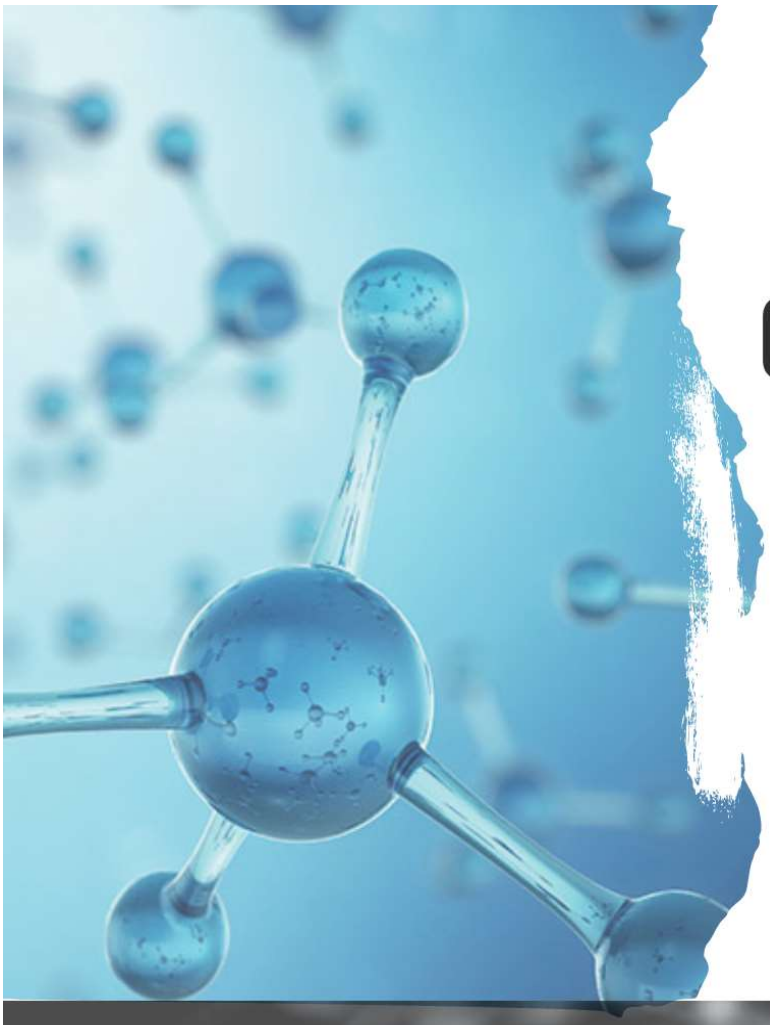

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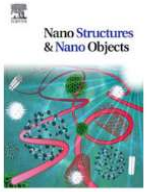

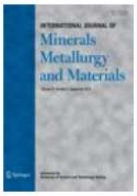

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Photoluminescence and Scintillation in New Oxyfluoride Glasses with Designed Fluoride Segregation

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Background/ Objectives and Goals

Transparent phosphors are key materials for lasers, sensors, amplifiers, and lightings. Fluorides are attractive host materials for RE3+-based phosphors because of their low phonon energy, large RE^{3+} solubility, low melting temperature, and wide transparent wavelength region. Fluoride glasses, however, have poor water resistance and high mechanical brittle nature. In this work, we realized a highly efficient photoluminescent glasses by fabricating fluoride rich segregation in oxyfluoride glasses by material design.

Methods

We synthesize new fluoroborate-based glasses such as BaF_2-Al_2O_3-B_2O_3 with a high fluorine content. Commercial powders of reagent grade raw materials were mixed, and mixtures (10 g batch) were melted in a platinum crucible at 1000-1250°C for 20 min in an electric furnace in air. Melts were poured onto iron plate and pressed into a thickness of ~1 mm using another iron plate. The glass transition and crystallization peak temperatures were determined using differential thermal analysis (DTA) at heating rate of 10 K/min. The glass plates were mechanically polished using colloidal silica. PL and photoluminescence excitation (PLE) spectra and lifetime measurements were performed. PL quantum yields in the visible region were measured with a PL spectrometer with an integrating sphere.
The glass structure of the undoped sample was investigated using MAS NMR and high-energy XRD, Ba K-edge X-ray absorption fine structure (EXAFS) spectroscopy.

Expected Results/ Conclusion/ Contribution

Glass structural analyses and MD simulation indicated that the glasses form fluoride-rich segregation. The Eu^{3+}-doped glasses showed an excellent luminescence with extremely high quantum yield of 97 % in the visible region at the excitation of near UV light. Scintillation characteristics of glasses were also investigated. The glass with Ce^{3+}-doping showed good characteristics of detecting gamma rays and neutron rays among glasses.

Keywords: Glass, Phosphor, Rare Earth, Oxyfluorides, Glass Structure

Acknowledgements

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Biography

Kenji Shinozaki has completed his PhD at the age of 26 years from Nagaoka University of Technology (Japan). He was a Research Fellowships for Young Scientists of Japan Society for the Promotion of Science (JSPS) in 2013, and he worked as an Assistant Professor at Nagaoka University of Technology from 2013 to 2016. Since 2016, he has worked at National Institute of Advanced Science and Technology (AIST) as a researcher. His current research interest includes materials science and fabrication processing of glasses and glass-ceramics for optical and photonic applications.

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Highly Efficient Future-Generation GaAs Solar Cells for Achieving Green Global Demand

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Abstract
Present COVID-19 pandemic outbreak is pushing the world backward and forcing to follow World Health Organisation (WHO) suggestions to control spreading of deadly coronavirus. Current ongoing lockdown process in many countries may help reducing the CO_2 emission to the environment due to having less human mobility and transportation systems; however, this situation continuously dragging down the world economy. The post-COVID world will be needed to have harmonious progress in all sectors to build its broken economy for which there will be a massive thrust of energy. Also, for the large population of the world, there is always a huge demand of energy for their daily life. Meeting that energy demand is a key challenge and big obstacle towards dreaming for a sustainable green globe and only conventional energy resources is not enough to mitigate the energy demands. Photovoltaic (PV) power generation technologies and their advancement can be the leading possibilities to minimize the gap between the power demand and generation. We focus on the improvement of conversion efficiency of GaAs solar cells by employing an advanced nano-technological approach that allows reducing the light reflection losses from the surface of solar cells. We have designed and optimized several types (triangular, trapezoidal, and rectangular shapes) of nano-grating assemblies that can be applied to reduce the incident light reflection losses of the GaAs solar cells. The finite-difference time-domain (FDTD) method was used to design, model and optimize the light trapping performance of the nano-gratings. The simulation results confirmed that it is possible to reduce light reflection losses up to 27% (depending on grating shapes), by using the nano-grating structures. In summary, we can conclude that nano-grating structures are enabled to absorb more light to increase the conversion efficiency of GaAs solar cells which can be a step forward towards achieving self-sustainable green globe.

Keywords: conversion efficiency; FDTD simulation; GaAs substrate; light absorption; nano-grating structures; reflection loss; solar cells

Biography

Dr. Narottam Das received PhD in Electrical Engineering from Yamagata University, Japan. He has about 3-decades experience as academia and industrial Engineer. Currently, Dr Das is a Senior Lecturer in Electrical Engineering, CQUniversity Australia, Melbourne, Victoria. He is the author/co-author of over 160 peer-reviewed journals and international conference papers, 8 book chapters and 4 edited books. Currently, he is a Guest Editor of MDPI Journal “Energies” and Journal of Nanomaterials, Hindawi. Dr Das is a senior member of the IEEE PES, USA; Fellow of the Institution of Engineers, Australia; CPEng, NER, and Life Fellow of the Institution of Engineers, Bangladesh.

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Role of Thermal Conductivity on Electrical Tracking failure of High Voltage Outdoor Insulation

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Background/ Objectives and Goals
Silicone rubber is a hydrophobic polymer which is widely employed for high voltage outdoor insulation. The material offers excellent electrical performance under contaminated environments. However, pristine silicone rubber has low thermal conductivity, and this may cause tracking failure due to severe dry band arcing and ohmic heating on the insulating surface. This work investigates the tacking performance of silicone rubber filled with Alumina trihydrate (ATH) and Boron nitride (BN) inorganic particles.

Methods
In this work, RTV 615 is used for the fabrication of specimens. Moreover, ATH and BN are used as micron additive with a particle size of 5 µm. Mechanical and ultrosonication mixing techniques are adopted for the synthesis of specimen. Electrical tracking performance of samples is investigated via inclined plane test as per IEC 60587. Apart from physical parameters and leakage current, an infrared thermal imager was used to measure the surface temperature.

Expected Results/ Conclusion/ Contribution
Improved performance in terms of tracking length, eroded mass and erosion depth is offered by BN-composites followed by ATH. All physical parameters decrease sharply to insignificant level with increasing BN filler loading. The r.m.s leakage current of composites show an increasing trend over the course of IPT and its pace is substantially higher in the first two hours. The current magnitude decreases with increasing contents of ATH and BN. Based on infrared thermal analysis, 30wt%-BN composite exhibits lower surface temperature and better resistance to thermal accumulation in the discharge region relative to its counterparts. The thermal conductivity of 30wt%-BN sample is measured at 0.745 W/m.K which is considerably higher than the values of 0.287 (30wt%-ATH) and 0.109 W/m.K (0wt%). It is concluded that addition of BN-composites improves ability to impede the tracking process, the reasons being enhanced thermal conduction in the discharge region.

Keywords: Silicone rubber, inclined plane test, dry band arcing, tracking resistance, thermal accumulation, thermal conductivity

Biography

Muhammad Tariq Nazir received his PhD degree in electrical engineering from the UNSW, Sydney in 2018. Currently, he is working as a postdoctoral fellow at UNSW, Sydney on an industrial CRC project. During 2016-17, he has been a visiting research fellow at Xi'an Jiaotong University, China. He is a member of the IEEE DEIS Society and Professional Engineer member of Engineers Australia. He is an associate editor of Applied Nanoscience and Transactions on Electrical and Electronic Materials. His research interests include high voltage generation, measurement, testing, condition monitoring of power system equipment, partial discharge, flame retardant materials and asset management.

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Study of Novel lithocholic acid-sodium alginate Matrix in the Microcapsule of the Potential Antidiabetic Drug

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Background/ Objectives and Goals

Probucol (PB) has potent anti-inflammatory and antioxidant properties and has shown a protective effect on pancreatic β cells and made a potential therapeutic agent in the treatment of type 2 diabetes mellitus. However, it accumulates extensively in adipose tissue and also has low and variable bioavailability and adverse effects. Lithocholic acid is naturally produced inside the human body and when they combine with drugs, have shown improve absorption and facilitate the drugs' uptake. The primary objective of this study is to develop a new and stable formulation using LCA and study the impact of LCA on PB's release kinetics, microcapsules membrane strength at different pH values and temperatures. We also aimed to test microcapsules' effect on pancreatic β cell line (NIT-1), cell viability, inflammatory profiles, and bioenergetics parameters.

Methods
Microcapsules were prepared with a Buchi-based microencapsulating system, based on the jet-flow microencapsulation technique using polymer sodium alginate (SA). Two kinds of microcapsules were prepared: PB-SA (control) and PB-LCA-SA (test).

Expected Results/
Incorporation of LCA, improved membrane resistance, and controlled and targeted release of PB. The microcapsules swelling and drug release patterns were higher at high pH values (pH 7.8, $p < 0.01$). LCA microcapsules enhanced cell viability but not statistically significant, reduced the inflammatory profile ($p < 0.01$), and increased anti-inflammatory cytokine, and improved the bioenergetics parameter ($p < 0.01$).

Conclusion
LCA improved the characteristics and release pattern of PB microcapsules and also enhanced their pharmacological activity *in vitro*, suggesting potential oral targeted delivery and applications in diabetes treatment.

Keywords: Microencapsulation, Probucol, lithocholic acid, type-2 diabetes mellitus, inflammation, antioxidant

Acknowledgements
This work has been partially funded by the University, State, and Commonwealth Governments. Al-Salami's work is partially supported by the European Union's Horizon 2020 SALSETH research and innovation program under the Marie Skłodowska-Curie grant agreement No 872370.

Biography

He completed MPhil from Curtin University, Perth, Australia, 2020. He is Biomedical Scientists working at Curtin University and published more than 7 papers in reputed journals such as nature publisher.

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The Role of Nano Metakaolin and Nano Metaclay in Ultra High Performance Cement Paste (UHPCP)

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Abstract
The inclusion of nano material in enhancing concrete properties is widely used now in the construction industry. The inclusion of nano materials is expected to enhance the cement properties by developing ultra filler effect and enhancing strength properties. In this research, the effect of nano metakaolin and nano metaclay in cement paste were evaluated in terms of materials, physical and strength properties. For material properties, the cement pastes are evaluated for particle size distribution, chemical composition using xrf technique and mineral composition using xrd evaluation. Eventually for physical properties is confirmed using standard consistency and setting time of cement. Finally, the strength property of cement paste is conducted using compressive strength test. It is confirmed that the nano metakaolin and nano metaclay is a reactive pozzolanic material which consist of high silica and alumina. Furthermore, the inclusion of nano material increased the water demand and finally enhanced the compressive strength of cement paste as compared to the plain cement. As conclusion, the inclusion of nano materials in cement provide filler effect which improve the surface area bonding with cement, pozzolanic reaction which enhanced strength at early ages and secondary hydration which prolong the strength enhancement at later ages.

Keywords: Nano metakaolin, nano metaclay, material properties, physical properties, strength property

Biography

Muhd Norhasri Muhd Sidek is a senior lecturer and also principal researcher in Institute for Infrastructure Engineering and Sustainable Management (IIESM) in UiTM Shah Alam, Selangor, Malaysia. Dr Muhd Norhasri has completed his PhD in civil engineering and majoring in nano materials in Ultra High Performance Concrete (UHPC) from Universiti Teknologi MARA (UiTM) at 2016. He has an experience ax lecturer at UiTM for 18 years. He also involved in many consultancy in Malaysia regarding structure and infrastructure investigation. His publication has been accepted in many high impact journal especially in Constructions and Buildings Materials for Elsevier and currently a reviewer for Elsevier journal and editorial board in American Journal for Construction and Buildings Materials.

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The Effect of Pulverization Methods on the Microstructure of Carbon Aerogels

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Abstract

Carbon aerogels are suitable for many fields of application. In many cases powders are required and pulverization is necessary. But how can we take care on material quality as various changes in the microstructure of carbon aerogels are induced by pulverization?. The extent of changes depends not only on the dominant forces of used technique, but also on the mechanical and structural properties of initial monolithic samples.

Various methods are available to produce carbon aerogels in a powdered form. the first of all monolithic samples of carbon aerogels can easily be grinded manually using sand paper. The accruing powder is collected from the surface and can be used for any application. During the grinding process, only low forces are applied to the sample which makes the method applicable for fragile or soft materials. Among many milling techniques, shaker milling is based on frequent percussions of a steel or ceramic bar or balls inside of the milling container. Depending on frequency, the steel bar will oscillate in the container and through the powerful impacts, crush the sample. Shaker mills are often used under cryo temperatures, whereby the container is arranged in liquid nitrogen. On the other hand milling in a planetary ball mill is the most frequently used method to get carbon aerogel powder, where the monolithic aerogel is placed in a container with balls.

In the present work, we discuss the influence of grinding, milling in shaker cryo mill and planetary ball mill on stiff, ductile and flexible carbon aerogels. Results show that stiff carbon aerogels do not undergo noticeable changes. In contrast, ductile carbon aerogels are very sensitive to friction forces. Soft and flexible carbon aerogels undergo drastic changes in the microstructure.

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Which is best Scaffold for Photo Catalytic Performance, C_3N_4, CQD or CNT?

Wilfried Wunderlich
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Background/ Objectives and Goals
Our experience on photocatalytic materials over there decades has revealed important parameters for performance, such as nanometer size, high absorption factor, slow recombination rate, high carrier concentration, p/n- junction and high carrier mobility. We restrict the search on metallic or semiconducting nanoparticles such as Ag, Pd, Fe, TiO_2, ZnO and ZnS. They are usually deposited by bottom-up, e.g, sol-gel or PLD-technology on a ceramic substrate, carbon nano-tubes (CNT) or recently developed graphitic-C_3N_4 or even carbon quantum dots (CQD). Recently the amount of literature increased tremendously, and needs to be studied in order to receive guidelines for new experiments and applications such as degradation of unwanted organics, water purification, hydrogen production, and others.

Methods
This overview paper summarizes literature data on the overall performance for photo catalytic materials. The data are usually achieved on different devices and pollutants but we try to find a common criteria for measuring the performance.

Expected Results/ Conclusion/ Contribution
CNT and C3N4 seems to be the ideal materials because they have sufficient mechanical and thermal satiability to act as a scaffold. CQD needs to be deposited on polymers and usually the unclear surface condition is mentioned as weak points, in spite of the large success in bio-medicine, and in some applications the metallic particles can even be substituted.

Keywords: Photo-catalyst, nano-particles, organic degradation, excitation, carrier concentration

Biography

Wilfried Wunderlich has completed his PhD at the age of 30 years from Max-Planck Institute for Metal Research, Stuttgart and University of Stuttgart (Germany). He is full professor for material science at Tokai University since 2006. He has published more than 140 papers in reputed journals and is serving as an experienced referee for several journals.

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Carbon Nanofoams: Tailored Laser Ablation Production, Structure, Processing, and Applications

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Background/ Objectives and Goals
Laser technologies can be successfully utilized for the production of a variety of carbon nanostructured materials such as carbon nanotubes, carbon nanohorns, or shell-shaped carbon nanoparticles. We here report on the tailored laser ablation production aerogel-like carbon nanofoams, as well as on their structure, properties, processing and applications.

Methods
The production of carbon nanofoams and metal/carbon nanostructured hybrids has been carried out by Nd:YAG laser ablation of coordination complexes, aromatic molecular targets, and graphene oxide. The resulting materials were characterized by electron microscopy techniques, Raman spectroscopy, thermogravimetric analysis, and cyclic voltammetry measurements.

Expected Results/ Conclusion/ Contribution
Metal/carbon nanohybrid foams consist of metal nanoparticles embedded within amorphous carbon nanoparticles, amorphous carbon nanoparticles, and carbon domains exhibiting a higher graphitic order, including graphene layers, hollow graphitic spheres, and carbon nanotubes. The composition, metal nanoparticle dilution and crystallite size, and structure of the nanohybrid foams can be tailored by suitably tuning the laser parameters used and choosing the metals and ligands of the irradiated targets.[1,2] Remarkable magnetic- and electrochemical properties are demonstrated for the produced carbon nanofoams.[2] These materials performed successfully when tested for catalysis [3] and gas sensor applications.[4] This work was funded by the Aragón regional government (Spain, projects PI119/09 and E25_20R).

Keywords: Carbon nanomaterials, laser ablation production, carbon aerogels, metal/carbon hybrids, catalysis, gas sensors

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Biography

Edgar Muñoz earned a PhD in Chemistry from the University of Zaragoza in 2000 for his pioneering work on laser ablation production of carbon nanotubes carried out at the Instituto de Carboquímica ICB-CSIC (Spanish National Research Council CSIC). He joined Ray H. Baughman's group at Honeywell International (Morristown, NJ), and later at the Alan G. MacDiarmid NanoTech Institute of the University of Texas at Dallas. He is staff research scientist at ICB-CSIC since 2005. His primary research interests are in the laser ablation production of carbon nanomaterials, the fabrication of carbon nanotube-based composite materials for sensor and actuator applications, and on supramolecular peptide self-assemblies and nanocomposite materials for optoelectronics (transparent electrodes and fluorescent probes), nanocarrier (theranostics, drug delivery) applications, and smart textile applications.

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Multifunctional Graphene Oxide/2D Oligoglycine Tectomer Hybrids

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Background/ Objectives and Goals

Amino-terminated oligoglycines non-covalently self-assemble, through cooperative hydrogen bonding formation, into biocompatible rigid 2D nanostructures called tectomers, either in solution or in surface-promoted processes [1,2]. We here explore the ability of tectomers to form hybrids with graphene oxide (GO), so the interaction at the interface of these 2D nanomaterials is maximized, providing new functionalities to GO.

Methods
GO/tectomer hybrids were prepared by mixing oligoglycine peptide solutions with aqueous GO solutions. The resulting composites were characterized by electron- and atomic force microscopies techniques, by UV-vis and X-ray photoelectron (XPS) spectroscopies, and contact angle measurements.

Expected Results/ Conclusion/ Contribution
Tectomers strongly interact with GO leading to GO instant flocculation and to the formation of novel multilayered hybrid assemblies. Hydrogen bonding formation accounts for the strong interfacial interaction of tectomers with GO [2]. Because of this high affinity of tectomers to GO, tectomers efficiently coat wet-spun GO fibers. We also show that, due to their versatile surface chemistry, tectomers act as supramolecular peptidic adhesives for the immobilization of a variety of carbon nanomaterials, nanoparticles, molecules and drugs on the GO fiber surface therefore allowing GO fiber functionalization. This tectomer-based functionalization strategy can be extended to other fibers, fabrics and substrates, making it very attractive for technological and smart textile applications [3]. This work was partially funded by the Aragón regional government (Spain, project E25_20R).

Keywords: 2D nanomaterials, carbon nanomaterials, graphene oxide, peptides, bio-nanocomposites

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Biography

Rosa Garriga got a postdoctoral position at the L'Institut de Chimie de la Matière Condensée de Bordeaux (ICMCB, CNRS, 1999-2000) to work on the production and spectroscopic characterization of metal nanoparticles in supercritical fluids. Since 2002 Rosa Garriga is a lecturer at the Science Faculty at the University of Zaragoza (Spain). She collaborates with the Nanochemistry Group at the Instituto de Carboquímica ICB-CSIC (Spain), where she is contributing with key developments in the physicochemical characterization and processing of carbon nanomaterials and their hybrids with metal nanoparticles and supramolecular bio-inspired nanostructures for technological (optoelectronics, theranostics, sensors) applications.

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Physico-Chemical Properties of the Si Nanowires Surface

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Background/ Objectives and Goals
The most common method for the silicon nanowires (Si-NWs) synthesis is the vapor liquid solid (VLS) growth using gold as catalyst. Au represents a drawback, because it creates deep traps in the Si band gap and it is difficult to remove. A review on the Si-NWs physico-chemical properties is here presented. Their surface chemical composition is investigated through advanced techniques and the mechanisms of atomic inter-diffusion taking place in the Au-SiNW system are discussed.

Methods
Gold nanodots with 1.6 nm average radius were deposited by sputtering on 6" Si wafers. The Si-NWs depositions were carried out on the wafers in a CVD chamber at 380 °C for 15 min using a gas ratio of SiH_4/Ar=30 and plasma power of 20W. Si-NWs underwent to a two steps procedure: 1) 5 min HF etch, 2) 4 min etch in a Sodium iodide and Iodine solution. Some samples underwent directly to step 2) and served as a comparison. All the samples have been analyzed by using advanced morphological and chemical characterization techniques to measure the NWs density, size and composition.

Expected Results/ Conclusion/ Contribution
A deep physical-chemical characterization has been performed on the as-grown Si-NWs, before and after any etching process, and a conformal SiO_2 layer was observed over the Au dots, passivating the catalyst metal dots from etchant blend. The formation of this shell is attributed to the kinetics of cooling in the Si-Au eutectic alloy after the Si-NWs synthesis: a positive thermal gradient is established during the cooling step. Consequently silicon atoms segregate onto their surface forming an external silicon shell covering gold, which oxidizes after exposure to air generating a insulating silica thin film.

Keywords: silicon, nanowires, gold, diffusion

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Biography

Researcher since 2001 at CNR-IMM, where she has developed various lines of scientific research. Member of the Professors Board of the PhD in Physics of the University of Messina since 2017. She has published more than 60 papers and serves as an editorial board member in 2 scientific Journals. She is scientific expert of the Italian Ministries: MISE and MIUR. Has activated collaborations with STMicroelectronics, Lyntech of America, Tyndall and various italian and foreign universities. Has taught numerous courses for postgraduate students. Co-tutor of 13 among PhD and degree theses. Scientific responsible for various scholarships or grants. Has held 7 invited seminars and an award talk, and organized several symposia at international conferences. She is the coordinator of a scientific dissemination project since 2017.

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Progress in the Application of Nanomaterials for Water Treatment and Their Impact on the Environment

Haleema Saleem and Syed Javaid Zaidi

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Abstract
In the recent past, as the world experiences scarcity for drinking water, scientists have proved that nanomaterials (NMs) will be a superior option for the wastewater treatment, due to the fact that the NMs have certain special properties. More developments have occurred in NMs in the form of nanosorbents, nanophotocatalysts, and nanomembranes, which can be efficiently used for the polluted water treatment. Along with its benefits, harmful effects of these NMs on marine plants and aquatic organisms should also be considered. In our study, we have examined the benefits of NMs in applications like membrane materials, adsorbents (removal of heavy metals, dyes, pharmaceuticals, and organic contaminants present in water), catalytic utilization, as well as microbial decontamination. We mainly analyzed the various carbon-based NMs (graphene, graphene oxide, carbon nanotubes, etc.), and metal and metal-oxide based NMs (titanium dioxide, zinc-oxide, nano zerovalent iron, etc.) for the water treatment application. We have also studied the hazardous effects of the NMs on marine plants and aquatic organisms. The examination of different studies confirmed that the NMs have the ability for improving the remediation of aqueous system. However, some studies have confirmed that NMs can cause membrane damage and cell damage to the living organisms present in the aqueous environment. It is recommended to use non-toxic materials for the water treatment operations that are considered to be environmentally less challenging. In this regard, the development of naturally occurring NMs such as cellulose-based NMs could be promising. Moreover, it is essential to properly design the systems in a manner that they marginally release NMs into the environment. Acknowledgment of the possible advantages as well as inadvertent hazards of NMs to the surroundings is significant for pursuing their future developments.

Keywords: Glass, Phosphor, Rare Earth, Oxyfluorides, Glass Structure

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Biography

Haleema Saleem is a Research Assistant in the Center of advanced materials, Qatar University, and she holds an MSc Degree in Chemical Engineering from Khalifa University (Petroleum Institute), UAE. Haleema has great interest and knowledge in the reverse osmosis membranes and processes. She has good experience working with polymers (Polyamide, polyethylene, polypropylene) and nano-materials (graphene, GO, CNT). She has published 7 papers in high impact international peer-reviewed journals and 10 book chapters. Haleema also has good experience working with instruments for the water and polymer nano-composite analysis.

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Active Cantilever Probe Development for New Atomic Force Microscope Capabilities

Fangzhou Xia

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Background/ Objectives and Goals
Atomic Force Microscope (AFM) is a versatile nanoscale imaging tool widely used for surface characterization. For the cantilever transducer, conventional designs with external optical deflection sensing and piezoacoustic actuation limit AFM applications and require significant experiment setup experience. In this talk, we present the development of active AFM probes with embedded sensing and actuation elements to overcome these challenges with example applications.

Methods
Active AFM probes are micro-electromechanical systems (MEMS) produced with nano-fabrication techniques to enable new AFM imaging capabilities. In our design, four piezoresistors are formed with p-doped silicon at the fixed end of the cantilever for deflection sensing via internal stress measurement. Aluminum heating wires are used to thermomechanically drive the two-layer silicon and silicon nitride bimorh cantilever. A protective coating layer with “Positiv 20” polymer can be applied through dip coating for active components protection. Centered around the active probe, an AFM system is developed specifically for chemically harsh opaque liquid imaging.

Expected Results/ Conclusion/ Contribution
Compared to conventional designs, AFM systems using active cantilever probes have several benefits. The active probe design removes the operational overhead for probe-laser alignment, reduces the footprint of the system, enables operation in non-transparent environments, and allows motion control of multiple parallel probes. Experiment details for the example application of imaging in various opaque liquids are provided in the paper to demonstrate the new capabilities. Additional related applications using the active probe technology will also be discussed including correlative imaging with AFM in scanning electron microscope, parallel cantilever array imaging, scanning probe lithography, etc. In summary, the development of active cantilever probes enables the observation of samples in their native environments and various other imaging scenarios. During this presentation, we will also provide a broader review for other cantilever sensing and actuation techniques to form a list of methods that AFM users can select from for specific applications.

Keywords: atomic force microscope, active cantilever probe, precision instrumentation, nano-fabrication, imaging

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Biography

Fangzhou Xia obtained his PhD at the age of 27 from the Massachusetts Institute of Technology (MIT) with specialization in control, robotics, and instrumentation. His PhD thesis focused on the development of Atomic Force Microscope (AFM) systems for extended capabilities with over 10 publications on relevant topics. He is currently a postdoc researcher at MIT Mechatronics Research Lab working on research projects centered around instrumentation and data driven learning algorithms.

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Influence of Superplasticizer and Nanomaterial Functionalization on the Nanostructure of Cement Reinforced with Carbon Nanofibers and Carbon Nanotubes

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Background/ Objectives and Goals
Cement nanocomposites have been heavily investigated in recent years due to their abilities to enhance the electrical conductivity, magnetic properties, and self-sensing potential of construction materials. Studies have shown that carbon nanomaterials can enhance the mechanical properties and durability of cement. However, what is not fully known is the influence of carbon-based nanomaterials on cement hydration products and the effect of superplasticizer and of nanomaterial functionalization on the nanostructure of cement.

Methods
We synthesized carbon nanofiber (CNF) reinforced cement and functionalized multi-walled carbon nanotube (F MWCNT) reinforced cement using a carboxylate-based superplasticizer. The reinforcement contents for carbon-based nanomaterials were 0.1 wt%, 0.2 wt%, and 0.5 wt% per mass fraction of cement. In addition, the multi-walled carbon nanotubes were functionalized with fluorine. After 7 days of curing age, the cement nanocomposite specimens were ground and polished for nanoscale characterization. We characterized the microstructure using high-resolution environmental scanning electron microscopy. To probe the pore structure and the distribution of chemo-mechanical phases, we used grid indentation integrated with statistical deconvolution methods. Finally, to probe the fracture response and the fracture micro-mechanisms, we used scratch testing.

Expected Results/ Conclusion/ Contribution
Carbon-based nanomaterials affect the capillary porosity and the gel porosity of Portland cement along with the distribution of calcium silicate hydrates (C-S-H): low-density C-S-H, high-density C-S-H, and calcium hydroxide. For CNF-cement with superplasticizer, the fraction of high-density C-S-H reaches a peak for 0.2 wt% CNF. For higher volume fractions, an increase in capillary porosity and on low-density C-S-H is observed. For functionalized F MWCNT-cement, the optimum is observed for 0.1 wt% F MWCNT. In all cases, the fracture response is non-linear, and the fracture micro-mechanisms involve crack deflection, micro-cracking, and crack ligament bridging. This study shed lights on the influence of super-plasticizer and nanomaterial functionalization on calcium-silicate hydrates.

Keywords: Carbon-based nanomaterials; superplasticizer; functionalization; cement; calcium silicate hydrates; pore structure; nanostructure

Biography

Ange-Therese Akono completed her PhD at the age of 25 years old from the Massachusetts Institute of Technology (U. S. A.). Dr. Akono's honors include an NIH Diversity Supplement grant (2020), an NSF GOALI award (2019), the ASCE New Faces of Civil Engineering Professionals Award (2016), and the MIT Energy Initiative Fellowship (2009). Dr. Akono's laboratory investigates multiscale fracture mechanisms in complex materials systems. This research is articulated over three main thrusts: natural and nano-engineered biomaterials, geological materials, and environment-friendly and high-performance structural materials, leading to more than 30 papers in reputed journals.

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Recovery of Cellular Proliferation, chromosomal and DNA Integrity by metals sequester activity of Cellulose-based Nanomaterials.
A cellular level investigation to test the safety of a nano-candidate for water nanoremediation process

Patrizia Guidi[a], Margherita Bernardeschi[a], Mara Palumbo[a], Vittoria Scarcelli[a], Giada Frenzilli[a]

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Background/ Objectives and Goals
The contamination of both marine and freshwater by metals represents a great problem posing a threat for human and environmental health. Techniques of nano-remediation, which is the application of nanotechnology and the use of engineered nanomaterials to clean contaminated environmental matrices, can be considered as appropriate tools. Selected nanomaterial needs to be efficient, completely reliable and not exerting toxicity towards biota. In this research a recently developed eco-friendly cellulose-based nanosponge (CNS) was investigated as a possible candidate for metal contaminated freshwater and seawater nano-remediation process.
To encourage the applicability of nano-adsorbent materials for cadmium and zinc removal, respectively from freshwater and seawater, cellular responses were measured before and after CNS treatment. *Dreissena polymorpha* and *Mytilus galloprovincialis* were selected as model species.

Methods
$CdCl_2$ (0.05 mg L^{-1}) contaminated artificial freshwater (AFW) was treated with newly developed eco-friendly cellulose-based nanosponges (CNS) (1.25 g L−1 for 2 h), and cellular responses were analyzed before and after CNS treatment in *Dreissena polymorpha* haemocytes. A control group (AFW only) and a negative control group (CNS in AFW) were also tested. DNA primary damage was evaluated by Comet assay while chromosomal damage and cell proliferation were assessed by Cytome assay. $ZnCl_2$ (10 mg L−1) contaminated artificial seawater (ASW) was treated with CNS (1.25 g L−1 for 2 h), and the cellular responses of marine mussel *Mytilus galloprovincialis* were measured before and after CNS treatment. A control group (ASW only) and a negative control group (CNS in ASW) were also tested. Genetic and chromosomal damages reversed to control levels in mussels' gill cells (DNA integrity level, nuclear abnormalities and apoptotic cells).

Expected Results/ Conclusion/ Contribution
AFW and ASW exposed to CNS did not cause any genotoxic effect in mussel haemocytes and gill cells. In *D.polymorpha*, both DNA damage and cell proliferation induced by Cd(II) turned down to control level after 2 day-co-exposed specimens. A reduction of Cd(II)-induced micronuclei and nuclear abnormalities was also observed. Moreover in *M.galloprovincialis* Zn-induced genotoxicity in in gills resulted significantly decreased and was absent in mussels exposed to CNS alone. CNS was thus found to be a safe and effective candidate in cadmium and zinc remediation process being efficient in metal sequestering, restoring cellular damage exerted by Cd(II) and Zn(II) exposure, without altering cellular physiological activity.

Keywords: DNA damage, Micronucleus, nuclear morphology alteration, cellular proliferation, apoptosis, Cadmium, Zinc, zebra mussel (*Dreissena polymorpha*), *Mytilus galloprovincialis*, Polysaccharide-based nanosponge, nanoremediation

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Biography

Patrizia Guidi defended her PhD thesis in 2011 at University of Pisa (Italy). She is a biologist, and, at the moment, she is Assistant Professor of Applied Biology at the University of Pisa. Her research is focusing on cellular responses and genotoxic effects of nanomaterials and xenobiotics. She has published 20 papers in reputed journals and many abstracts presented at national and international congresses.

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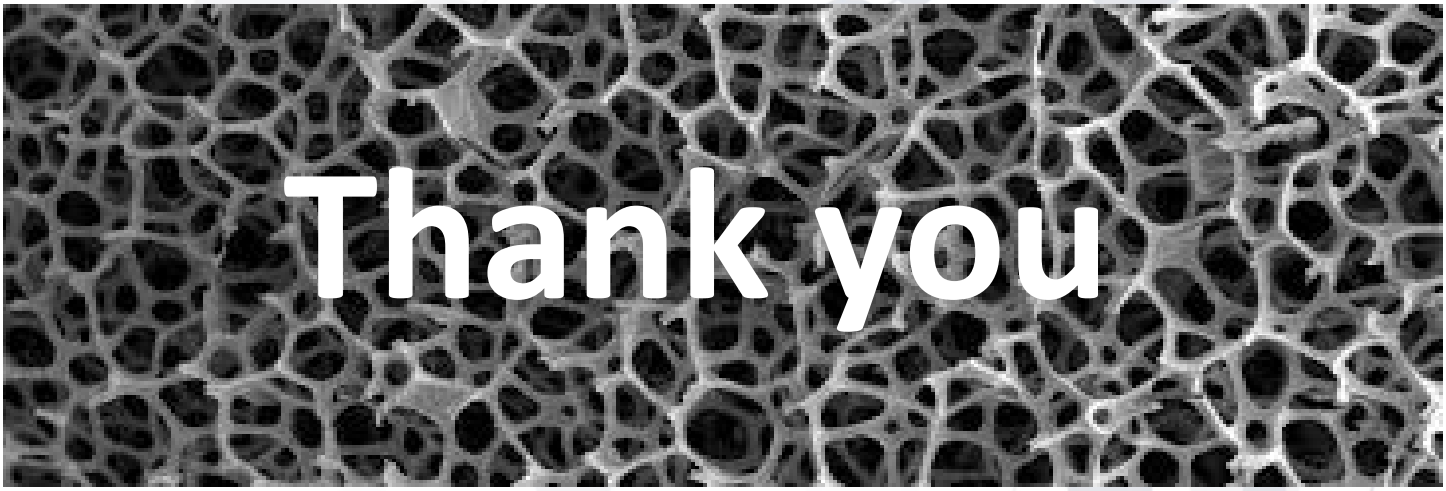

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