dioxide with 300 nm in average diameter were dispersed in to photo sensitive liquid resins at 50 % in volume fraction. The resin paste was spread on a glass substrate at 50 µm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted at 10 µm in diameter and scanned on the surface. Irradiation power was increased to 1 W for enough solidification depth. The half wavelength of the incident ultraviolet ray should be comparable with the nanoparticles gaps in the resin paste, and electromagnetic field can be resonated and concentrated through Anderson localization. After the layer lamination, the barium titanate or titanium dioxide structures with about 99 % in volume fraction were successfully processed to create thermoacoustic or electromagnetic devices for supersonic or terahertz waves modulations..

Biography

Soshu Kirihara is a doctor of engineering and a professor of Joining and Welding Research Institute (JWRI), Osaka University, Japan. In his main investigation “Materials Tectonics” for environmental improvements of “Geotechnology”, multi-dimensional structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic and metal components were fabricated directly by smart additive manufacturing, design and evaluation (Smart MADE) using high power ultraviolet laser lithography. Original stereolithography systems were developed, and new start-up company “SK-Fine” was established through academic-industrial collaboration.

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Magnetism in 2D Flatlands

The two-dimensional (2D) atomic crystals exhibiting magnetic properties provide an ideal platform for exploring new physical phenomena in the 2D limit. This new approach represents a substantial shift in our ability to control and investigate nanoscale phases. Experimental studies have shown doping of dissimilar atoms into transition metal dichalcogenides to create 2D dilute magnetic semiconductors, which are a promising candidate for spintronics applications. The success of these previous attempts, however, was fairly limited, resulting in either a Curie temperature well below room temperature or random local clustering of magnetic precipitations, *i.e.,* lacking uniformity for integration into devices. Here our work demonstrates a 2D dilute magnetic semiconductor at room temperature via an *in situ* synthesis and characterization of Fe-doped MoS_2 monolayers. We simultaneously achieve the *in situ* doping of Fe and the growth of MoS_2 monolayers via low-pressure vapor deposition growth. Using advanced characterization techniques, we show that Fe incorporates substitutionally into Mo lattice sites, and probe ferromagnetism at room temperature. This new class of van der Waals ferromagnets finds critical applications, including on-chip magnetic manipulation of quantum states or in spintronics.

Keywords— 2D materials, transition metal dichalcogenides, dilute magnetic semiconductors, 2D magnets, room temperature spintronics

Biography

Dr. EH Yang is a Professor of the Mechanical Engineering Department at Stevens Institute of Technology. The first to receive a MEMS Ph.D. in his native South Korea, he joined Stevens in 2006 following tenure as a senior member of the engineering staff at NASA Jet Propulsion Laboratory, where he was awarded, among other honors, the Lew Allen Award for Excellence for developing MEMS-based actuators and microvalves for large-aperture space telescopes and deformable mirrors capable of correcting for optical aberrations to improve high-resolution imaging. Through the Stevens Micro Device Laboratory, Dr. Yang facilitates student research and hands-on education in emerging nanotechnologies. In addition to his role as a faculty advisor of the nanotechnology graduate program, he spearheaded the design of Stevens' first undergraduate nanotechnology research-track training program. Dr. Yang has secured more than 35 federal grants and contracts totaling approximately $8.5 million, including funding from the National Science Foundation, Air Force Office of Scientific Research, National Reconnaissance Office, US Army, and NASA. Dr. Yang's professional service credits include editorial or editorial board positions for several journals, including Nature's Scientific Reports and multiple track chair positions for ASME International Mechanical Engineering Congress and Exposition (IMECE). He has produced more than 300 journal papers, conference proceedings, and presentations and has delivered 86 keynote or invited talks. He holds 17 issued or pending patents in the fields of micro- and nanotechnology. Dr. Yang was a featured Micro- and Nano-Systems Engineering and Packaging track plenary speaker at IMECE in 2018. He received the Award for Research Excellence at Stevens in 2019. Dr. Yang has been elected a Fellow of the National Academy of Inventors, the highest professional distinction for academic inventors. He has also been elected a Fellow of the American Society of Mechanical Engineers (ASME) for his extensive contributions to the fields of micro- and nanotechnology.

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Improving fatigue of mechanical system subjected to repetitive loads

The basic reliability concepts - parametric ALT plan, failure mechanism and design, acceleration factor, and sample size equation were used in the development of a parametric accelerated life testing method to assess the reliability quantitative test specifications (RQ) of mechanical systems subjected to repetitive stresses. To calculate the acceleration factor of the mechanical system, a generalized life-stress failure model with a new effort concept was derived and recommended. The new sample size equation with the acceleration factor also enabled the parametric ALT to quickly evaluate the expected lifetime. This new parametric ALT should help an engineer uncover the design parameters affecting reliability during the design process of the mechanical system. Consequently, it should help companies improve product reliability and avoid recalls due to the product failures in the field. As the improper design parameters in the design phase are experimentally identified by this new reliability design method, the mechanical system should improve in reliability as measured by the increase in lifetime, L_B, and the reduction in failure rate, λ

Biography

Dr. Woo has a BS and MS in Mechanical Engineering, and he has obtained PhD in Mechanical Engineering from Texas A&M. He major in energy system such as HVAC and its heat transfer, optimal design and control of refrigerator, reliability design of mechanical components, and failure Analysis of thermal components in marketplace using the non-destructive such as SEM & XRAY. Especially, he developed parametric accelerated life testing (ALT) as new reliability methodology. If there is design fault in the mechanical system that is subjected to repetitive stress, it will fail in its lifetime. Engineer should find the design faults by parametric ALT before product launches. In 1992–1997 he worked in Agency for Defense Development, Chinhae, South Korea, where he has researcher in charge of Development of Naval weapon System. In 2000-2010 he had been working as a Senior Reliability Engineer in Side-by-Side Refrigerator Division, Digital Appliance, SAMSUNG Electronics, where he focused on enhancing the life of refrigerator as using parametric the accelerating life testing. Now he is working as associate professor in mechanical department, Addis Ababa Science & Technology University

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Achievement of 3D Bioprinting in Situ in Regenerative Medicine could have Clinical Implications during the COVID-19 Pandemic

Tissue engineering techniques enable the fabrication of tissue substitutes integrating cells, biomaterials, and bioactive compounds to replace or repair damaged or diseased tissues. Despite the early success, current technology is unable to fabricate reproducible tissue-engineered constructs with the structural of 3D printing technology empowers the opportunities of developing bio functional complex tissue substitutes via layer-by-layer fabrication of cell(s), biomaterial(s), and bioactive compound(s) in precision and the concept of *in situ* 3D bioprinting in the lab to cut out the middle step of *in vitro* growing cells and just implanting cells directly into the body for growth. Mesenchymal stem cells (MSCs) have been reported to be promising treatments for lung diseases. 3D bioprinting of human MSCs with bioink hypothesize as a possible therapy for lung damage. Human lungs have no regenerative capacity. Constructing artificial lung to replace diseased lung is the only alternative to treat patients with severe lung diseases. 3D printing has helped fabricate lung tissue analog. So, clinical progress in the use of 3D bioprinted MSCs as a cell therapy for acute respiratory distress syndrome may have clinical implications during the COVID-19 pandemic. The development of 3D-printed biological tissues for organ replacement hopes to offer a new solution for the patients on the waiting list. The current development of fabricating tissue-engineered constructs using 3D bioprinting technology are essential for potential biomedical applications such as tissue replacement therapy, personalized therapy, and *in vitro* 3D modeling for drug discovery.

Biography

Laila M. Montaser is Professor of Clinical Pathology. She is Distinguished Scientist, Chair, of Stem Cell, Regenerative Medicine, Nanotechnology and Tissue Engineering (SRNT) Group. She serves as the Head, Founder Leader of Clinical Pathology Department, Faculty of Medicine, Menoufia University. She is the nominator of Council of Menoufia University to TWAS prize in Medical Sciences and award of Nano Science Research Excellence. She gained 3 Awards: - Medal of Merit from Egyptian Medical Syndicate in 1986, 1998, and 2002. She has a philosophy on how to manage research specifically with Stem Cell, Regenerative Medicine, Nano medicine and Tissue Engineering.

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Graphene Nanomaterial and its Promising Applications in Regenerative, Reconstructive and Orthopedic Medicine

The discovery of the interesting intrinsic properties of graphene, a two-dimensional nanomaterial, has boosted further research and development for various types of applications from electronics to biomedicine. During the last decade, graphene and several graphene-derived materials, such as graphenes and three-dimensional graphene foams, have been extensively explored as components of biosensors or theranostics, or to remotely control cell-substrate interfaces, because of their remarkable electro-conductivity. To date, despite the intensive progress in human stem cell research, only a few attempts to use carbon nanotechnology in the stem cell field have been reported. Interestingly, most of the recent in vitro studies indicate that graphene-based nanomaterials (i.e. mainly graphene, graphene oxide and carbon nanotubes) promote stem cell adhesion, growth, expansion and differentiation. Although cell viability in vitro is not affected, their potential nanocytoxicity (i.e. nanocompatibility and consequences of uncontrolled nanobiodegradability) in a clinical setting using humans remains unknown. Therefore, rigorous internationally standardized clinical studies in humans that would aim to assess their nanotoxicology are requested. In this paper we report and discuss the recent and pertinent findings about graphene and derivatives as valuable nanomaterials for stem cell research (i.e. culture, maintenance and differentiation) and tissue engineering, as well as for regenerative, translational and personalized medicine (e.g. bone reconstruction, neural regeneration). Also, from scarce nanotoxicological data, we also highlight the importance of functionalizing graphene-based nanomaterials to minimize the cytotoxic effects, as well as other critical safety parameters that remain important to take into consideration when developing nanobionanomaterials.

Biography

Dr. Menaa has over than 15 years experiences in academic institutions and more than 10 years in (bio)pharmaceutical industries such as Guerbet SA, SANOFI, Fluorotronics, Inc. Polyglot, he is experienced as Professor, Principal Investigator, Executive Director, Healthcare, Consulting for companies such as Exiquon and Novartis, Supervisor/Group leader, Thesis Evaluator, Advisor, Editor, Editor-in-Chief, Reviewer, Event organizer, Speaker, Chairman, Moderator, Scientific collaborator, Entrepreneur, Member of various medical and scientific associations. In 2009, Dr. Menaa was promoted to Chief Scientific Officer and R&D&I Executive Vice-President for Fluorotronics, Inc, CA, USA, a leading company in Fluorine Chemistry. He co-developed and applied an innovative green technology called “SpectroFluor™” to Nanomedicine, Oncology, Pharmaceutical and Life Sciences. In 2013,Dr. Menaa has (co-)authored more than 100 scientific articles including 1 book, and participated to over 200 scientific events.

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Modification in properties of copper nanowires mesh for optoelectronic devices

This contribution reports on modifications in optical transparency and electrical conductivity of copper nanowires (Cu-NWs) mesh by ions irradiation with different fluencies of 3.5 MeV Proton ions. The Proton ions irradiations of Cu-NWs meshes are done at room temperature and beam fluencies of Prot-cal are selected in the range ~$1x10^{14}$ ions/cm^2 to ~$1x10^{16}$ ions/cm^2. Optical and electrical characterizations of Cu-NWs meshes are done using ultraviolet-visible (UV-VIS) spectroscopy and four probe techniques. Transmission electron microscopy (TEM) and x-ray diffraction (XRD) techniques are employed to describe the structural changes in Cu-NWs meshes before and after irradiating with Proton ions. Optical transparency is first decreased and then increased with increment in beam fluence of Proton ions. Initially at low beam fluence of Proton ions, the electrical conductivity of Cu-NWs mesh decreases and after that increases with increase in beam fluence. Ion beam irradiation technology is found to be a superb approach in order to modify electrical conductivity and optical transparency of meshes of Cu-NWs for application as transparent conducting electrodes.

Biography

Dr. Shehla Honey is Assistant Professor of Physics at University of Okara, Pakistan. Her research focuses on ion irradiation-induced defects and characterize respective changes in physical properties of Nanowires (NWs), Nanorods (NRs) and Nanotubes (NTs) of metals and other 1D-nanostructures of various materials (e.g., semiconductor, metal oxides etc.) for applications in nanodevices. She was a PhD Fellow at University of the Punjab, Lahore from 2012 to 2017, where she developed the large-scale metal nanowires (MNWs) networks for the first time using ion irradiation-induced nanoscale welding of NWs.