Posters
Zero valent iron (ZVI) nanoparticles as an inducer of microbial oxidative stress and the possibility of its elimination

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Zero valent iron (ZVI) nanoparticles have strong reducing properties and therefore they are applied in remediation of groundwater contaminated by halogenated compounds etc. These reducing properties, however, induce oxidative stress in indigenous microflora, which often has an irreplaceable position with regard to complete mineralization of present contaminants. Finding a way to protect microorganisms against negative effects of ZVI nanoparticles in this and another situations would significantly extend the possibilities of their safe use. The microorganisms of different taxonomic category (G+ bacterium Rhodococcus erythropolis, G- bacterium Pseudomonas fluorescens and yeast Trichosporon cutaneum) were exposed to commercially produced products NANOFER 25 and its stabilized form NANOFER 25S (Nanoiron, Ltd. Czech Republic). Inhibitory activity against above mentioned microorganisms was studied over time and concentration dependence, and compared with other agents that cause oxidative stress as menadione (100 μM) and hydrogen peroxide (500 μM). Application of both types of nanoparticles in the amount of 1.0 or 5.0 g/l caused a higher oxidative stress than the mentioned chemicals. Humic substances isolated from oxyhumolite (material occurred in overburden of brown coal deposits on the North part of the Czech Republic) are able to interact with microbial cells without significant changes of metabolic activity of microbial populations. Selected humic substances provided very good protection of the microorganisms against oxidative stress induced by ZVI nanoparticles. With regard to the origin and availability of these substances, they can be suitable additives for decontamination technologies, where both the ZVI nanoparticles activity of and the biodegradation activity of microorganisms is needed.

Biography

Alena Cejkova received Ph.D. at the Department of Biotechnology, Institute of Chemical Technology in Prague, where she is a Full Professor of biotechnology since 2002. Her research is focused on the physiology, communication and biotechnology applications of microorganisms. She is author of more than 40 publications in peer-reviewed scientific journals and monographs.

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Carbon nanofibers with surface-attached platinum nanoparticles as cost-effective and efficient counter electrode for dye-sensitized solar cells

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Dye-sensitized solar cells (DSCs) have attracted incredible attention as a relatively inexpensive alternative to silicon solar cells. Conventionally, a transparent fluoride-doped tin oxide (FTO) conductive glass that is coated with a thin layer of platinum (Pt) is used as counter electrode in DSCs. The reason for the widespread use of Pt as counter electrode in DSCs is its catalytic ability to enhance the reduction of I₃- ions in electrolyte. However, Pt is costly and the corrosive nature of the I-/I₃-redox couple may significantly deteriorate Pt’s catalytic activity and hence affect the long-term stability of DSCs. In this study, carbon nanofibers with surface-attached Pt nanoparticles were prepared by electrospinning polyacrylonitrile (PAN) solution followed by the stabilization and carbonization of PAN precursor nanofibers and subsequent Pt nanoparticle growth on carbon nanofiber surface via redox reaction. The obtained carbon/Pt composite nanofibers were then employed as cost-effective counter electrode in DSCs. The effects of size, morphology, and loading of Pt nanoparticles on the performance of DSCs were investigated. Compared to conventional counter electrode, the counter electrode that was made of carbon nanofibers with surface-attached platinum nanoparticles exhibited higher fill factor (FF) and larger open circuit voltage (Voc). DSCs containing the carbon/Pt composite nanofiber counter electrode demonstrated good solar energy conversion efficiencies in the range of 7% and 8%.

Biography
Alex Aboagye received his B.S. and M.S. degrees in Chemical Engineering from Kwame Nkrumah University of Science and Technology, Ghana, and North Carolina Agricultural and Technical State University, respectively. He joined Prof. Zhang’s research group at the Joint School of Nanoscience and Nanoengineering, North Carolina A&T State University in spring 2012 and is now pursuing a Ph.D. degree in nanoengineering. His research interests include ceramic and carbon nanomaterials and their applications.

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Structured DNA nanoparticles for delivery of RNA therapeutics

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Nanoparticles are useful for delivering therapeutics into cells. However, size, shape, surface chemistry and the presentation of targeting ligands on the surface of nanoparticles can affect circulation half-life and biodistribution, cell specific internalization, excretion, toxicity, and efficacy. A variety of materials have been explored for delivering small interfering RNAs (siRNAs) - a therapeutic agent that suppresses the expression of targeted genes. However, conventional delivery nanoparticles such as liposomes and polymeric systems are heterogeneous in size, composition and surface chemistry, and this can lead to suboptimal performance, lack of tissue specificity and potential toxicity. Here, we show that self-assembled DNA tetrahedral nanoparticles with a well-defined size can deliver siRNAs into cells and silence target genes in tumours. Monodisperse nanoparticles are prepared through the self-assembly of complementary DNA strands. Because the DNA strands are easily programmable, the size of the nanoparticles and the spatial orientation and density of cancer targeting ligands (such as peptides and folate) on the nanoparticle surface can be precisely controlled. We show that at least three folate molecules per nanoparticle is required for optimal delivery of the siRNAs into cells and, gene silencing occurs only when the ligands are in the appropriate spatial orientation. In vivo, these nanoparticles showed a longer blood circulation time ($t_{1/2} \sim 24.2$ min) than the parent siRNA ($t_{1/2} \sim 6$ min).

Biography

Hyukjin has received his Ph.D. from KAIST and did postdoctoral studies from chemical engineer department and Koch institute for integrative cancer research at MIT. Currently, he is working at the graduate school of pharmaceutical science in Ewha Womans University.

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Layer-by-layer assembled oligodeoxynucleotide drug nanosponge for highly efficient drug delivery

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To achieve efficient drug delivery, a novel method for preparation of nucleic acid based carrier was developed. As carrier and drug, highly concentrated oligodeoxynucleotide (ODN) formed sponge-like nanostructure by enzymatic elongation without any crosslinker. The size of nanosponge dramatically decreased to favorable size for cellular uptake by a layer-by-layer assembly of poly-L-lysine (PLL), DNA, and polyethylenimine (PEI), without losing the amount of ODN. This LbL-coated nanosponge contained extremely high amount of ODN, 1X10^6. In addition, LBL assembled nanosponge showed significant improvement of stability in in vivo environment and ability of endosomal escape.

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Development of a polymeric nanoactuator with its applications

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Recently, there are huge demands for nanoscale actuation and positioning with the rapid progress of nanotechnology. Nanoactuation based on piezoelectricity is one of the most popular methods for nanoactuation. Flexure mechanism has been introduced as one of the most effective methods to guide nanometer-scale motion to the desired motion mode. As a result, various types of nanoactuators using both piezoelectric actuator and flexure mechanism are applied to a great variety of applications. However, typical materials for flexure mechanism is metal and it is machined using wire-cut electrical discharge machining to ensure manufacturing accuracy. Therefore, careful consideration needs to be made to avoid corrosion and circumference interference. Here, we presented a chip-like polymeric nanoactuator based on a flexure mechanism and piezoelectric actuation. Motion specification and injection moldability were expected using FEM softwares in its design stage to achieve higher motion accuracy and avoid parasitic motion. The material for the actuator was a cyclic olefin copolymer (COC), which provided superior mechanical and optical properties and biocompatibility than other polymers. The nanoactuator was fabricated using mesoscale injection molding, then it was equipped with piezoelectric stack actuation, capacitive displacement sensor and a PID controller for experimental verification. From the experiments it could be demonstrated that the nanoactuator had a travel range of 15 microns and control error was less than 3 nm. The developed nanoactuator is being applied to optical alignment and micro-bioreactor for cell biology.

Acknowledgement: This work was supported by the Platform Technology Development program of the Ministry of Trade, Industry and Energy, Republic of Korea.

Biography

Y. H. Jeong has completed his PhD at the age of 30 years from POSTECH and postdoctoral studies from Yonsei University and University of Illinois at Urbana-Champaign. He is an Assistant Professor at Department of Mechanical Engineering, Korea Polytechnic University, Gyeonggi, Korea. He is currently a co-PI of Immune-network Pioneer Research Center sponsored by the National Research Foundation of Korea. He has published more than 30 papers in reputed journals.

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Preparation and characterisation of conducting biopolymer-carbon nanotube composite materials

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Carbon nanotubes (CNTs) have unique electronic, mechanical, optical and thermal properties which make them interesting as a material for nanotechnology applications. However, the use of CNTs is limited due to their aggregation behaviour and insolubility in most common solvents. This poor process-ability is due to high surface energy and the extremely strong π and Van Der Waals interactions. Many different processing methods for fabrication of conducting CNT materials have been used including filtration, fiber spinning, inkjet printing and drop casting. Carrageenan is a generic name for the biopolymer family of water soluble, linear sulphonated galactans extracted from red seaweed which is known for their gel forming and thickening properties.

Homogenous CNT dispersions using Kappa-carrageenan (KC) as dispersant were prepared by sonication. The length of sonication required to disperse SWNTs and MWNTs in KC was optimized using UV-vis-NIR spectroscopy. Our results indicate that MWNTs require less sonication time compared to SWNTs, i.e. 20 minutes versus 35 minutes. Rheology results show that increasing the sonication time reduces the apparent viscosity of KC solutions, while addition of CNT increases viscosity significantly.

Free standing films were prepared by evaporative casting and vacuum filtration processes. The conductivity of MWNT composite films prepared by an evaporative casting process were similar compared to those of the SWNT composite films (7-9 S/cm). In contrast, the conductivity values of SWNTs composite films (25 S/cm) prepared by a vacuum filtration process were higher compared to those of the MWNTs composite films (16 S/cm). Addition of glycerin to these films reduced their conductivity, but increased their flexibility. Scanning electron microscopy revealed that the difference in conductivity is due to the biopolymer coverage of the CNT-CNT junctions in the CNT network. This work contributes to the development of conducting biopolymer composite materials.

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Anticancer potential of bimetallic nanoparticles synthesized from quercetin and gallic acid

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Background: The synthesis of metal nanoparticles from plant extracts is a single step process used for the reduction of metal salts to nanoparticles. The compounds or chemical entities present in the plants reduce the metal ions to nanoparticles and stabilize them. This method of synthesis is advantageous over existing chemical and physical methods and can be easily scaled up. Metal nanoparticles are emerging nano-products that have gained much attention towards the field of nanomedicine. Biomolecules present in the plants such as proteins/enzymes, polysaccharides, alkaloids, flavonoids, terpenoids, phenolic compounds and vitamins are generally involved in the reduction, formation and stabilization of metal nanoparticles. The aim of the present study was to synthesize metal nanoparticles using bio-active flavonoids, phenolics (quercetin and gallic acid) and find out its cytotoxic effect on the Dalton lymphoma (DL) cells.

Experimental: To synthesize the nanoparticles from a mixture of gallic acid and quercetin, different concentrations of the salts were prepared. The resulting solutions were reacted with a mixture of silver and selenium salt by incubating at 35°C (200 rpm) in dark condition. Various parameters for nanoparticle synthesis (quercetin, gallic acid and metal salt concentration, pH, temperature and reaction time) were optimized to enhance the yield of the nanoparticles. These nanoparticles were characterized using various techniques including UV-Vis spectroscopy, Dynamic light scattering (DLS or Zetasizer), Fourier transform infrared spectroscopy (FTIR), Electron microscopy (TEM and S-TEM), Differential scanning calorimetry (DSC), Elemental analysis (EDS) and Thermo gravimetric analysis (TGA) analysis. Various concentrations of these nanoparticles were evaluated for cytotoxic effect against DL cell lines by MTT assay.

Results and discussion: Silver and selenium bimetallic nanoparticles were synthesized using quercetin and gallic acid as a standard flavonoids and phenolics. Quercetin and gallic acid were added to the aqueous solution of silver nitrate and sodium selenite. The color of the resulting solution was changed from clear to dark brown indicating the formation of bimetallic nanoparticles (Ag-Se NPs). A combination of quercetin and gallic acid resulted bimetallic nanoparticles but neither of the chemical compounds could produce nanoparticles alone. A mixture of silver nitrate (1 mM) and sodium selenite (1 mM) was reacted with gallic acid and quercetin. A mixture of gallic acid and quercetin (each 1000 µl) gave maximum yield of bimetallic nanoparticles. Above or below this concentration of quercetin and gallic acid, the yield of synthesized nanoparticles decreases sharply. When only quercetin was used it was also able to produce bimetallic nanoparticles but the yield was lower than that of the salt mixture (gallic acid and quercetin). The characterization data of Ag-Se NPs revealed the stable mono-disperity with controlled shape and size (~35 nm in diameter). These results showed that flavonoids and phenolics act as reductant as well as stabilizer of nanoparticles. The effect of these biogenic nanoparticles on the viability of tumor cells was determined by MTT assay. The Ag-Se NPs reduced the viability of Dalton lymphoma cell lines in a dose dependent manner. Silver nanoparticles at a concentration of 50 µg/ml decreased the viability of DL cell lines to 50% of the initial level and this was chosen as the IC50.

Conclusion: The findings of the present study suggest that the Ag-Se bimetallic nanoparticles are synthesized as well as stabilized by quercetin and gallic acid. These biogenic nanoparticles being highly cytotoxic to the cancer cell lines have great importance as a therapeutic agent in preventing or lowering oxidative stress related to degenerative diseases, such as cancer.

Summary: The synthesis of bimetallic nanoparticles (Ag-Se NPs) was accomplished using quercetin and gallic acid at room temperature. The synthesized Ag-Se nanoparticles were characterized by various analytical techniques and their size was determined to be 30 to 35 nm. Our findings suggest that the flavonoids and phenolics were responsible for both the reduction as well as stabilization of nanoparticles. The present study also shows the efficacy of biologically synthesized Ag-Se nanoparticles as an anticancer agent by destroying Dalton lymphoma (DL) cells in vitro. At 50 µg/ml, Ag-Se nanoparticles decreased the viability of DL cells to 50% of the initial level. Overall, our study was very useful for the biomedical research as it involved the biosynthesis of bimetallic nanoparticles followed by the anti-cancer studies.

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Development of a novel ZnO/PVC nanocomposite material for medical implant applications

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In hospitals and clinics worldwide, medical device surfaces have become a rapidly growing source of nosocomial infections. Contamination can occur from the presence of just a small number of microorganisms due to surgical procedure, improper sterilization, and more commonly the simple migration of bacteria from the skin into the body after an operation. Almost immediately after adhering to a device surface, bacteria can begin to form a biofilm: A robust, sticky matrix that provides protection against the host immune system and antibiotics. This makes the infection especially difficult to treat, and often necessitates device removal. Adding to the severity of this problem is the spread of bacterial genetic tolerance to antibiotics, in part demonstrated by the recent and significant increase in the prevalence of methicillin-resistant Staphylococcus aureus (MRSA).

Nanomaterials are beginning to be used for a wide variety of biomedical applications due to their unique surface properties which have the ability to control initial protein adsorption and subsequent cell behavior. This “nanoroughness” gives nanomaterials a greater functional surface area than conventional materials, which do not have significant features on the nanoscale. In addition, it is theorized that nanoparticles may also have general mechanisms of toxicity towards bacteria that do not cause problems for mammalian cells.

The objective of the present in vitro study was to reduce S. aureus density on conventional polyvinyl chloride (PVC) by embedding the polymer with zinc oxide nanoparticles through a simple and inexpensive procedure. The effect of nanoparticle size and %wtZnO was also investigated. The surface roughness and features of the ZnO/PVC nanocomposites were visualized using SEM. Results demonstrated that this technique significantly decreased bacterial density and biofilm formation without the incorporation of antibiotics or other pharmaceuticals, thus providing much promise for use in the manufacture of common implanted medical devices.

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Complementary resistive switch based on nanostructured memristors

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Since the first realization of capacitor in 1745 followed by conceptualization of resistor and inductor in 1827 and 1831 respectively, the design community has been limited to these three fundamental passive circuit elements. Memristor and memristive constructs at nanoscale have emerged over the last few years through a combination Metal-Insulator-Metal (MIM) processing technology; thus paving the way for an efficient adoption of memristor constructs such as ReRAM crossbar-based architectures. However, a noticeable drawback of the crossbar architecture that remains to be solved is the existence of sneak-paths between adjacent cells.

This work presents a novel approach in implementation of complementary resistive switch based on transparent memristors. The upper TiO$_2-x$ layer was deposited by atomic layer deposition using titanium tetra-isopropoxide and O$_2$ as the precursor and the oxygen source respectively; with oxygen deficiency of 5%. The lower TiO$_2$ is 4 nm thick while the upper TiO$_2-x$ layer is 12 nm thick. The fabricated MIM structure has shown promising results in terms of functional reproducibility and high speed switching for digital and low-voltage analog application.

Biography
Sung-Jin Kim received the Ph.D. degree in the School of Electrical and Computer Engineering from Seoul National University, Seoul, Korea, in 2006. In 2007, he was a Postdoctoral Research Scientist with the Department of Electrical Engineering, Columbia University, New York, NY, where he was initially engaged in research on the application of nano technology and new processing strategies for highly integrated systems. In 2008, he joined the School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA, as a Postdoctoral Fellow working on solution-processable nanoscale devices. His current research interests include the nanodevices, flexible nanoprinting electronics, and energy harvesting nano applications.
Controlled agglomeration of plasmonic gold nanoparticles enhances sensitivity of optoacoustic assays

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Gold nanoparticles of various shapes are promising tools for biomedical applications. One type of gold nanoparticle with a strong tunable plasmon resonance in the near-infrared spectral range is the gold nanorod (GNR). Unique properties of gold nanorods (GNR) such as high longitudinal surface plasmon resonance (LSPR) absorption, different absorption wavelengths, and low level of light scattering, favor these nanoparticles as ideal contrast agents for optoacoustic imaging.

Optical properties and optoacoustic imaging suggest that novel methods can be developed to determine protein concentration and aggregation. Such methods are based on changes in LSPR of GNR conjugates during association with analytes. GNR conjugates with specific and non-specific antibodies, as well as PEGylated GNR used as control, were incubated with solutions of specific protein or PBS as control. The properties of the conjugates were monitored through light absorption, zeta-potential and size distribution. Experimental results showed dramatic agglomeration for antibody GNR and their antigen but not for nonspecific binding and control samples. This effect could also be quantified by a LSPR shift of specifics conjugate and was used for optoacoustic assay calibration and measurement. Investigation of new methodologies to examine protein-protein interactions and protein-complex binding partners are essential to the understanding of the biological function and activity of the proteins, and the detection of different analytes into non-optically-transparent media with high light scattering.

Biography

Boris Ermolinsky completed his Ph.D. at the Engelhardt Institute of Molecular Biology, Russian Academy of Science, Moscow, Russia and carried out postdoctoral studies at University of Texas Health Science Center, School of Public Health. He is currently Assistant Professor at the Department of Biomedicine, University of Texas Brownsville. He has co-authored well over 30 papers in peer review journals. His research program is focused on the understanding of intermolecular interactions, modifications and characterization biomolecules and nanoparticles by different analytical methods.

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Fabrication of Au@SnO$_2$ NPs mixed SnO$_2$ composite and its sensing behavior for CO gas

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In this report a core shell material Au@SnO$_2$ (0.03 M Au colloid) core shell nanoparticles (NPs) has been synthesized by microwave synthesis method. However in this Au@SnO$_2$ core shell NPs the high resistance restricts the commercial value. Hence to overcome this issue, we prepared a mixture of Au@SnO$_2$ core shell NPs and SnO$_2$ powder which was prepared by SnCl$_4$ (0.28 M), (NH$_4$)$_2$CO$_3$ (0.1 M) and NH$_4$OH (1.6 M NH$_3$) as initial precursors. The prepared SnO$_2$ powder was calcined at different temperatures of 500$^\circ$C, 600$^\circ$C, and 700$^\circ$C. From TEM images, the particle sizes were found to be 15 nm, 20 nm, 30 nm respectively. XRD measurements show the well crystallinity of all the prepared SnO$_2$ powders at different calcined temperatures. The surface morphology of as prepared SnO$_2$ powders was examined in FESEM. The amount of SnO$_2$ powders were fixed at 0.5 g, whereas the mixing amount of Au@SnO$_2$ NPs was varied from 50 to 100 μL. The sensing properties of Au@SnO$_2$ NPs mixed SnO$_2$ composite for CO gas (200 to 1000 ppm) were examined at testing temperature of 200$^\circ$C. When the amount of Au@SnO$_2$ into SnO$_2$ powder increases, the resistance of Au@SnO$_2$ NPs mixed SnO$_2$ composite device increase. The response of Au@SnO$_2$ NPs mixed SnO$_2$ composite sensor was found to be 8.78 and 6.82 for 50 μL and 100 μL of Au@SnO$_2$ core-shell NPs amount respectively.

Biography

Bum-Soo Chon is pursuing his Master degree in Department of Information and Electronics Materials Engineering, Chonbuk National University. He is interested in the synthesis of core-shell nanostructures and nanopowder such as Au@SnO$_2$, SnO$_2$ powder and their applications for gas sensor.

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Strategy to reduce the characteristic yellowing of antibacterial fabrics treated with silver nanoparticles

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The competitive market of textile materials has driven industries to look for solutions that add values to their products. A strategy adopted by these industries to reach this goal is the use of additives to functionalize the fabrics. Different classes of additives are available in the market, but the antibacterial are of special interest. Fabrics treated with this sort of additive can avoid bacterial growths which may be responsible for cross contaminations, infections and the onset of bad odors. Among the antibacterial additives used for this purpose, silver nanoparticles have gained increasing attention due to the powerful and long-term bactericidal action that the treated fabrics can exhibit even when extremely small amounts of this product is used. Although the proved efficiency of silver nanoparticles against a wide variety of bacteria, the characteristic color changes of some clear dyed fabrics and mainly the yellowing of white fabrics appears as a barrier for the increase in the consumption of this sort of antibacterial additive by industries. The present work presents a strategy to reduce the yellowing effect in white fabrics through the adding of optical brighteners in the silver colloids. Colorimetric results showed that the use of these chemical compounds significantly reduced the yellowness of treated fabrics composed by synthetic and a mix of cotton and synthetic fibers. The proposed strategy can be successfully applied in industrials textile processes once the stability and antibacterial properties of the colloidal silver were not compromised by the adding of the optical brightener.

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Preparation of SiC nano-sized powder by using solid state reaction and plasma process

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Silicon carbide (β-SiC) is a material used in advanced ceramic applications due to its high thermal conductivity, corrosion resistance, and strong mechanical property even at high temperature. Many methods have been used to produce SiC powders, such as carbothermal reduction, sol-gel, gas-phase reaction, solid state synthesis of silicon with carbon and so on. Among these methods, solid state synthesis of silicon with carbon can be considered to be an attractive method due to its proven advantages: Lower energy requirement, simpler and cheaper equipment. In this work, β-SiC was synthesized by solid state method from the reaction of Si and C powder, and SiC nanoparticle was prepared from the synthesized fine SiC powder by DC thermal plasma reactor. Si powder of 99.5% purity with average size of 6 µm was mixed with activated carbon of average size 50 µm using ball milling. The mixture of Si and C were placed in a controlled atmosphere furnace at temperature of 1200°C. Two different atmospheres i.e., 100% Ar and 97% Ar and 3% H₂ were used to investigate the effect of H₂ gas on formation of SiC. It was found that H₂ gas lead to delaying the reaction time and lower particle size of SiC powder created. The surface areas of synthesized SiC powders were found to be 23.6 m²/g and 40.6 m²/s for 100% Ar atmosphere and H₂ atmosphere respectively. The particle size of SiC powder was reduced until 10-50 nm by DC thermal plasma treatment.

Biography
Changhyun Lee is pursuing his Master’s degree in Department of Information and Electronics Materials Engineering, Jeonbuk National University. His research interest is mainly about the synthesis of Si/SiC and SiC for lithium ion battery.

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Magnetic properties of Fe55Pd45 nano-dots deposited on top of the nano-meterwide Si(100) pillars

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Magnetic nano-dot arrays with (tilted) perpendicular anisotropy are useful for the high-density magnetic recording. In this study, we deposited Fe55Pd45 alloy on top of the 54 nm wide and 430 nm long Si(100) nano-pillars. The size of each FePd nano-dot formed on top of a pillar-tip or -tips is 90-110 nm in length and 66-130 nm in diameter. After fabrication, each sample underwent a rapid thermal annealing (RTA) treatment; with a heating rate of 40°C/sec up to 500°C, being annealed there for 30 minutes, and then quenched to room temperature. X-ray diffraction (XRD) indicated that after RTA the FePd alloy transformed from the fcc to the fct phase with lattice constants: a=0.380 nm and c=0.378 nm. Magnetic domain (MD) pattern of the FePd nano-dot array was studied by MFM. The dot-like MDs, with the size from 300 to 400 nm, show the tendency of perpendicular anisotropy. The squareness ratio (SQR) of the magnetic hysteresis loop reaches the largest value, when the field (H) is along the (z) direction or the long-axis of the pillars; i.e., (SQR)z=0.65> (SQR)x and/or (SQR)y. Because (SQR)z is still not close to 1, the easy-axis (EA) of the FePd dots is slightly tilted relative to the z (or perpendicular) direction. From the in-plane rotation angle ($\phi$:azimuth) and the out-of-plane tilting angle ($\theta$:inclination) dependencies of the coercivity (HC), we find that the former exhibits the characteristics of the curling-mode-like switch, while the latter exhibits the Stoner-Wohlfarth-like switch. The relative half-width ($\Delta H/H_C$) of the switching field distribution reaches the minimum, 1.61, when $\theta=0^\circ$, and the maximum, 2.30, when $\theta=\phi=90^\circ$.

Biography

Liu Chi-Ching is doing his Ph.D. with National Chiao Tung University under the guidance of Professor Jen, Shien-Uang. His research mainly focused on Magnetostriction and application; Magnetic domains and domain walls; Ferromagnetic resonance.

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Polyelectrolyte coated clay nanotubes with pH controlled release
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Halloysite nanotubes (HNTs) exist abundantly throughout the natural world and have versatile hollow tubular structures composed of two-layered aluminosilicates. The geometrical structure and surface charges of HNTs allow it to be loaded and nanocoated with a variety of materials, such as drugs and bioactive macromolecules and polymers, for sustained and extended releases. HNTs exhibit high levels of biocompatibility and very low cytotoxicity, making it an ideal candidate for new drug delivery systems. The incorporation of nanocoatings on HNTs offers more possibilities for target and trigger-responsive drug delivery platforms. Our previous studies have shown that the release time of drugs from HNTs can be extended and adjusted by the addition of polyelectrolyte nanocoatings. This study showed controlled pH-dependent releases of two model drugs, alizarin red (AZ), methylene blue (MB), and methotrexate (MX) from HNTs and polyelectrolyte multilayers including polyvinylpyrrolidone (PVPON), poly-acrylic acid (PAA), and polyacrylamide (PAM). Results showed that the stability of the nanocoatings and the release of drugs were greatly influenced by the pH of immersing solution and stock solutions. It is suggested that these molecular architectures have potential applications in nanoscale trigger-responsive drug delivery systems.

Biography
Lin Sun has completed his medical degree at the age 23 years from Zhengzhou University in China, and is currently a Ph.D. candidate at Louisiana Tech University for Molecular Science and Nanotechnology. He has presented at international conferences such as the 2013 Biomaterials Revolution in Massachusetts.
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Neutron diffraction study of dynamic process in Li-ion batteries

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In situ neutron diffraction was used to show that charge/discharge process of LiFePO$_4$ based real Li-ion battery can be effectively studied by time-of-flight technique at the IBR-2 pulsed reactor. The important option of the HRFD diffractometer is a possibility to utilize both high-intensity and high-resolution modes without any changes in the geometry of an experiment. The results clearly show that the kinetics of LiC$_6$ phase's appearance and LiFePO$_4$ ↔ FePO$_4$ transformations are well observable and can be treated quantitatively.

Biography

Sangaa Deleg received his Ph.D. degree in Solid State Physics at the Moscow state University, Russia in 1990. He received the degree of Doctor of Habilitation at the Institute of Physics and Technology, Mongolian Academy of Sciences, Ulaanbaatar, in 2002. He is the author/coauthor of over 80 publications in international journals. He is a senior researcher of National Nano Center, Institute of Physics and Technology in Mongolia. His research program is focused on the study of crystal and magnetic phase transition in different crystals and characterization nanoparticles by different methods, including synchrotron and neutron diffraction.

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Magnesium oxide nanoparticles improve cell functions for tendon to bone insertion applications

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There are about 100,000 ACL reconstruction surgeries performed every year in the United States, with a failure rate ranging from 5-25%, depending on the criteria of the study. It is believed that this high rate of failure is a result of insufficient healing at the tendon-to-bone insertion site (TBI). The TBI disperses critical stress concentrations that arise naturally between ligaments and bone by providing a compositional and mechanical transition from ligaments, through a fibrocartilaginous zone, to bone. However, this complex, inhomogeneous, and avascular tissue is incapable of regenerating following surgery. Therefore, there is considerable interest in the development of a nanostructured biomaterial that is capable of directing healthy regeneration of spatially controlled tissue across the TBI.

In this study, magnesium oxide (MgO) nanoparticles were used to mineralize poly(l-lactic acid) (PLLA) and tested for their ability to improve the attachment and growth of TBI-related orthopedic tissue. Magnesium is an essential mineral in bone which is thought to regulate the size and density of hydroxyapatite (HA) crystals, and further, Weng and Webster demonstrated that nano-rough MgO increased bone cell density three-fold compared to bulk MgO. Presently, the ability of materials to promote tissue growth at the TBI was characterized via cell adhesion and proliferation experiments with fibroblasts and osteoblasts. Materials were also tested for their mechanical properties, and further characterization was performed using SEM, TEM, XRD, FTIR, EDS, and contact angle tests.

Results indicated for the first time that MgO nanoparticles in plain PLLA or PLLA/HA composites significantly increased osteoblast and fibroblast adhesion on PLLA. Interestingly, both cell lines followed the same general trend of adhesion on each sample, indicating that variations in only the secondary phase of a scaffold material will not be sufficient to direct the formation and maintenance of spatially controlled tissue heterogeneity at the TBI. However, nano-MgO can be used to mineralize different polymer phases to promote the formation of bone tissue at one end of the scaffold and fibrous tissue at the other end.

Mechanical tensile testing revealed that the addition of a secondary nano-phase to plain PLLA hardened the polymer, reducing the material elongation and increasing its elastic modulus. Moreover, the observed changes in mechanical strength of PLLA seemed to be dictated by the size and shape of its secondary nano-phase, indicating that the mechanical properties of PLLA composites can be tailored to align with the strength of bone or ligament tissue.

Biography

Daniel J. Hickey received his Bachelor of Science degree in Chemical Engineering in 2012 from UC Santa Barbara. He joined Professor Thomas Webster’s Nanomedicine Lab at Northeastern the following fall to pursue his Ph.D., in Chemical Engineering. He is the treasurer of the Northeastern chapter of the Society for Biomaterials, and he is the winner of the Boston area ISPE poster competition.

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Formulation of oral microparticulate drug delivery system for cancer
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The development of oral controlled-release cancer drug formulations with enhanced bioavailability and efficacy is highly desired. Our research aim to develop controlled-release capsule formulations containing sulforaphane-encapsulated in a biodegradable polymeric microparticulate system. Sulforaphane, a histone deacetylase inhibitor (HDAC), was investigated as this therapeutic agent reverses aberrant epigenetic changes in cancer cells and the effects of this drug are reversible. Biodegradable polymeric microspheres were prepared by a microencapsulation method, and prepared microspheres were characterized for various properties, including encapsulation efficiency, percent yield, particle size, size distribution, surface morphology, and Zeta potential. Dissolution studies were carried out to analyze the release profiles of the microspheres and capsule-containing microsphere formulations. Data indicated that microspheres were less than 2 µm in diameter size. It has been shown that particles within this size range are effectively taken in by the cells. The prepared microsphere formulations had Zeta potential values of about -30 mV, which suggest that they are stable. Furthermore, microsphere formulations were shown to provide controlled-release of the drug over 36 hours. Capsule formulations containing microspheres exhibited similar drug release characteristics; however, the lag time for drug release was longer. Thus, oral gelatin capsules containing sulforaphane-encapsulated biodegradable microspheres show potential for effective delivery of epigenetic agents.

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Design of a nanoparticulate drug delivery system for cancer therapy
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Most anticancer agents are not targeted to neoplastic cells. As a result, the development of dosage forms and drug delivery systems containing anticancer drugs capable of targeting cancer cells is highly desired. Our research investigated an albumin-based nanoparticulate delivery system as a platform technology for the delivery of anticancer agents. Doxorubicin hydrochloride was used as the model drug. Drug-encapsulated nanoparticles were prepared by microencapsulation through spray-drying and were characterized for their physicochemical properties. Raman spectroscopy was used to investigate the stability of the encapsulated drug. Additionally, Zeta potential measurements were used to assess the colloidal stability and surface properties of the nanoparticles. Dissolution studies were carried out to examine the release profile of the drug from the nanoparticles. The in vitro efficacy of the drug-loaded nanoparticulate drug delivery system was analyzed in MCF-7 breast cancer cell line. Raman spectroscopy data suggested that the drug is stable in the nanoparticulate drug carrier. Nanoparticles have Zeta potential measurements of approximately -30 mV, suggesting that the system is stable in an aqueous environment. Dissolution studies showed that the drug was released from the nanoparticles at a sustained rate over a period of over 24 hours. In vitro data in MCF-7 cell line indicated that there was more than 10% more inhibition of cell viability when doxorubicin was used with the biodegradable polymeric carrier. Similar results were observed from clonogenic studies. Additionally, our in vitro data suggested that cell death induced by the drug-loaded nanoparticles was caused by apoptosis. Hence, the data suggest that biodegradable albumin nanoparticles are capable of targeting cancer cells.

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Explaining station inhibition effectiveness by quantum biochemistry computation

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Hundreds of millions of adults have high cholesterol, which has generated a billion market of drugs (mainly statin-based drugs) devised to reduce and control the total serum cholesterol levels. Patents covering the leading statins have expired recently, which pressures the development of new drugs for the market. Statins act by inhibiting the 3-hydroxy-3-methylglutaryl coenzyme (HMG-CoA) reductase in the process of converting HMG-CoA, a committed step in the biosynthesis of cholesterol.

In this work, we take full advantage of the published crystallographic data of HMGR complexed with statins to perform computer simulations within an ab-initio quantum mechanical approach, based on the density functional theory (DFT) and in the framework of the molecular fractionation with conjugate caps (MFCC) strategy, to investigate the details of the binding interaction of the statins atorvastatin (A, PDB ID 1HWK), rosuvastatin (R, 1HWL), fluvastatin (F, 1HW1), cerivastatin (C, 1HWJ), mevastatin (M, 1HW8), and simvastatin (S, 1HW9) to the HMGR enzyme. The purpose is to elucidate why statins have differences in their efficiency to reduce cholesterol levels by obtaining and comparing the interaction energy between the HMGR residues and the ligand atoms. The main advantage of the methodology we propose here is the possibility to evaluate which amino acid residues contribute more intensely to the stabilization of the statin-HMGR complex, which can be very helpful for purposes of drug design and delivery.

Biography

E. L. Albuquerque is a Full Professor at the Department of Biophysics, Universidade Federal do Rio Grande do Norte, in Natal-RN, Brazil. He received his Ph.D. degree in Physics in 1980 from the University of Essex, England. He spent sabbatical leaves, among others, at the International Centre for Theoretical Physics (Trieste-Italy) in 1982, the Centre for Chemical Physics, University of Western Ontario (London-Ont, Canada) in 1991/92, and Harvard University (Cambridge-MA, USA) in 1995/96. He has authored or co-authored over 200 scientific articles, including one book and three review articles.

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Production of carbon nanostructures by pyrolysis of nut shell

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Biomass chemical composition is mainly carbon, which is considered a primary source for the manufacture of functional carbon materials. The high carbon composition of biomass attracted scientists’ attention as a standpoint to solve economic and environmental issues. The aim of this work is to obtain carbon nanostructures using a pyrolysis process followed by a chemical vapor deposition (CVD) (called from here pyrolysis vapor deposition). Pyrolytic carbon from nutshell was obtained at 450°C with a 0.75 h of residence time. Deposit nanoparticle morphologies were obtained with respect to the location in the downstream part of the reactor. At L1 position, carbon deposit groups in layers with a composition of 98.3% carbon and 1.7% oxygen. Carbon deposit at position L2 presented a semispherical conformation with a carbon composition between 98.3-100% by weight. Carbon deposit at position L3, shows a formation of carbon and iron nanobelts, as well as semispherical sintered nanoparticles, which corresponds to carbon and inorganics detected during tests. All These results support the statement that it is possible to achieve several carbon nanoparticles deposition morphologies from biomass pyrocarbon. Synthesis of carbon nanostructures from biomass by pyrolysis vapor deposition is possible but is still in early stages of development. A throughout study of pyrolysis conditions, biomass source, kinetics, morphologies and chemistry must be done in order to refine the synthesis and be able to have high quality an quantity of carbon nanostructures.
The structural study of Pt supported on TiO$_2$ catalyst doped by Nb

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In this paper, niobium doped titanium oxide (Nb$_x$Ti$_{1-x}$O$_2$, x=0.1, 0.005) were synthesized and investigated as a cathode catalyst support material for polymer electrolyte membrane fuel cell (PEMFC). Two different methods to synthesis the catalysts: (1) a room temperature synthesis for Nb$_{0.1}$Ti$_{0.9}$O$_2$ (x=0.1, 0.005) via a surfactant templating, and (2) high temperatures synthesis (700°C and 1000°C) for Nb$_{0.1}$Ti$_{0.9}$O$_2$ (x=0.1). X-ray absorption spectroscopy (XAS) and X-ray diffraction (XRD) techniques were applied for characterization of synthesized supporting material. Niobium doped titanium oxide supported Pt nanocatalyst synthesized; using polylol method was characterized by SEM technique. Pt particle sizes, interatomic distances and distribution were found by XRD, Raman scattering, XAS and SEM.

Titanium dioxide exists in three crystalline forms: the most common types are rutile and anatase. Among three phases, rutile crystalline is the thermally stable phases. The grain size of the rutile phase is always larger than that of the anatase phase. The anatase phase of titania is usually stabilized by cation addition.

Niobium (Nb) is known to be the most promising dopant since the similarity of the ionic radii of Nb$^{5+}$ (r=0.70 Å) and Ti$^{4+}$ (r=0.68 Å) results in almost no lattice distortion. Doping of TiO$_2$ with Nb slows down the anatase to rutile phase transformation preventing growth of the grains, and that might lead to enhancement of the specific surface area of the support. The transformation from anatase to rutile can be easily monitored using X-ray diffraction.

Biography

G. Sevjidsuren has completed her Ph.D. from National University of Mongolia. She is the Head of Fuel Cell Laboratory, Institute of Physics and Technology, Mongolian Academy of Sciences. She has published more than 40 papers in refereed journal articles.

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Observation of Bloch oscillations and current plateaus in small Josephson junctions array embedded in a network of dc-SQUIDs

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A distinct Bloch nose and current plateaus were measured in the current-voltage characteristics of small Josephson junctions array at low temperatures (T=80 mK) by embedding the array in a network of direct-current superconducting quantum interference device (dc-SQUID) structures. The dc-SQUID structures in the design were used to serve as RF current sources owing to ac Josephson effect and also to vary the impedance around the small Josephson junctions array via introducing a magnetic field perpendicular to the dc-SQUID structures. The observed current plateaus seem to be a phase locking phenomenon between coherent oscillations of Cooper pairs in small Josephson junction, Bloch oscillations, and the RF signal from the dc-SQUIDs. The magnitude of the current plateaus was measured to as high as 300 pico-Ampere. The demonstrated result has a potential in renovating the calibration technique of dc-current in electrical metrology by modifying the dc-current definition as the product of Cooper pair charge and frequency.

Biography

S. Gandrothula has completed his Ph.D. from The University of Electro-Communications, Tokyo, Japan in 2013. He has been working as a post-doctoral fellow at National Metrology Institute of Japan (NMIJ) and also a fellow in the Innovation school of AIST, Japan.

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Fabrication of highly aligned nanofiber with different weight ratios of the magnetic-nanoparticles by electrospinning

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Electro spinning has emerged as a very attractive approach to the fabrication of nanofibers. In electrospinning process, the ability to control the alignment and arrangement of fibers is critical to achieve the designed functions. When magnetic nanoparticles are mixed with polymers, aligned fibers can also be fabricated. In this paper, we have successfully obtained highly aligned nanofibers by adding properly an external magnetic field at the collector. The PVA polymer solutions with different weight ratios of Fe$_3$O$_4$ nanoparticle (20 nm) were firstly prepared with the help of ultrasonic clean machine for 24 h. The aligned nanofibers could be achieved by the magnetic-electrospinning set-up. These nanofibers fabricated using the magnetic-electrospinning are substantially more uniform and with much less splitting than those without the field. By making observations and doing experiments we found that the electrical conductivity and viscosity of the polymer solutions had been obviously improved with the increase weight ratios of super-paramagnetic Fe$_3$O$_4$ nanoparticle, and the proper magnetic-electrospinning concentration of PVA polymer solutions is 8%-10% and the weight ratio of magnetic nanoparticles is less than 0.5%. In addition, the scanning electron micrographs (SEM) showed the magnetic field could decrease the diameter of fibers and enhance the uniformity of fibers distribution. The X-Ray Diffraction revealed the magnetic field intensity and the weight ratios of magnetic nanoparticles could obviously improve the crystallinity of the nanofibers. In summary, the magnetic-electrospinning technique for generating uniaxially aligned nanofibers was illustrated. The well-aligned nanofiber has the potential applications such as fiber-reinforcement, fiber-oriented liquid crystal, and tissue engineering. It is a simple and efficient way which could generate highly aligned nanofiber mats.

Biography

Hong-Ying Liu has got her Bachelor’s degree at Dezhou University and now is a postgraduate in College of Textile and Clothing Engineering, Soochow University. She has got two patents since 2013.

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The effect of Fe$_2$O$_3$ doping on TiO$_2$ particle/nanotube composite layer for enhancement photovoltaic efficiency of dye-sensitized solar cells

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The dye-sensitized solar cell (DSSC) are composed of a dye-adsorbed nanoporous TiO$_2$ layer on a fluorine-doped tin oxide (FTO) glass substrate, redox electrolytes and a counter electrode. The heart of the system is a mesoporous TiO$_2$ film composed of nanometer-sized particles possessing a large specific surface area. However, an unusual feature of this kind of DSSCs is the lack of the space charge layer, which separates the injected electrons from the holes in the dye or electrolyte. A unidirectional charge flow with no electron leakage at the interfaces is essential for high energy-conversion efficiency. In this paper, DSSC were constructed by application of Fe$_2$O$_3$ and TiO$_2$ nanoparticle/TiO$_2$ nanotube (TNT) composite particles with various percentages. The use of oxide semiconductors in the form of nanorod, nanowires and nanotubes may be an interesting approach to improve electron transport through the film. In addition suitable amount of TNT in the film could provide large surface area for the adsorption of the dye. The Fe$_2$O$_3$-doped reduced the surface trap states of TiO$_2$, suppressed the charge recombination, and increased the driving force of electron injection, thereby improved its power conversion efficiency. The impedance results indicate improved electron transport at the TiO$_2$/dye/electrolyte interface. This result is attributed to the prevention of electron recombination between electrons in the TiO$_2$ conduction band with dye or electrolytes. TiO$_2$ passivating layer was deposited on the substrate by hydrolysis of TiCl$_4$ aqueous solution. TiO$_2$ layer was coated on FTO glass by doctor blade method. The dye-sensitized solar cells were fabricated using dye of ruthenium (II)(N719) and electrolyte (I-/I$_3$). The DSSC based on Fe$_2$O$_3$/TiO$_2$/TNT composite particles hybrids showed a better photovoltaic performance than the cell purely made of TiO$_2$ nanoparticles. The crystalline structure and morphology were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM). The absorption spectra were measured by UV-vis spectrometer. The conversion efficiency was measured by solar simulator (100 mW/cm$^2$).

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Heat transfer enhancement of metallic nanofluids using the electrical explosion of the wire in liquids

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The enhancement of the critical heat flux (CHF) contributes to increase the safety and/or economic competitiveness of the thermal system. There are many application areas, such as nuclear power plants, fusion applications, electronics cooling, etc. Until now, many researchers have been attempting to enhance the CHF in various ways. Recently, there have been many experimental results for improvement of the heat transfer using the nanofluids as working fluids. The nanofluids have superior properties compared with the existing base fluid due to properties of dispersed nanoparticles.

In this study, the silver, copper and aluminium nanofluids were produced by the electrical explosion of the wire in liquids (EEWL) technique. These nanofluids have the high purity and superior dispersion state, compared to the nanofluids prepared by the two-step methods. The effect of the energy deposited in the exploding wire was analyzed in terms of the size and shape of the metallic nanoparticles. These metallic nanofluids have shown the significant improvement of the critical heat flux (CHF). It was also observed that their CHF enhancement is related with changing the morphology of the heated surface during the boiling process. We conducted pool boiling experiments using these metallic nanofluids prepared by the EEWL process. After pool boiling experiments, metallic nanoparticles were deposited on the heater surface and formed the nano/micro structure, which causes the changing the wettability on the heater surface. In addition, the variation of the surface morphology was observed.

Biography

Hyung Wook Park is an Associate Professor at the Ulsan National Institute of Science and Technology. He was a senior researcher in KIMM. He received his Ph.D. from Georgia Institute of Technology in 2008. Before joining Georgia Tech, he worked at Hyundai Motor Company. He has published more than 21 papers in reputed journals.
Biomanufactured nanoscale palladium catalyst: Effects of biomass type on catalyst activity in the reductive dechlorination of chlorobenzene

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Nano-metallic catalysts have multiple industrial applications. Recent focus has been on their clean manufacture and biofabrication. Biofabricated nano-scale palladium (bio-Pd) is active in the reductive dehalogenation (hydrogenolysis) of chlorinated aromatic compounds. Bio-Pd catalyst is made via biosorption of Pd (II) and its subsequent reduction to Pd (0) to give bio-scaffolded Pd-nanoparticles on bacterial cell surfaces. Gram negative cells (e.g. Desulfovibrio desulfuricans) and gram positive cells (e.g. Bacillus spp.) made bio-Pd comparably active in hydrogenation reactions but have not been compared with respect to hydrogenolysis and dechlorination of chlorinated aromatic compounds. Bio-Pd (0) by D. desulfuricans and Bacillus benzevorans were prepared and compared with respect to their patterning on bacteria. The Pd-nanoparticle sizes were measured via X-ray powder diffraction via data analysed using Scherrer’s equation which indicated a significant difference in particle size. The bio-Pd catalysts were evaluated with respect to their differing abilities in the dehalogenation of chlorobenzene; both showed higher catalytic activity than commercial palladium on carbon (Pd/C) catalyst.

Biography

Jacob B. Omajali graduated in 2004 from Kogi State University, Nigeria where he studied Biochemistry. He got sponsored by Petroleum Technology Development Funds, PTDF, in 2008 for Master’s in Industrial and Commercial Biotechnology at Newcastle University, UK. While at Newcastle, Jacob developed an interest in bio-catalysis and environmental remediation. Currently, he is a Ph.D. student at the University of Birmingham, UK under another scholarship.

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Infrared absorption enhancement phenomenon on nano materials
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The intensification of infrared-active vibrational modes of molecules in close proximity to nanometer-thick metal films, commonly known as surface-enhanced infrared absorption (SEIRA), is receiving increased attention from both a phenomenological and practical viewpoint. The resonant excitation of plasmon in metallic nanostructures can provide large field enhancements on the surfaces of metals, which in turn provide dramatic increases in the detected spectroscopic signals for molecules adsorbed on their surfaces. The most widely used surface enhanced spectroscopy (SES) is surface enhanced Raman scattering (SERS), where the electromagnetic enhancement factor is proportional to the fourth power of the field incident on the molecule. Recently there has been a resurgence of interest in another type of SES, surface enhanced infrared absorption. It has been widely applied to surface trace analysis, bio-sensing, electro sorption, and electro catalysis because of its significant amplification of surface signal and simple surface selection rule. The surface enhanced infrared absorption can be observed easily on metal island films prepared by vacuum evaporation or sputtering and electrochemical or electroless deposition. Metal colloids also support the enhancement. Like surface-enhanced Raman scattering (SERS), SEIRA is chiefly of electromagnetic origin, that is, due to an increase in the local optical field exciting the adjacent molecule. Metal nano clusters much smaller than the wavelength of light facilitate the interaction of the infrared radiation with the metal and adsorbed molecules, resulting in the enhancement. It was explained that the enhancement is greatly affected by the size, and planer density of metal nano clusters compared with metal nano films. Phenomenological and theoretical difference of infrared absorption in broad ranges of wave length including near field to far field infrared rays between metal nano clusters and metal nano films. Especially, metal nano clusters exhibit much higher infrared absorption than metal nano films on broad ranges of wave length. The phenomenon of infrared absorption in the range of near infrared wave length was different from that of far infrared wave length. This different phenomenon involves shift of resonant peaks and absorption intensities on them. Also the planar density of the metal nano clusters suggests a mechanism to explain the phenomenon.

Biography
Jae Hong Park has completed his Ph.D. at the age of 33 years from Seoul National University and postdoctoral studies from Korea Institute of Science and Technology and Harvard Medical School, respectively. He is a senior researcher of National NanoFab Center in Korea. He has published more than 30 papers in reputed SCI journals and serving as an editorial board member of repute.

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Vacuum packages for MEMS based sensors

Jae Hong Park, Tae Hyun Kim, Woo Choong Kim, Ha Jung, Chung Mo Yang, Eun-Mi Park, Hee Yeoun Kim and Kwyro Lee

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Vacuum continues to be an enabling environment for electronic devices into the 21st century. Here, examples include infrared IR sensing systems. Out-gassing from surfaces in these systems destroys these controlled ambient over time days to years. MEMS and MOEMS are not immune to these issues. Most of MEMS based sensors are sensitive to the operating pressure, the partial pressure of water vapor in the package, or both. For example, infrared sensors need to operate in a pressure 10^{-3} Torr in order to be thermally isolated from the outside world and maintain adequate sensitivity. The situation is further complicated by the need for high degrees of hermeticity leak rates on the order of 10^{-12} atm-cc/s and the lack of space to mount getters to control the contaminants in the package. Hermeticity is currently a significant issue in the microelectronics packaging field as a whole. Hermetically packaging MEMS devices in a reliable and economical manner is a topic of great interest to the MEMS community. The development of MEMS technology has reached a point where the packaging of the device is proving to be more difficult than the actual device development itself. Many development groups are finding their efforts stymied at this point, and interest in MEMS packaging and related topics is at a high level. In this study, among various and significant factors such as structural and geometric design of a device, considering optical design, thermal design, electrical design, mechanical design, and process design, fabrication of the device, design and fabrication of a circuit, device analysis, property measurement, design and fabrication of optical system, and design and fabrication of package module on R&D for MEMS based opto-electro-thermo-mechanical device, we will address a methodology for design, fabrication, and analysis of MEMS based infrared sensor array packaging. Also, ultimate type of wafer level packaging will be introduced in a viewpoint of design factors and structural differences compared with on-going metal packaging.

Biography

Jae Hong Park has completed his Ph.D. at the age of 33 years from Seoul National University and postdoctoral studies from Korea Institute of Science and Technology and Harvard Medical School, respectively. He is a senior researcher of National NanoFab Center in Korea. He has published more than 30 papers in reputed SCI journals and serving as an editorial board member of repute.
Ballon perfusion novel bi-layer nanoparticles to inhibition restenosis in animal models

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Introduction: At present, percutaneous transluminal coronary angioplasty (PTCA) and stent implantation is the most effective treatment for coronary atherosclerotic heart disease. However, the incidence of restenosis within 6 months after the operation is as high as 30% to 50%, becoming a main cause for the restricted long-term clinical efficacy and the increased medical expenses. Recent studies show that the difficult healing of blood vessel endothelium and the neointimal proliferation arising from excess migration and proliferation of vascular smooth muscle cell are two main causes for the formation of restenosis. Prevention and treatment of restenosis using systematic administration is often restricted by systematic toxic and side effect as a result of overdose and such factors as low efficiency of drug distribution and metabolizing in blood vessel, resulting in hardly effective local concentration of drug in blood vessel and short lasting of effective local concentration of drug. Local administration can directly deliver the high concentration therapeutic agent to the target tissue, improving the efficiency of administration and avoiding the above-mentioned defects of systematic administration. Nanotechnology can be used in manufacturing pharmacy to improve infiltration and redistribution of drug in tissues and increase local retention of drug. In our study, we designed a novel kind of VEGF/PTX nanoparticles (VEGF/PTX NPs) which can release VEGF and PTX step by step, to healing of endothelium and inhibiting smooth muscle cells proliferation. By local infusing VEGF/PTX NPs in atherosclerotic animal models, we detected the effective of VEGF/PTX NPs to inhibit restenosis.

Materials and Methods: VEGF/PTX NPs were prepared by double emulsion evaporation methods. Detection of VEGF/PTX NPs diameter and morphology by SEM, TEM and dynamic laser light scattering were done. Gene and PTX release sequently in vitro be checked, the function of gene which release from VEGF/PTX NPs were detected by ELISA. The cell activity was tested by MTT. The effective of VEGF/PTX NPs to inhibit restenosis be tested in atherosclerotic rabbit models, saline, PTX NPs, VEGF NPs be using in control groups.

Results and Discussion: VEGF/PTX NPs were successfully prepared, with a mean particle diameter of 78.82 nm and mean Zeta electric potential measurement of -12.2. The PTX entrapment rate was 92%, the PTX load was 28.58%, the gene entrapment rate was 98%, and the gene load was 4.67%. Protein expression can be detected by ELISA in cells medium which transfected gene, and after protein expression two days, inhibition of proliferation can be observed by the result of MTT. After in vivo perfusion into rabbits, the vascular restenosis in both the VEGF NPs group and the VEGF/PTX NPs groups was inhibited. Particularly, good healing was observed in VEGF NPs group by OCT. Immunohistochemical results indicated that the VEGF/PTX NPs group had lower PCNA positive cell expression rate and MMP-2 & TIMP-2 protein positive expression volume than the physiological saline control group and the blank NPs control group.

Conclusions: Novel VEGF/PTX NPs which release gene and PTX sequentially, it is effective to controlled restenosis in atherosclerotic animal models than control groups. By this way, we can see the sunshine of restenosis therapy.

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Nano-biosensor for continuous environmental monitoring system

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Public concern and legislation are nowadays demanding better environment control, and various types of sensor, especially biosensor, is the essential technology which meets to current and future tendency of the environmental monitoring system. It is important that pollutants must be sensed in real-time, so that can make decision fast and inexpensively. In fact, monitoring systems for environment has encouraged the development of new technologies and more suitable methodologies, the ability to monitor the increasing number of analysis of environmental relevance as quickly as possible, and even the possibility of allowing on-site field monitoring.

The atmospheric monitoring field, which is less explored than water environment, seems needed more research for managing diversiform toxic chemicals as Volatile organic compounds (VOCs) and suspended bacteria. Suspended bacteria are found widely in the environment.

We classified all types of biosensor according to method of signal transaction, and reviewed among of them, which are actively researched for the environmental monitoring. As a result of that, in this paper, we propose a new method of the monitoring of the pollutants using nano-biosensor with the change of the microbes by metabolism in a simple culture and matrix for attaching infectious aerosol. Using this method, we have accomplished for use as continuous monitoring systems that can provide easy, rapid and on-side measurement for analyzing multiple pollutants.

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Detection of airborne fungi using biosensors based on carbon nanotube-field effect transistors

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Airborne particles contain fungi that can cause several diseases such as allergies and human asthma. Especially, Aspergillus niger is known as one of the most frequently-observed allergenic antigens. Although the conventional Aspergillus detection method based on the sequential process of collection, culturing and DNA sequencing or immunoassay shows excellent sensitivity to the Aspergillus species, the process is highly labor-intensive and time-consuming. In this work, single-walled carbon nanotube (SWNT)-integrated field effect transistors (FET) were fabricated and employed to the rapid detection of Aspergillus niger in real time with high sensitivity. The amount of the specific primary antibody of Aspergillus niger was carefully determined using the enzyme-linked immunosorbent assay. Then, the antibody was covalently immobilized on the SWNT channel using conventional EDC/NHS chemistry. The FET current increase was observed with sequential adding of a concentrated solution of Aspergillus on the antibody-immobilized SWNT-FET, showing high sensitivity and selectivity. Our study will be of great importance for the health care and environment monitoring of elderly people and children which are more vulnerable to allergy disease.

Biography

Taejin Jeon has been working for the school of mechanical engineering in Korea University.

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Enhancing photovoltaic performance of P3HT/PDI donor-acceptor system via morphology control

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Semiconducting polymers and small molecules based organic solar cells (OSCs) offer a promising option for clean, renewable, and affordable energy sources. Over commercialized silicon solar cells, OSCs exhibit advantages of solution processibility to enable large-scale roll-to-roll fabrication, mechanical flexibility, potential low cost, and synthetic variety. In OSCs, the active layer that consists of two distinct components: An electron donor (D) and an electron acceptor (A), plays a critical role in determining the device efficiency. It is essential to control the morphology of the active layer where excitons are generated and dissociated into charge carriers that then migrate in opposite directions to the electrodes. Nevertheless, several challenges still remain to be addressed in order to make OSCs competitive compared to their inorganic counterparts.

To improve the progress of organic-based devices, synthetic methods need to be developed to make well-defined three-dimensional structures with a controlled size and shape in conjunction with delicately organized self-assembly properties. In this work, we report enhancing photovoltaic performances of poly (3-hexylthiophene) (P3HT) and perylenediimide (PDI) donor-acceptor system via controlling the structural morphology of the D-A dyads. Various shapes and sizes of donor P3HT and acceptor PDI nanostructures were prepared by base-catalyzed condensation of their respective alkoxysilane precursors and evaluated their device performance. Through morphology control, we were able to enhance the device performance of P3HT/PDI system up to the power conversion efficiency (PCE) of 2.6%. The future work will focus optimizing the aspect ratio of nanostructures and device architecture to improve PCE of this D-A dyad.

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Biosynthesis of TiO$_2$ nanoparticles from alfalfa extracts

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In this work, we present the green synthesis of TiO$_2$; focusing on several effects that impact the particle size distribution: an initial concentration of precursor (titanium isopropoxide), the ratio of hydrolysis, and different pH values. Nanoparticles were synthesized from a hydrolysis reaction using 2-propanol as a solvent; starting from titanium isopropoxide and sugars and carboxylic acids as additives extracted from alfalfa. The extraction of these additives was obtained by dissolving powdered alfalfa in 2-propanol. This substrate has been harvested in the southern region of the city of Leon, Guanajuato in Mexico. Figure 1 shows the onset wavelength of the optical absorption for the uncapped TiO$_2$ that appears at 290 nm in UV–Vis spectroscopy which is blue shifted compared to the bulk anatase TiO$_2$; indicating the formation of nanoparticles solution. Moreover, the spectrum gives an indication about nanoparticle polydispersity: systems with low polydispersity present a well-defined peak, as shown in this figure.

Figure 1. UV-Vis spectrum for TiO$_2$ nanoparticles synthesized at different pH.

Biography

José de Jesús Ibarra-Sánchez has completed his Master’s in Chemical Engineering from the University of Guanajuato, Mexico. Since 2011, he is a Ph.D. Student at the same university. He has published two papers.
Effect of stirring speed on particle size in the synthesis of magnetic nanoparticles for biomedical applications

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The effect of stirring speed on particle size in the synthesis of magnetite nanoparticles was investigated. Magnetite nanoparticles from size 7.7-10.2 nm were prepared by the technique of thermal decomposition of acetylacetonate iron (III) at different agitation speeds; from 0.0 rpm up to 240 rpm, in a reaction flask with a diameter of 15.24 cm. Results show that the speed of agitation in the synthesis is a critical value for determining the size of the particles. At 100 rpm (maintaining constant the reaction conditions), the particles reached a maximum size of 10.4 nm. All synthesized nanoparticles showed superparamagnetic behavior at room temperature. Finally, a study of growth kinetics was conducted at a stirring speed of 100 rpm and it showed that when magnetite nanoparticles are synthesized their growth over the time of the synthesis exhibits sigmoidal behavior. The kinetic of growth showed a pattern similar to presented by bacteria and autocatalytic reactions, since in these cases a stage of rapid growth is followed by one of slow growth and so on until finally becomes asymptotic to the end value. This behavior gives an indication that particles grow at the expense of others newly formed. The data were fitted to a function type BiDoseResp (double Boltzman function). Thus, it was concluded that given the size and size distribution obtained, these particles are candidates for biomedical applications, as in controlled drug release or hyperthermia.

Biography

Jose de Jesus Ibarra-Sanchez has completed his Master’s in Chemical Engineering from the University of Guanajuato, Mexico. Since 2011, he is a Ph.D. Student at the same university. He has published two papers.

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Encapsulated nanodispersion biocidal systems will be used in the industry for the production of environmentally friendly paints. In this report, we demonstrate the antimicrobial activity of polymer dispersion systems against bacteria and fungi.

Tests were performed according to CSN EN 15457: Paints and varnishes. Strains of microorganisms originated from: (1) The Czech collection of microorganisms: Staphylococcus aureus (Sa) and culture collection of fungi, Prague, Czech Republic: a mixed population of Aspergillus brasiliensis and Penicillium chrysogenum (AbPc) and (2) the environment - the roof of a building: A mixed population of bacteria (mpb) and a mixed population of fungi (mpf).

1. We compared the biocidal activity of 23 samples against different microorganisms. Results:

2. (Sa) vs. (AbPc): 8 samples (35%) showed biocidal activity against bacteria and moulds, 4 samples (17%) had no biocidal activity, and 11 samples (48%) showed variation in biocidal activity,

3. (AbPc) vs. (mpf): 8 samples (35%) showed biocidal activity against both groups of moulds, 8 samples (35%) had no biocidal activity against moulds, and 7 samples (30%) showed variation in biocidal activity.

Six samples showed biocidal activity against all test microorganisms.

For further work, it is recommended to continue using all strains of microorganisms tested so far.

Biography

Katerina Klanova received Ph.D. at the Department of Microbiology, Komensky University of Bratislava, Slovakia. She works at National Institute of Public Health as a researcher in the field of Microorganisms in the Environment.

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The effects of seed layer thickness on the properties of ZnO nanorod photoelectrode for dye-sensitized solar cells

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The ZnO nanorod photoelectrodes for dye-sensitized solar cells (DSSC) were grown on ZnO seed layer/FTO using hydrothermal method. The ZnO seed layers with various thicknesses were fabricated by magnetron sputtering method. The ZnO nanorods were synthesized in a solution of zinc nitrate hexahydrate and hexamethylenetetramine at 90°C for 24 h. As the seed layer thickness was increased from 200 nm to 600 nm, the average diameter of the ZnO nanorod increased from 100±10 nm to 250±10 nm. The diameter of a ZnO nanorod strongly depends on the grain size of the seed layer, which acts as a base for the ZnO nanorod. As the results, the maximum values of energy conversion efficiency of ZnO nanorod photoelectrode DSSC indicated 0.91% with seed layer thickness of 600 nm.

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Some characteristics of the pulmonary phagocytosis response to deposition of different metal nanoparticles


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Suspensions of gold (50 nm), silver (49 nm) or copper (40 and 50 nm) nanoparticles and silver or copper microparticles (1 mcm) were instilled intra-tracheally to rats. Cell population of bronchoalveolar lavage fluid (BALF) obtained 24 hrs later was studied with optical, transmission electron (TEM) and semi-contact atomic force microscopy (sc-AFM).

All nanometals evoked much more significant recruitment of phagocytic cells to the free surface of lower airways as compared with their micrometric counterparts. A marked increase in the count ratio of NLs to alveolar macrophages (AMs) testified for high cytotoxicity of all nanometals but for nanoparticles of similar diameters this response depended on their chemical nature, that to nanogold being the least while that to nanocopper - the most pronounced. Within both AMs and NLs we saw a lot of nanoparticles and obtained TEM and sc-AFM images proving the important part played by active endocytosis, rather than by diffusion only, in nanoparticles’ internalization. This inference is in agreement with that earlier made by us from a similar experiment with Fe₃Ο₄ nanoparticles which demonstrated also that the NL/AM index and avidity of phagocytosis increased with decrease in particle diameter. We found marked differences between different nanoparticles as concerns the intracellular distribution, the most important being the ability of gold and copper, but not of silver and iron oxide to penetrate into nuclei and more marked affinity of the latter two to mitochondria with expressed damage to these organelles.

Biography

Larisa I. Privalova, M.D., D.Sc., graduated from Sverdlovsk State Medical Institute (Russia) as a Doctor of Medicine in 1972, and since then is working in the Ekaterinburg Medical Research Center for Prophylaxis and Health Protection in Industrial Workers where she is now the Head of the Laboratory of Scientific Principles of the Biological Prophylaxis. She has got experience in studying: Toxicology of low-soluble industrial dusts and of metallic nanoparticles; mechanisms controlling pulmonary dust kinetics; establishing occupational exposure limits; environmental epidemiology and risk-assessment. In these fields, she co-authored several monographs and many scientific papers in peer-reviewed Russian and international journals.

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Analysis of micro and nanoencapsulated porphyrin formulation for PDT treatment in biological system

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In the treatment of melanoma and other skin diseases, the Photodynamic therapy (PDT) is a medical procedure with excellent results, whereas the porphyrins and derivatives have been extensively employed. Some limitations have been imposed, particularly by the long persistence time in the organism, leading to undesirable skin photosensitivity. For this reason, more effective and safe photosensitizers and formulations have been pursued. The polymeric encapsulation represents an interesting choice among the other alternatives, because the capsule shell can be made by several biocompatible polymers and with variable degrees of cross-linking allowing the control of permeability and mechanical resistance. A new cream-like polymeric emulsion containing 3 MMe porphyrin was prepared by the coacervation method. This study is aimed to analyze and compare the effect of a micro nanoencapsulated porphyrin 3MMe in fibroblast lines, murine melanoma lines and melanocytes lines in vitro through indicators of cell viability and function and evaluated the effect in murine melanoma model in vivo. The results showed that the cytotoxicity was directly proportional to the amount of porphyrin 3 MMe and to time of incubation and irradiation, and significantly more effective treatment for melanoma cell lines. It was not observe cellular cytotoxicity in the presence of porphyrin (3 MMe) and absence of light, proving the photodynamic action of the formulation. In vivo studies showed that animals with melanoma who received the treatment, showed a significant decrease in tumor mass compared to the control groups. Thus, the proposed 3 MMe micro/nanocapsule formulation does provide a promising alternative for application in PDT treatment.

Biography

Lucia Jamli Abel did her Ph.D. at the São Paulo University and postdoctoral studies from São Paulo University and Albert Einstein Hospital. She is currently Full Professor at the Department of Pathology at Paulista University. Her research is focused in Nanotechnology on the understanding of drug delivery systems and recently she submitted a paper of her research group about nanoencapsulated porphyrin formulation. She has published papers in reputed journals and she is a nanotechnology consultant of the Ministry of Science and Technology (MCTI).

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Synthesis of carbon encapsulated iron nanoparticles for applications in biomedicine

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Magnetic nanoparticles are being of great interest because of their unique properties especially in drug delivery, magnetic resonance imaging, hyperthermia and cell separation. The ultimate goal of magnetically controlled drug delivery and drug therapy is to selectively delivering drug molecules to the diseased site without a concurrent increase in its level in healthy tissues. The objective of this study is to synthesize carbon encapsulated iron nanoparticles (CEINPs) as suitable nanocarriers. Although to date most studies have focused on the development of polymer or silica protective coatings, recently CEINPs are receiving more attention, because carbon-based materials have many advantages over polymer or silica, such as high chemical and thermal stability, as well as biocompatibility of carbon-based materials. A modified arc discharge reactor was utilized to synthesize CEINPs at near atmospheric pressure (5-8 x 10^4 Pa). The morphologies and composition mapping features of CEINPs were investigated by electron microscopy (HTEM and SEM), energy dispersive X-ray analysis (EDX) and electron energy loss spectroscopy (EELS). SEM and HTEM images illustrate Core@Shell nanostructure and spherical shape of particles. Only iron peak was observed from EELS and EDX analysis and no trace of oxygen or other impurities were found. Thus, all iron particles were well protected by carbon shells. In addition, detailed information of carbon shell crystallinity was examined by Raman spectroscopy. The iron core magnetic properties were studied by superconducting quantum interference device and their superparamagnetic behavior was investigated at body temperature. It is concluded that the morphological and magnetic properties of obtained CEINPs meet the requirements of a suitable candidate for biomedical applications.

Biography

M. Reza Sanaee has completed his master program in Nanoscience and Nanotechnology with “Excellent Average Grade Point” distinguished by the University of Barcelona, Spain. Since 2011 he is a Ph.D. Student at the same university and is a member of FEMAN Group at the institute of Nanoscience and Nanotechnology, Dept. of Applied Physics and Optics. During the recent one-two years, he has been succeeded in developing and presenting seven manuscripts at international level.
Identification of aptamer-based potent inhibitors against *Mycobacterium tuberculosis* acetohydroxyacid synthase

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*Mycobacterium tuberculosis* AHAS is a potential and promising candidate in the development of novel anti-tuberculosis drugs. Acetohydroxyacid synthase (AHAS) from *M. tuberculosis* is one of the biosynthetic enzymes, which catalyzes the first common step in the biosynthesis of the essential branched chain amino acids (BCAAs: valine, leucine, and isoleucine). Aptamers are single-stranded nucleic acid molecules that can fold into complex three-dimensional shapes, forming binding pockets and clefts for the specific recognition and tight binding of any given molecular target, from metal ions and small chemicals to large proteins and higher order protein complexes, whole cells, viruses, or parasites. Aptamers are selected by in vitro process known as systematic evolution of ligands by exponential enrichment (SELEX).

In this study, an *in vitro* selection method, SELEX, was used to find single-stranded DNA aptamer towards *M. tuberculosis* AHAS. We found twelve ssDNA aptamers against *M. tuberculosis* AHAS through *in vitro* selection by SELEX. Among these aptamers, 3 aptamers of the biotinylated modified demonstrated higher binding affinity determined by aptamer-based ELISA method. One of the aptamer showed inhibitory action against *M. tuberculosis* AHAS. This study would further be useful in discovering and producing novel class of aptamer-based inhibitors.

Biography

Moon-Young Yoon has completed his Ph.D. from University of North Texas and postdoctoral studies from UCLA Molecular Biology Institute. He has published more than 150 papers in reputed journals and has been serving as an editorial board member of repute.

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Therapeutic potential of cerium oxide nanoparticles for the treatment of sepsis induced cardiac dysfunction

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Severe sepsis is a medical emergency characterized by systemic inflammatory response syndrome that progresses to multi-organ dysfunction and death if left untreated. Sepsis is the leading cause of death in non-coronary intensive care units and ranks among the top ten causes of mortality in the United States. Current treatment for sepsis typically involves the use of antibiotics, fluid resuscitation, vasopressors, NSAIDS and mechanical ventilator support. Recent clinical trials using anti TNF-α antibodies, activated Protein C and antioxidants have been employed in animal models and have been shown to improve survivability by 30-40%. Although promising in animals, similar results in humans have yet to be realized. According to our knowledge, there is currently no FDA approved drug to treat severe sepsis suggesting an acute need for new therapeutic agent. Previous studies have shown that cerium oxide (CeO$_2$) nanoparticles exhibit anti-inflammatory, anti-bacterial and anti-oxidant activity. Herein we propose to examine the use of cerium oxide nanoparticles for the treatment of severe sepsis. Our preliminary data suggests that CeO$_2$ nanoparticles significantly improve survivability in Sprague Dawley rats with severe sepsis. Improvement in animal survivability was associated with normalization of body temperature and significantly decreased the levels of blood urea nitrogen along with major inflammatory proteins. Additional data also demonstrated that CeO$_2$ nanoparticles treatment decreased the expression of VCAM-1, a major marker for vascular dysfunction along with other proteins involved in inflammatory pathways in heart.

Biography

Nandini D.P.K Manne has earned his first doctoral degree in veterinary medicine from Sri Venkateswara Veterinary University, India. He is currently pursuing a doctoral degree in biomedical sciences at Marshall University while maintaining a strong focus on research and publishing articles in peer reviewed journals.

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Nanoelectronic of DNA-based segments with a diluted base pairing topology

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We report in this work a quantum-mechanical investigation of the one-electron states in DNA-based segments with a diluted base pairing topology. Our main intention was to reinforce that the resonance mechanism reported in our work leads to an anomalous wave-packet dynamics, even in the worse case of strong localization in single-strand molecules. Specifically, we will consider poly(CG) and poly(CT) segments in a special topological case in which the guanine (G) bases are attached laterally at a fraction of the cytosine (C) bases. Our theoretical model is based on a tight-binding electronic Hamiltonian to compute the density of states and eigen functions of the one-electron states. We will show that the model Hamiltonian for this system can be mapped onto that of the Anderson chain with diluted disorder. We will explore the influence of the effective disorder on the nature of the one-electron states as well as on the wave-packet dynamics. In particular, we will show that in segments formed with complementary units [as in poly(CG)], dilution indeed leads to a complete exponential localization of all one-electron states. On the other hand, in chains with non-complementary units [as in poly(CT)], a resonant state is not affected by the disorder and remains extended. In the presence of such resonant state, the wave-packet develops a diffusive dynamics.

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ZnS and CdS based nanomaterials: Synthesis, characterization and photocatalytic activity

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ZnS and CdS nanoparticles were prepared by precipitation of zinc and cadmium acetate with sodium sulphide in the presence of the cationic surfactant cetyltrimethylammonium bromide (CTAB). The nanoparticles with the radius of 2.0-2.2 nm were prepared. ZnS and CdS nanoparticles had the hexagonal and cubic structure, respectively. The dispersions of ZnS, CdS nanoparticles and CTAB were investigated by means of several instrumental techniques and also by molecular modelling methods. Based on zeta potentials measurements and results of molecular simulations it was found that ZnS and CdS nanoparticles were covered by CTAB arranged into bilayers forming positively charged micelles.

These micelles were immobilized on particles of the clay mineral montmorillonite (MMT). ZnS and CdS nanoparticles were mostly deposited in micro- and mesopores of MMT that were closed during drying. The resulting nanocomposites contained 4-7 wt. % of ZnS, resp. CdS. The MMT nanocomposites along with free ZnS and CdS nanoparticles were applied for the photocatalytic decomposition of phenol, nitrous oxide and photocatalytic reduction of carbon dioxide. Using free nanoparticles as well as the nanocomposites the 90% efficiency of the phenol decomposition was achieved. For the reduction of CO₂ the nanocomposites were more suitable. They provided 5-6 fold higher efficiency than the commercial TiO₂ catalyst (Evonik P25) in production of hydrogen and methane. In case of the N₂O decomposition ZnS nanoparticles and the ZnS-MMT nanocomposite were also more efficient (80%) than TiO₂ (57%).

Biography

Petr Praus obtained his Ph.D. in Analytical Chemistry from University of Pardubice. He is a full professor in the field of Material Science and Engineering at VSB-Technical University of Ostrava. He is an author or co-author of more than 60 papers in peer-reviewed scientific journals. His research is focused on synthesis, characterization and photocatalytic applications of nanomaterials.

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Modification of photocatalytic nanocomposites by controlled vacuum freeze-drying

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Photoactive ZnS nanoparticles were precipitated by heterogeneous nucleation on the surface of carrying silicon nanoparticles, dispersed in an aqueous solution of zinc acetate with sodium sulphide. The produced photoactive colloidal dispersion was desiccated in two different ways. 1. The dispersion was filtered and the residual water evaporated in the presence of air at 100°C. 2. The aqueous dispersion was very rapidly freeze to -20°C and water molecules sublimated at the required optimal rate in the controlled vacuum. The structure of the composite material (Si)ZnS produced via thermal drying at 100°C is significantly tighter than the structure obtained by vacuum freeze-drying. Controlled freeze-drying enables self-organization of composite nanoparticles into lamellar structures, as shown in Figure 1, with a significantly larger specific surface area than the product of ordinary thermal drying. It thus provides several times higher catalytic efficiency.

The combination of two semiconductor materials of Si (band gap of 1.11 eV) and ZnS (band gap of 3.6 eV) is also promising, in particular enabling adjustment of the spectral dependence of the photocatalytic efficiency of the new composite material.

Biography
Richard Dvorsky obtained the RNDr. degree in Nuclear Physics from the Faculty of Mathematics and Physics of the Charles University in Prague, and the Ph.D. degree in Material Science from the VSB-Technical University of Ostrava. He is an associated professor in field of physics and material science in the Institute of Physics at the VSB-Technical University of Ostrava. He is the author or co-author of 23 papers in peer-reviewed scientific journals and 3 patents. His research focuses on top-down and bottom-up preparation of nanoparticles and functional particle nanocomposites.

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Synthesis and characterization of gold nanocomposite loaded hydrogels and their antibacterial applications

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Sodium carboxymethyl cellulose and Polyvinyl alcohol/ acrylic acid (CMC/PVA/AA) semi-interpenetrating polymer network (semi-IPN) hydrogels were prepared by free radical polymerization technique. Gold nanoparticles were formed by reduction of AuCl₄ in semi-IPN hydrogels with trisodium citarate under microwave radiation. UV-visible spectroscopy, thermogravimetrical analysis, X-ray diffractometry, scanning electron microscopy, and transmission electron microscopy techniques were used to characterize the formation of gold nanoparticles in hydrogels. SEM images indicated clearly the formation of group of gold nanoparticles with size range of 10-12nm. The sizes of gold nanoparticles were also supported by transmission electron microscopy results. The semi-IPN gold nanocomposite hydrogels reported here might be a potentially smart material in range of applications of antibacterial activity.

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Size dependent properties of amorphous InP quantum dots

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Quantum confinement in amorphous phase is rarely reported. We systematically explored the quantum confinement in the amorphous phase of InP. Size dependent optical gap of well characterized InP a-QD (amorphous quantum dots) is reported in this work. Amorphous nature of the grown QDs was confirmed by selected area electron diffraction (SAED) images. The growth of dot size with growth duration was found to follow a linear trend. The short range order of InP differs slightly in crystalline and amorphous phases as evident by the structural analysis reported in literature. This was also confirmed by Raman analysis of our samples. Calculated value of $E_g$ (bulk) and $\mu$ was found to be different than the values reported in literature. This confirms a different short range order in the two phases. The magnitude of blue shift in energy gap of the amorphous dots is smaller than that of crystalline dots for InP consistent with the significant difference in $E_g$ of the two phases. This study shows that the nature of quantum confinement in InP dots is almost same in amorphous and crystalline phases, although different in magnitudes.

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Artificial neural networks: Genetic algorithm based optimization of solid lipid nanoparticles of asenapine maleate

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The purpose of this study was to develop and optimize the Solid Lipid Nanoparticles of the Asenapine maleate, an antipsychotic drug using Artificial Neural Networks-Genetic Algorithm (ANN-GA) technique. Nanoparticles were prepared by the high shear homogenization/sonication technique. A set of experiments was carried out to evaluate the effect of composition (drug/lipid ratio and surfactant concentration) and process variable (homogenization and sonication time) for the preparation of nanoparticles. The experimental data of 31 trials were designed using central composite design (CCD). Data were divided into two sets: training and test data set. A feed forward back propagation (FFBP) model of ANN was constructed and its input space was optimized using a genetic algorithm (GA) program. The ANN consisted of three levels of neurons: an input layer, a hidden layer and an output layer. The output results were observed in the form of particle size, polydispersity index and entrapment efficiency. The obtained result shows a correlation coefficient (r2) value of 0.97 and a root-mean-square error of 0.21 for the calculated/predicted properties with respect to experimental values, demonstrating the reliability of the proposed model. Therefore, ANN-GA represents a novel tool for optimization of composition, process variables and their predicted outcomes in development of solid lipid nanoparticles.

Biography
Sanjay Kumar Singh is a research fellow at Indian Institute of Technology (Banaras Hindu University), Varanasi. His current area of research is lipid based nanoparticulate drug delivery system. Before joining as doctoral research, he had worked in IPMG-Formulation department with R&D center of Lupin Pharmaceutical Limited (Pune) India. He has three publications with cumulative impact factor 10.8 and has presented/co-authored 7 research/review works in national/international conferences. He has qualified GATE-2008 with 99.78 percentile. He received UGC-JRF for his post graduation research work and awarded Institutional fellowship, from MHRD, Gov. of India for continuing his doctoral research.

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Poly (lactide)-based nanoparticles by free-radical dispersion polymerization: Fabrication, characterization and in vitro studies

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We have used the macromonomer method to prepare crosslinked, paclitaxel-loaded PLA-PEG (stealth) nanoparticles using free-radical dispersion polymerization. The nanoparticles were optimized using statistical D-optimal mixture design. Nanoparticle fabrication with poly(lactide) is mainly carried out by the dispersion of preformed polymers which makes it difficult to attach targeting moieties to the surface of the nanoparticle and to produce crosslinked networks. Confirmation of nanoparticle synthesis was by scanning electron microscopy. Particle size and size distribution and the zeta potential of the optimized formulation were determined using Zetasizer nano Zs. The release profile of paclitaxel-loaded nanoparticles was determined by high performance liquid chromatography and revealed that encapsulated drug is released over 7 days. In vitro cytotoxicity studies were carried out using the CellTiter®glo luminescent cell viability assay in MCF7, MDA-MB-231 (breast cancer) and SK-OV-3 (ovarian cancer) cell lines. The cytotoxicity assay shows that the blank nanoparticle is biocompatible with no toxicity for the duration of the assay compared to medium-only treated controls. Further, the paclitaxel-loaded nanoparticle formulation exhibits similar cytotoxicity compared to free drug in solution against the cancer cell lines tested. In vitro intracellular localization of nanoparticle by confocal microscopy also demonstrated that the nanoparticles are rapidly internalized by MCF-7 cancer cells within one hour probably by non-specific endocytosis. The stealth nanoparticles are suitable for the design of controlled delivery systems for bioactive agents.

Biography

Simeon K. Adesina completed his Ph.D. at the Howard University College of Pharmacy in December 2010 under the direction of Professor Akala. He has published four research articles in peer reviewed journals and also has a patent with Professor Akala. He joined Howard University as Assistant Professor in January 2012.

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Size-control and characterization of nanoGUMBOS

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Nanoparticles derived from a Group of Uniform Materials Based on Organic Salts (NanoGUMBOS) have unique and versatile properties derived from ionic liquids. These organic nanoparticles display enhanced and uniform properties at the nanoscale level. NanoGUMBOS, with melting points between 25°C and 250°C, are useful for various applications depending on the type of anion and cation used for formation. The performance and reliability of these applications are often size-dependent because the properties of nanoparticles often change with size and stacking arrangement due to electron confinement into small spaces. Therefore, my research has focused on controlling the size of nanoGUMBOS that are composed of imidazolium based organic salts. In this talk, I will discuss non-templated ultrasonication and microwave-based synthesis methods. Transmission electron microscopy (TEM), dynamic light scattering (DLS), and zeta potential measurements (ζ measurements) were used to study the size and stability of nanoparticles in aqueous medium. Spectrophotometric measurements were also useful for investigating structural effects related to decreases in size of nanoparticles. Furthermore, the behavior of nanoGUMBOS formation under microwave heating was explained by observing their dielectric properties. As result of this study, I was able to reduce the size of zero-dimensional particles derived from GUMBOS to nanoscale and understand their behavior by use of various characterization techniques.

Biography

Suzana Hamdan is a Ph.D. candidate in the area of analytical chemistry at Louisiana State University under the guidance of Professor Isiah Warner. She pursued her undergraduate studies in general chemistry at Lebanese University and graduated in 2006. She then joined East Tennessee State University where she completed her master’s degree and defended a thesis on the analytical applications of immobilized enzymes in sol-gels. After graduation in 2009, she began her Ph.D. studies in analytical chemistry and her recent research interest is in the area of nanotechnology where she is studying nanoparticles produced from novel materials based on organic salts. She currently has several manuscripts under preparation which disclose her studies.

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Biosensor to probe fibrous/not fibrous polypeptides

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The focus of this work is on the numerical investigation of the charge transport properties of the de novo-designed alpha3 polypeptide, a 21-residue with three repeats of the seven-residue sequence Leu-Glu-Thr-Leu-Ala-Lys-Ala, as well as its variants (the so-called 5Q-alpha3 and 7Q-alpha3 peptides), all of them probed by gene engineering. The theoretical model makes use of a tight-binding Hamiltonian within the density functional theory approach.

We investigate if the biased alpha3 polypeptide and its variants can be identified by charge transport measurements through current-voltage (IxV) curves, as a pattern to characterize their fibrous assemblies. We found that, from their IxV profiles, the alpha3 peptide, that has the most fibrous assemblies, shows the smaller current saturation; the 5Q-alpha3 variant, which forms fibrous assemblies more attenuated than those of the alpha3 peptide, has a current saturation higher than alpha3, but smaller than 7Q-alpha3; finally, the 7Q-alpha3 variant does not form fibrils and shows the highest current saturation, suggesting that charge transport in peptides can turn to be a useful tool for the development of biosensors to probe the onset of amyloidosis-like diseases. We hope that this biomedical application of the charge transport in proteins and polypeptides should stimulate experimental and engineering technological development.

Biography

U.L. Fulco is a Ph.D. student at the Department of Biophysics, Universidade Federal do Rio Grande do Norte, in Natal-RN, Brazil. The focus of his Ph.D. thesis is in the field of NanoBiotechnology, mainly with the investigation of charge transport in polypeptides and the development of biosensor devices.

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Glucose: Responsive release of insulin

Yousef Haik
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The World Health Organization (WHO) estimated the number of diabetic patients would increase from 250 million people today to 380 million by 2025. Today, about half million Emiratis suffer from diabetes and about half a million in pre-diabetic stage. Insulin dependent diabetic patients desire effective and convenient therapeutic options. Huge research investment has been made to develop insulin delivery systems for diabetic patients. The existing delivery systems (injection, oral, inhalation) for insulin all suffer from the inability to regulate insulin without patient intervention. There is a pressing demand to produce self-regulating insulin delivery system that takes the monitoring of insulin release away from the end-user, particularly for diabetic young patients.

A delivery system that meets the on-demand insulin release was reported, however it was based on toxic lectin (Con-A), which limited its application for diabetic patients. In here we describe a novel nano-system for insulin delivery that is regulated by glucose concentration. Insulin is entrapped by a non-toxic nanostructures that has affinity to glucose, once the glucose concentration reaches above the therapeutic range the insulin will be released, thus maintaining a therapeutic glycemic levels. The insulin release polymer is prepared by copolymerizing acrylic acid with different concentrations of 3-methacrylamidophenylboronic acid (MAAPBA). The loading capacity and release of the loaded insulin at different concentrations of glucose under physiological pH were studied. The release of insulin, in response to a glucose dose, from the insulin-loaded polymer is dependent on the composition between acrylic acid and MAAPBA. With increase in concentration of 3-methacrylamidophenylboronic acid, the glucose responsive insulin release from poly(acrylic acid-co-methacrylamidophenylboronic acid) polymer at the physiological pH of 7.4 was enhanced. The presence of glucose resulted in disintegration of the polymer leading to release of the loaded insulin. With increase in the MAAPBA, the insulin loading capacity of the polymers decreased, but their sensitivity to glucose increased. This resulted in better release of loaded insulin corresponding to the glucose concentration in the solution at physiological pH of 7.4.

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Hollow polymeric capsules: Size exclusive fishing of gold nanoparticles and universal carrier for precious metal nanoparticles

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Hollow polymeric capsules of nanometer to micrometer dimensions have been endowed with variety of applications. They can be used for drug and gene delivery, as microreactor and as templates for inorganic and organic nanoparticles. We present here polymer bound hollow capsules that are capable to fish gold nanoparticles within a certain size range and encapsulate other precious metal nanoparticles. Polymer bound hollow capsules of a sulfur containing polymer were prepared by dissolving gold core of an analog gold nanoparticle containing hybrid material, which was prepared by free radical copolymerization of methyl methacrylate and mono-functionalized gold nanoparticle with vinyl group as artificial monomer. The size exclusive fishing of gold nanoparticles has been carried out by using simple ligand exchange reaction. Citrate stabilized gold nanoparticles of different sizes ranging from 56 nm to 4 nm in the aqueous phase were used as "fish". Successful fishing process was proven by UV-Vis spectroscopy and transmission electron microscopy (TEM). The hollow capsules can encapsulate gold nanoparticles under 15 nm effectively. When a mixture of citrate stabilized gold nanoparticle in different sizes was used as "fish", the hollow capsules caught more small "fish" (3 nm) than large "fish" (15 nm) and the oversize "fish" was excluded. The hollow capsules can also act as universal carrier for precious metal nanoparticles. Silver, palladium, platinum nanoparticles have been successfully refilled in the hollow capsules via in-situ reduction route, which have promising future in the field of catalysis.

Biography
Ziyin Fan has completed her bachelors and masters from Philipps University of Marburg in Germany (2008-2012). In 2009 she won the DAAD (German Academic Exchange Service) prize. She is now Ph.D. student in groups of Prof. Andreas Greiner from University Bayreuth, Macromolecular Chemistry II. She has scholarship from FCI (Fund of chemical industry) for her Ph.D. Her research interest is stoichiometric functionalization of gold nanoparticles and synthesis of novel hollow capsules for various applications.

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