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Poster Presentations

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Smart nano composite paint sensors for infrared detecting and energy harvesting

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Functionality of nano composite Paint/PLZT films for use in pyroelectric infrared sensors and piezoelectric energy harvesting devices is presented. Smart Paint/Lead Lanthanum Zirconate Titanate (Paint/PLZT) nanocomposite films have been fabricated by the conventional paint-brushing technique on copper substrate. The pyroelectric and dielectric properties of the composite films were measured for their use in uncooled infrared detectors and thermal energy conversion devices. The properties investigated include: dielectric constants (ε' and ε''); pyro electric coefficient (p); and conductivity as a function of temperature. From the foregoing parameters, material's *figure-of-merits*, for infrared detection and thermal energy conversion, were calculated. The results indicated that composite films are functional and *figure-of-merits* increase with increase in amount of PLZT nanoparticles in paint. Based on the preliminary results obtained, it was found that the Paint/PLZT films are attractive for use in un-cooled thermal sensing elements and thermal energy conversion devices, especially in applications where flexible and curved-surface sensors are required. Efforts were also made to investigate the performance of nanocomposite films on copper substrate to mechanical vibrations. Thus, could be utilized for energy scavenging combining piezoelectric and pyroelectric effects. [This work is funded by NSF-HRD-1546965 grant.]

Biography

Ashok Batra has completed his PhD at the age of 28 years from Indian Institute of Technology, Delhi. With more than 24 years of experience in the diverse areas of solid state physics/materials and their applications, he is presently a professor of Physics. He is currently engaged in research related to the development of ambient energy harvesting and storage devices, nanoparticle-based chemical sensors, and organic photovoltaic solar cells. He has obtained various research grants as the principal or co-investigator from the U. S. Army/SMDC, NSF, DHS and NASA. The NASA grant was related to the International Microgravity Laboratory-1 experiment flown aboard the Space Shuttle Discovery. A recipient of a NASA Group Achievement award and the Alabama A&M University School of Arts and Sciences Researcher of the Year award, he has published over 180 publications, including two book, book chapters, proceedings, review articles, and NASA TMs. Professor Batra is a member of SPIE, MRS, AES, and AAS. He is an editorial board member of refereed international journal: Advanced Science, Engineering and Medicine.

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Notes:

Pascal Binda et al., J Material Sci Eng 2018, Volume: 7
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Poly(α-methylene-γ-butyrolactone) as potential smart polymeric material for healthcare applications

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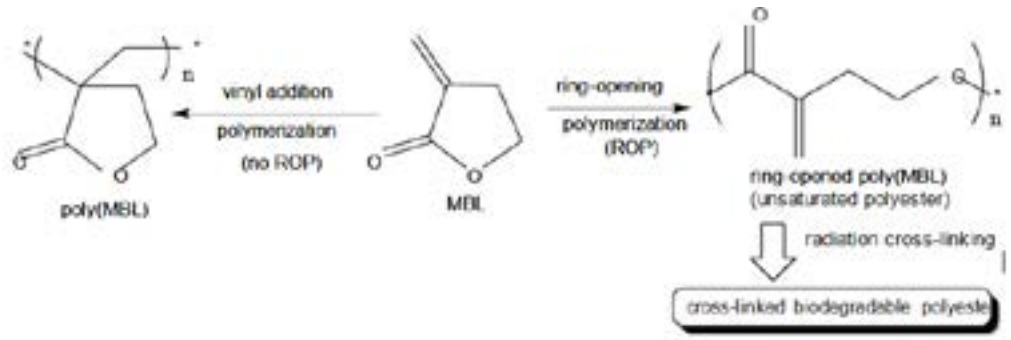
Aliphatic polyesters are commonly applied in bio-medical engineering for drug delivery devices and tissue engineering products because of their biodegradable and biocompatible properties. Unsaturated aliphatic polyesters, such as poly(α-methylene-γ-butyrolactone) (PMBL), are of scientific and technological interest for producing tailor-made functionalized biodegradable shape memory materials due to their exocyclic alkene functionality. Cross-linking in biodegradable polymers, like hydrogels, usually produces shape memory polymers that are sensitive to their environment. Due to unfavourable thermodynamics involved in the ring-opening polymerization (ROP) of MBL, which is from its low strain energy of the five-membered lactone ring that brings about too small negative change of enthalpy (ΔH) to offset a large negative entropy change (ΔS) of its ROP, MBL prefers vinyl addition polymerization to ROP. Therefore, ring-opening homo polymerization of MBL and developing an effective cross-linking strategy will provide a gateway into a smart biodegradable polymeric material for shape-memory applications.



Biography

Binda is an Associate Professor of Chemistry at Savannah State University, USA. He obtained his Ph.D. in 2008 from the University of North Dakota in Grand Forks, ND USA and earned a bachelor's degree in Chemistry (First Class Honors) from the University of Buea in Cameroon. Binda is a member of American Chemical Society Division of Polymer Chemistry.

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Ultra-High Molecular Weight Polyethylene (UHMWPE) material for lithium battery separators

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Ultra-high molecular weight polyethylene is a kind of resin with excellent physical, chemical, mechanical properties and low price.With high mechanical strength and gel-like structure when melting,UHMWPE lithium ion battery separators show better safety properties than traditional separators. In this work, UHMWPE separators were prepared by thermally induced phase separation (TIPS), using liquid paraffin (LP) as diluent. Specified UHMWPE resin for LiB separators with 1.2 million viscosity molecular weight in average was produced by Shanghai Research Institute of Chemical Industry and used as raw material.The UHMWPE resin was dissolved by LP under heat and shear of a twin-screw extruder, then processed to be film. Raw films were cooled through a series of casting rolls and followed with solid-liquid phase separation, where paraffin was extracted from the film by dichloromethane. The film was then drawn to ideal thickness and tested.The preparation process was optimized by Uniform Design, where permeability, tensile strength, puncture intensity and heat shrinkage was considered as key characteristic for the separators.The results were analyzed via DPS (Data Processing System) software by quadratic polynomial regression method. The simulation result show that ideal experiment condition is the extrusion temperature at 225°c, twin-screw speed at 36rpm, solution concentration at 24% and cooling temperature at 55°c. Verification test was then taken place and the results showed that the air permeability of the separator increased by 53% to 820 s/100ml ,the tensile strength increased by 21% to 173 Mpa,puncture intensity increased by 11% to 515 g/20μm, the heat shrinkage decreased by 57% to 1.2%.

Biography

Xinwei Wang has completed his PhD at 2007 from Donghua University. He is now the Vice Chief Engineer of Technology and Research Center and member of Technical and Economic Committee in Shanghai Research Institue of Chemical Industry. He has been rewarded 2017 Shanghai Outstanding Technology Leader, 2017 Houdebang Chemical Industry Award, First Prize of Shanghai Technological Invention 2016, Shanghai Youth Rising-star Award. He has published more than 20 research papers and 10 patents, which lead to more than 3 billion dollar economic benefits in downstream industries.

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A comparison of graphene and graphene oxide fibers in antimicrobial applications

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Airborne and waterborne diseases, caused by the inhalation, ingestion or absorption of pathogenic microorganisms, pose a serious threat to human health. Functionalization of polymeric fibres with antimicrobial agents is an attractive strategy to overcome these concerns. Graphene and graphene oxide have presented themselves as promising materials for the inhibition of bacterial colonization. Here we fabricated a novel class of ultra-thin polymeric fibres loaded with either 2, 4, or 8 wt% of graphene or graphene oxide nanoparticles using pressurized gyration. Electron Microscopy was used to characterize graphene and graphene oxide nanoparticles, as well as fibre morphology. Scanning Electron Microscopy revealed the formation of beaded porous fibres. The concentration of carbon nanoparticles in the composite was found to dictate fibre morphology. As the concentration increased, the average fibre diameter increased, whilst fibre porosity decreased. The antimicrobial activity of these nanocomposite fibres was assessed against both Gram-negative and Gram-positive bacteria. Pure polymer fibres were used as the negative control. The fibres were incubated in bacterial suspensions for 24 hours at 37°C; bacterial colony forming units were enumerated by adopting the colony counting method. The presence of 2 and 4 wt% graphene loaded fibres promoted microbial growth, whilst 8 wt% graphene loaded fibres showed antimicrobial activity. 2, 4 and 8 wt% graphene oxide loaded fibres exhibited excellent antibacterial activities with bacterial reductions of 45%, 70% and 85%, respectively. The results presented in this research have identified a novel application of carbon based hybrid materials.

Biography

Rupy Kaur Matharu has completed her Bachelor's degree in Biomedical Sciences with a first-class honours and her Master's degree in Biomaterials and Tissue Engineering with a distinction. She was awarded the Dean's List for her academic achievement during her Master's degree, where she received 92% for her independent research. She is currently in her second year of doctoral studies at University College London, in which she is focusing on the production of antimicrobial fibres for air and water filtration systems.

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Preparation and Characterization of Poly(ether-block-amide)/Polyethylene glycol Composite Films for Packaging Application

Sarinthip Thanakkasaranee and **Jongchul Seo***
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The microwave markets are expected to witness remarkable growth fueled by consumer demands due to the need for the ease of preparation and portability to consume on the go. The critical problems of microwave cooking are expansion of internal pressure, explosion of package, and migration of chemical compound from the package into the food product during cooking. This issue can be solved by improving the packaging materials and design such as a weak heat seal, shrink-film-covered vent valves, and laser scored or perforated film. However, multiple processes are required to produce such packages, which lead to relatively high production cost. In this study, it is proposed to develop polymer/phase change materials (PCM) films with temperature responsive gas permeability as packaging materials as it have the characteristic of self ventilation and applicable to use in microwave oven by preventing the damages and explosion of packaging during the cooking process. A series of poly(ether-block-amide)/polyethylene glycol (PEBAX/PEG) composite films are prepared by solution casting technique. The permeation properties, morphologies, thermal properties, and water sorption are interpreted as a function of PEG with different molecular weights. The phase change and gas permeation property of composite films are significantly dependent on the molecular weight of PEGs. Incorporation of low molecular weight PEGs (PEG 950-1050 and PEG 3350) into PEBAX matrix showed a lower oxygen transmission rate (OTR) than pure PEBAX films in the measured temperature ranged from 10 °C to a relatively low melting temperatures of each PEGs, which is due to good interaction between PEBAX and PEGs, and an increase in crystallinity of the composite film by introducing PEGs. As the measurement temperature is increased from the melting temperatures of each PEGs to 80°C, the OTR of composite films dramatically increased. The composite films exhibited permeation jumps that occur at the melting point of crystallized phase depending on the molecular weight of PEGs. The composite film incorporated with high molecular weight PEG exhibited highest permeation jump.

Biography

Sarinthip Thanakkasaranee has completed her Master of Science in Packaging Technology from Kasetsart University, Thailand. During her M.Sc., degree, she has received research grant under "The Thailand Research Fund - Master Research Grants (TRF-MAG) Window I " from Thailand Research Fund in 2011. She also won outstanding Master's thesis award in the discipline of physical science, and the excellent student award in the Master's degree program from Kasetsart University in 2012. She had worked in the position of Product Development Executive, SML (Thailand) Co., Ltd. and Innovation Designer and Coordinator, Science and Technology Park, Chiang Mai University (CMU STeP). Now, she is doing Ph.D under a guidance of Prof. Jongchul Seo in the Department of Packaging, Yonsei University, South Korea. She also received the Outstanding Foreign Student Scholarship for her Ph.D. program. She has published 2 research papers in peer-reviewed International Journals and also presented her 4 (2 oral, 2 poster) research results in International Conferences.

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Copper Sulfide Nanodot Decorated TiO_2 Nanotube for Photocatalytic Hydrogen Generation from Water

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Hydrogen energy presents an ideal alternative to fossil fuels in the future because of its high energy capacity, environmental friendliness, and cost-effectiveness. To date, much attention has been devoted to one-dimensional (1D) semiconductor nanomaterials for hydrogen generation due to its stability, catalytic activity and simple fabrication. 1D semiconductor material such as TiO_2 nanotube (TNT) shows potential as a solar photocatalyst for hydrogen generation by its large surface area and superior charge transport property. However, some problems such as large band gap (3.3-3.8 eV) and high recombination rate of the photogenerated electron–hole pairs limits the solar application of TiO_2 as a photocatalyst. Particularly, sensitizer decoration offers an effective strategy to improve the activity of photocatalyst for solar application by extending the photo-response and promoting the separation of photogenerated electron-hole pairs. Recently, copper sulfide (Cu_xS, x is the undefined stoichiometric ratio) family has emerged as a class of effective sensitizers for semiconductor nanomaterials to improve hydrogen generation reaction. The Cu_xS family offers a wide spectrum of derivatives, which are attractive due to their wide absorption band and low reflectance in the visible range, making them promising candidates for solar energy-harvesting. The Cu_xS nanodots (NDs) attached TNTs are fabricated by wet chemistry technique at mild conditions. The morphologies, crystal phase, and optical properties as well as the photocatalytic behavior of the resulted Cu_xS/TNT are elaborately investigated. The results demonstrated that the Cu_xS ND/TNT offers a cost-effective and stable photocatalyst comparable with noble metal decorated TNT for efficient hydrogen generation from water.

Biography

Liu is now pursuing his PhD degree at the Department of Applied Biology and Chemical Technology, the Hong Kong Polytechnic University. He is involved in research projects related to photocatalysis, semiconductor nanomaterial and related characterizations, funded by University Grant Committee (UGC) of Hong Kong. He has published several research papers in international peer-reviewed journals such as *J. Phys. Chem. C, Electrochim. Acta, J. Chin. Polym. Sci., Sci. China Chem., Sci. Rep.,* etc.

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Accepted Abstracts

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About the order-disorder transition in arc melted Fe_3SiAlx soft alloys

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There is an increasing interest in soft magnetic Fe-Si-Al alloys due to their promising properties for applications in various fields; however, all these structural and magnetic properties depend on the structure of the composition alloys The Fe-rich side of the phase diagram of the Fe-Al, Fe-Si and Fe-Al-Si systems presents the same structures; at room temperature, Fe-Al system is characterized by a wide range of ferromagnetic disordered body centered cubic solid solution (A2) up to 22 at.% Al at room temperature. On increasing the Al content, the first intermetallic structure is Fe_3Al with $D0_3$ cubic structure and it exists over the 18-32 at.% Al range. The other stable intermetallic structure is FeAl, which is also cubic with B2 structure (CsCl) and it exists over the range 32-50 at.% Al. The magnetic behavior of ordered Fe-Al alloys is complex in the 27 to 32 at.% Al region where the magnetization actually decreases with decreasing temperature. It was found that partial substitution of Al by Si leads to significantly improved $D0_3$ structural stability against ordered B2 structure and disordered A2 structure. Moreover, there have been extensive studies, both experimentally and theoretically, of order-disorder transitions of Fe-rich ternary alloys. Mutual solid solubility between Fe_3Al and Fe3Si is well-established. The solid solubility and the magnetic behavior of $Fe_3(Al,Si)$ was correlated with the ratio of electron-atom . Polishchuk and Katsnel´son studied the existence of the ordered phases $\alpha 1$ (Fe_3Al and Fe_3Si which have $D0_3$ or BiF_3 type order) and α_2 (FeAl and FeSi which have B2 or CsCl type order) along the Fe_3Al-Fe_3Si section by means of high temperature X-ray diffraction and recording the disappearance of $D0_3$ superlattice (111) and (200) reflections as a function of temperature and composition. In this work, alloys of nominal compositions of sendust Fe_3SiAlX (X =1, 0.75, 0.5, 0.25). The phase purities of the arc-melted ingots were studied by x-ray diffraction using a Rigaku D-MaxB X-ray diffractometer with Cu-Kα radiation. It was found that decreasing Al leads to more disorder in the alloy by the formation of α-Fe solid solution. However, the addition of Al influences both of the lattice parameter and crystallite size of the Fe_3Si phase. Results show that the presence of α_1-$Al_{0.3}Fe_3Si0.7$ with a (422) preferred orientation has been noticed over the 70 at% Fe range.

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The effect of fabrication technique of thin film YSZ/GDC based bi-layer solid oxide fuel cell electrolyte

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Yttria stabilized zirconia (YSZ) and gadolinia doped ceria (GDC) have been reported to be ideal solid oxide fuel cell (SOFC) electrolyte materials due to their outstanding chemical stability and ionic conductivity properties respectively. Notwithstanding these properties, YSZ is known for its low ionic conductivity while GDC exhibit high electronic conductivity and vulnerable to chemical instability. In this study, Anode aluminium oxide-supported thin-film fuel cells having a bi-layered electrolyte consisting of a GDC layer and YSZ layer were fabricated using plasma enhanced atomic layer deposition PEALD technique and electrochemically characterized to investigate the effect of the fabrication technique. The result showed that the PEALD yielded pinhole-free and highly densethin film YSZ/GDC electrolyte which inhibitelectrical shortage and gas leakage. The resulting bi-layered thin-film fuel cell produced a considerably higher open circuit voltage compared with a thin-film fuel cell with a single-layered GDC or bi-layered YSZ/GDC electrolyte fabricated via other methods.

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Analytical modeling of electrical conductivity and magnetic permeability of magnetorheological elastomers

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In this work, the analytical homogenization method is used to model electrical conductivity and magnetic permeability of magntorheological elastomers (MREs). MREs are considered as spherical particulate composites of infinite matrix and spherical particles, composed of simple cubic (SC), body-centered cubic (BCC), and face-centered cubic (FCC) lattices. The analytical homogenization method is used in this work, which combines multiscale method and asymptotic techniques in order to solve for effective conductivity and permeability of MREs. The effect of cluster formation, and particles volume fraction are also discussed as it reaches percolation threshold. Additionally, the impact of external mechanical loads and magnetic field are considered in the solution. The edge effects corresponding to redistribution of the load between components are also considered, which plays an important role in nonhomogeneous composite materials. The employed edge effect model shows good results for transversely isotropic composites, which correspond to aligned MREs with chain-like structures. The analytical solution shows similar behavior of electrical conductivity and magnetic permeability under external loadings or changes in volume fraction. External mechanical loads and magnetic fields show increase in both electrical conductivity and magnetic permeability in particulate composites, although with different rate. Furthermore, the obtained analytical solution in this work, especially the ones obtained for the SC lattice structure, is in good correlation with the results of previous experimental studies obtained for aligned MREs.

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Innovation of graphene fibre composite processing using pressurised gyration

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A simple and effective process combining pressure and gyration has been developed to produce graphene-nanoplatelets-fibres composites using thermoplastic polyurethane (TPU) and phenolic resin (PR) polymers. Processing parameters such as rotation speed, pressure and polymer concentration had a marked influence onthe fibre diameter. Morphological, rheological, physico-chemical and thermal properties of the composite fibres were evaluated to uncover possible application areas of these products. The aim of the work is to develop a novel processing route to generate well dispersed polymer-graphene composite fibres which could be used in fuel cells and in electronic packaging. The pressurised gyration processing conditions, such as vessel rotating speed, working pressure and the polymer concentration used, had a significant effect on fibre diameter. FTIR and Raman spectroscopy analysis confirmed the various bonding characteristics of the hybrid composite fibre structures. Focussed ion beam milling and etching verified the effective incorporation of graphene nano platelets into the fibre composites. The well dispersed and strongly adhered graphene in the polymer matrices will contribute to a unique reinforced polymer composite for many applications. Importantly, the approach is a promising large-scale manufacturing route for producing graphene reinforced composite fibres at low cost that has been developed here.

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Two-dimensional Arsenene as a potential anode material for LIBs, NIBs or MIBs: First principal study

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In view of the interest in new energy storage technologies. A novel architecture using two dimensional (2D) nanomaterials have been widely attracted researcher for designing a new electrode material with nanometer improving the performance of lithium-ion batteries, including Na-ion batteries, Mg-ion batteries In this paper, the first-principles density Arsenene likely to phosphorene are atomic thick material, it is possible to be manufactured in experiment by exfoliating from grey due to the weak interaction between layers of grey arsenic. Functional theory (DFT) calculations are employed to investigate and compare the interaction of Na, Mg and Li ions with arsenene monolayer. The results indicate that the Li, Na and Mg adatom preferably adsorbed on valley sites, with negative adsorption energy of -2.55, -1.91 and -1.10 eV, respectively. Then the ions concentration increased until the full saturation of the surfaces is achieved. The highest capacity estimated to be 358 mA h g^{-1} which is close to graphite and phosphorene capacity. Accordingly, a semiconductor to conductor transition is observed and gives rise to a good electrical conductivity. Furthermore, the diffusion barrier energies of Li, Na and Mg ions are calculated using utilized nudged elastic band method. The activation energy barriers of these ions show isotropic behavior for different pathway (X, Y and diagonal direction) where the obtained values are 0.16, 0.05 and 0.016 eV, for Li, Na and Mg ion, respectively. Our findings show that the high capacity, low open circuit voltage, ultrahigh barrier diffusion makes the arsenene a good candidate for application as an electrode material for Li (Na or Mg) batteries.

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Converting glassy carbon into amorphous diamond

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Diamond owes its unique mechanical, thermal, optical, electrical, chemical, and biocompatible materials properties to its complete sp3-carbon network bonding. Crystallinity is another major controlling factor for materials properties. Although other Group-14 elements silicon and germanium have complementary crystalline and amorphous forms consisting of purely sp3 bonds, purely sp3-bonded tetrahedral amorphous carbon has not yet been obtained. In 2011, Lin et al found that glassy carbon was converted into a new carbon allotrope with a fully sp3-bonded amorphous structure under high pressure of about 45 gpa. However, the transition was reversible upon releasing pressure. In this study, by using a diamond anvil cell coupled with in situ laser heating, we explore a P-T range rarely studied before for the carbon system. Using glassy carbon as a starting material, we synthesize an sp3-bonded tetrahedral amorphous carbon which can be recovered to ambient conditions, i.e. Quenchable amorphous diamond. With the aberration-corrected TEM, some fragmented curved graphene can be observed in the amorphous carbon (Fig. 1a). The EELS of glassy carbon shows a sharp pre-peak at ~285 ev that corresponds to π bonding, as a result of its nearly 100% sp2 bonds. This pre-peak is not present in the EELS of the nanocrystalline diamond due to its purely sp3 bonds. Similarly, the EELS pattern of the recovered carbon sample has no pre-peak, implying its atoms should be fully sp3-bonded like those in crystalline diamond. This amorphous carbon form converted from glassy carbon is fully sp3-bonded, optically transparent, dense, and is named quenchable "amorphous diamond". The structure, bonding, and properties of quenchable amorphous diamond are investigated using XRD, high-resolution transmission electron microscopy, electron energy loss spectroscopy, and ab initio molecular dynamics simulation. Amorphous diamond is optically transparent, dense, and shows ultrahigh incompressibility (bulk modulus) comparable to crystalline diamond.

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Fabrication, characterization and application of graphene-polymer nanocomposites; a review

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As graphene has developed into an advanced carbon nanomaterial, it is logical to add graphene to polymeric composites either in bulks or as fibers to enhance their performance and implement functionalities. It is reasonable to expect some significant improvement in a range of properties in the composite with grapheme as nanaofiller. Polymer matrix Nano composites with grapheme and its derivatives as fillers have shown a great potential for various important applications, such as electronics, green energy, aerospace and automotive industries. There are three main methods for incorporation of grapheme into polymer matrices that are commonly used. The main methods are; in-situ polymerization, melt intercalation technique and solution mixing. Significant improvement in strength, facture toughness and fatigue strength has also been achieved in nanocomposites. These factors can be altered by the fabrication process and methods. The advantage of grapheme in comparison with other fillers is that it allows for large changes in the properties of composites. Therefore, grapheme-polymer nanocomposites have demonstrated a great potential to serve as next generation functional or structural materials.

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Synthesis and characterization of dental light-cured composites based on modified organic resins and nanofillers

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Restoring both anterior and posterior teeth with resin-composite materials is now an established clinical procedure. Dental composites are popular in the field of dentistry due to superior aesthetics, mechanical and physical properties. The current project has been divided in two parts firstly nanofiller (hydroxyapatite) was modified with gamma-(Methacryloyloxy)propyl] trimethoxysilane (γ MPS), by silanization process. The particle size, pore width and morphological status of nanofillers were found out by XRD, BET and SEM studies respectively. In the second part hyperbranched aliphatic polyester were methacrylated and were used to formulate dental composites by photopolymerization in presence of camphorquinone (CQ) as photoinitiator, dimethylaminoethyl methacrylate (DMEM) as coinitiator along with bisphenol A glycidyl methacrylate (BisGMA) and triethyleneglycol-dimethacrylate (TEGDMA) in 70:30 ratio. The concentration of methyl methacrylate varied in the resin mixture and its effect on different properties like degree of conversion, polymerization shrinkage, mechanical (micro Vickers hardness, compressive and flexural strength) were investigated. All these formulated resins, with partly methacrylated hyperbracnched polymer H20, have much higher double bond conversion and less linear polymerization shrinkage. High molecular weight multi-methacrylates have been considered as one of the most promising resin systems to reduce the shrinkage and improve the mechanical strengths of dental restorative composites. Thus, it can be concluded that these composites can be used in dentistry to produce promising effects.

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High shear thin film fabrication of nanocarbon

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Thin film microfluidics is developing for a wide range of applications, and includes the synthesis of various types of nanocarbon material, involving both 'top down' and 'bottom up' continuous flow processing. Such processing addresses scalability at the inception of the science, and is applicable not just to the synthesis of nanocarbon, but also composites or hybrid material where one or more components is nanocarbon. We recently developed the vortex fluidic device (VFD) as a thin film microfluidic platform where the liquid is subjected to shear stress (mechanical energy) in a rapidly rotating tube. The shear stress offers scope for controlling the shape, morphology and size of carbon nanomaterial, with the prospect of high green chemistry metrics of the processing. Applications of the VFD are many and varied, and for nanocarbon we have established (i) the formation of toroidal arrays of SWCNTs with control over their diameter, (ii) the slicing of SWCNTs, DWCNTs and MWCNTs while the thin film is irradiated with a 1064 nm wavelength pulsed laser, in the absence of harsh chemicals, exfoliation of graphite, and (iii) assembling fullerene C60 into nanotubules in the absence of surfactants. Other aspects of composite structures of nanocarbon generated in the VFD for both confined mode and continuous flow mode will be presented.

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Smart biosensors - wearable biosensors in medical care

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Smart technology is certainly something that will be the key to the optimal operation of our future society, especially when it comes to health care. Today, the industry of medical care and control has undergone significant changes owing to a wide range of facilities and services; these changes include more emphasis on prevention, recognition of primary risks, proper education of users, new ways of health care, and people's authority in control of their personal health. Considering significant advances in science and technology such as basic developments emerging in the fields of micro/nanotechnology, wireless communication, information technology, and biomedical sciences during the past one decade. In fact, one of the ways to improve the quality of care in the health care industry is through application of new technologies. One of the new technologies in the field of health is wearable biosensor, which provides vital signs monitoring of patients, athletes, premature infants, children, psychiatric patients, people who need long-term care, elderly, and people in impassable regions far from health and medical services. These biosensors provide vital signs monitoring of patients, athletes, premature infants, children, psychiatric patients, people who need long-term care, and people in impassable regions far from health and medical services, and they are significantly effective in the prevention, timely diagnosis, control, and treatment of diseases.

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Novel frequency conversion devices and optoelectronic devices based on 2D materials

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Graphene and other two-dimensional (2D) materials have captured extensive research interests due to its outstanding electronic, optical, mechanical, and thermal properties. Here, we will show several novel frequency conversion devices and optoelectronic devices based on 2D materials. We achieved two kinds of novel frequency mixer based on graphene photodetectors. One can mix optical signal and electronic signal directly and the other one can mix two optical signals directly. With ambipolar graphene, we achieved frequency tripler and frequency quadrupler. We also integrated graphene photodetectors onto silicon integrated circuit chips to achieve a prototype monolithic optoelectronic integrated optical receiver. These novel RF devices and optoelectronic devices based on 2D materials achieved in our group show unique properties as comparing with traditional bulk semiconductor material.

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Charge transport in disordered graphene

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Since the exploration of fullerenes (C_{60}), carbon-based materials have the subject of intense research, which led to the exploration of carbon nanotubes and the fabrication of individual one-atom thick graphene layers. These systems share a similar underlying electronic structure, whose exact details depend on confi nement effects, crucial differences emerge when disorder becomes into play. The transport properties of these materials considered with particular affirmation on the case of graphene nanoribbons which the presence of the edges exposes the system to further sources of disorder. The electronic transport properties of boron doped armchair ribbons shown, by means of ab initio calculations, to depend strongly on the symmetry of the ribbon, as B-induced potentials that preserve the parity of the wavefunctions do not affect the conductance of odd indexed ribbons at low energies. Scattering investigete by certain defects might be repressed, provided that the defects preserve the underlying symmetric geometry of the ribbon. Transport properties in graphene-based materials also turn out to be strongly affected by disorder, which can originate from impurities such as charges trapped in the oxide, chemical impurities, etc., topological defects such as vacancies, edge disorder..., or long range deformation modes (ripples) in 2-D graphene. The analytical expressions for the elastic mean free path of carbon nanotubes and graphene nanoribbons, and discuss the onset of weak and strong localization regimes, which are genuinely dependent on the transport dimensionality. The effects of edge disorder and roughness for graphene nanoribbons consider in relation to their armchair or zigzag orientation. The study with Anderson disorder indicates that even in the strongest case of short range scattering potential (with possible short range potential fluctuations as large as 1 eV), the computed 2-D localization lengths remain in the range of several hundred nanometers to microns. The results show to observe weak and strong localization regimes, the presence of edges as well as a reduced lateral size are essential factors. Nanoribbons with zigzag symmetries are even more spectacularly sensitive to disorder owing to the edge state-driven lower transport dimensionality. In contrast, for charge carrier energies lying in the higher energy subbands, the properties of nanotubes and ribbons provied similar features, with strong energy dependence of elastic mean free paths and localization phenomena.

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The convergence of technologies, generates convergence in the regulations

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The convergence of nanotechnologies generates synergies among different technologies to say, nanotechnologies, neurotechnology, computers and biotechnology, these technologies must converge their regulations, the application of medical devices in nanotechnologies should lead us to a link between the technical committee TC 210 and ISO technical committee 229 link that does not exist in our work in this moment In this do an analysis of the management of risk from an optical NC-ISO 14971.Studying the global trend in this respect as imported for manufacturers medical Devices worldwide. The convergences of technologies is a consequence of atomic precision, where the boundary between the biotic and abiotic mute blur the interaction. The interaction between nanotechnologies, biotechnology and informatics and communications (NBI) generates a synergy of unusual consequences of all is known that the industry of semiconductor is the one of greater precision that is atomic, the new medical devices that will be applied in the teranocis will dose Physical principles that will be governed under the laws of quantum mechanics, but there are two problems that have not been solved even though they are one the non-existence of quantum biology and the transition from quantum to classical mechanics. On the other hand, the redefinition of the international system of units based on the universal constants that will be implemented by 2018 has a deficiency that is the second that redefirms implies redefinition of the meter the chain of traceability proposed for nanometrology presents a serious difficulty when putting the microcopy of atomic force wing of effect tunnel situation that is changing the verification of the Wiedemann-Franz law at atomic level yields a result where the phononic component is taken into account, a result that launches STM to the cusp of the chain of traceability above inclusive of interferometry.

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A rapid and sensitive detection of glutathione using nanostructured V_2O_5 mimicking the oxidase activity as inorganic nanozyme

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Glutathione detection has been one of the important and critical line of investigations for biotechnologists in recent years. Herein, we introduce vanadium pentoxide nanosheets (V_2O_5 NS) as a novel nanozyme mimicking peroxidase reaction as a fast selective colorimetric assay for the detection and quantification of glutathione (GSH). The V_2O_5 NS have been prepared by ultrasonication assisted exfoliation of bulk V_2O_5 and characterised. The present process involves catalysis by V_2O_5 in the oxidation of pale yellow 3,3′,5,5′,-tetramethylbenzidine (TMB) to blue color with an absorption peak centered at 650 nm. On introduction of GSH, a fading in deep blue color of oxidized TMB occurs with a simultaneous decrease in absorbance intensity at 650 nm, indicating the sensitivity of V_2O_5 catalysed reaction. Also, GSH selectively inhibits this reaction with a detection limit of 10 nM. The high specificity of inhibition by GSH allows this system to be used for determination of GSH concentration in human serum samples. This method is simple, fast and cost effective and can evolve as a potential method in discriminatively detecting GSH.

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Design and analysis of a magneto-rheological damper for an all terrain vehicle

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A shock absorber design intended to replace the existing conventional shock absorber system with a controllable system using a Magneto-rheological damper is introduced for an All Terrain Vehicle (ATV) designed for Baja SAE competitions. Suspensions are a vital part of an All Terrain Vehicles as it endures various surfaces and requires utmost attention while designing. COMSOL multiphysics software is used for applications that have coupled physics problems and is a promising new tool that aids in designing complex problems. The model is optimized using Taguchi model using DOE software. A unique model based on finite element analysis is generated using COMSOL multiphysics platform to model, analyze and interpret the observed results. The magneto-rheological damper is designed to maximize the damping force with measured geometric constraints. The MR damper makes use of the properties of the magneto rheological fluid, a smart material, which alters its physical behaviour with actuating magnetic field. The varying terrain endured by an ATV makes it necessary for the variable damping properties that can be introduced by the magneto-rheological damper to be put into use.

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Methanol sensing material based on conductive polyindole

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Polyindole (PIn) was applied as methanol sensing material in this work. The electrical conductivity change of PIn was monitored at room temperature. The electrical responses of PIn under various vapors from non-polar, low polar, and high polar solvents were also investigated; the highest relative responses of conductivity were observed when exposed to vapors from high polar solvents, especially methanol possessing the highest dielectric constant and hydrogen bonding interaction compared to other vapors inducing the highest interaction to PIn. The discrimination analysis of sensor was evaluated by the principal component analysis (PCA), it was demonstrated that the sensor possessed the good discrimination efficiency towards high polar vapors. Moreover, the sensor response depended on the doping mole ratio, the dPIn/$FeCl_3$ with the doping mole ratio of 10:1 provided the highest relative response of conductivity of 57.83 at the low concentration of 11.36 ppm, which nitrogen was used as a base gas. The sensitivity to methanol vapor obtained from the calibration curve in the methanol concentration range of 1.14-11.36 ppm was 5.27 ppm^{-1} with the correlation coefficient (R2) of 0.9965, and the theoritical limit of detection was as low as 0.048 ppm. The sensor based on the dPIn/$FeCl_3$ 10:1 reported here is a good candidate for use as a methanol sensing material.

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Performance characteristics of radially poled piezoelectric fiber in viscoelastic matrix composite structures

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Piezoelectric composite structures are widely used as components of adaptive structures due to their superior sensing and actuating capabilities. Such composites are usually made of piezoelectric fibers embedded in an elastic matrix, and for damping application, the fibers are embedded in a viscoelastic matrix. The micromechanical modeling of piezoelectric composites aims to find a coupled multiphysics static solution when the matrix is elastic, while the solution is frequency dependent for a viscoelastic matrix. Many research works related to the piezoelectric fiber composite have been published, both for elastic and viscoelastic composite matrix. However, the work published so far considered only piezoelectric fibers poled in the fiber direction. In this work, the michomechanical model for a radially poled piezoelectric fiber in a viscoelastci matrix will be formulated and numerically solved using the finite element method. The full set of the homogenized electromechanical properties of the composite will be determined. The stiffness and damping characteristics of the composite will be studied and compared with the common case where the piezoelectric fibers are poled in the fiber direction.

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Cutting and extruding processing technology for ceramics based on edge-chipping effect

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Edge-chipping referred to the fact that the edges of hard, brittle materials are easily broken during processing. This problem has brought many difficulties to their quality control. In fact, it was that the machining process itself destroyed materials, even though it could be controlled. Based on this principle, a new machining technology based on crack propagation driven by edge-chipping effect was proposed here. Multiple flanges caused by the cutting could increase the number of edges. Additionally, the fracture defects were prefabricated on the surface of flanges. When the turning tool made of cemented carbide came into contact with the surface of the ceramics, under the intermittent impact. The fractures were generated on the sides of flanges contacted with the tool and the prefabricated micro cracks were expanded rapidly under this three-dimensional stress field applied externally by the tool. In addition, due to the stress release toward the free surface, the cracks would expand to the surfaces of newly generated edges and the chips would be broken off continuously, resulting in irregular edge-chipping and removal of material pieces. Furthermore, based on the spatial distribution of grayscale images, the surface quality after rough processing under the different conditions was reasonably reflected with the grayscale co-occurrence matrix (GLCM). With the new processing technology, these cracks became advantageous under specific conditions. Therefore, the high external energy and ultra-hard tools required for the traditional processing technologies could be significantly reduced, and the ceramics could be removed with less energy consumption and the tools with the hardness of lower than its own one. Therefore, it not only could reduce the processing costs, but also could promote the extensive applications of engineering ceramic materials.

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Electro-mechanical impedance-based damage detection of concrete beam under impact loading

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Ship and vehicle collision with pier can trigger catastrophic calamity on bridge structures. It is essential to quantify the collision damage degree of pier after collision and to take steps for preventing the full structural failure. The novelty in this paper is the development of a relationship of the root-mean-square deviation (RMSD) index and the damage volume ratio of bridge pier after collision that allows for the quantification of damage degree of concrete based on the observed impedance signatures. The bridge pier is simplified to a concrete beam subjected to continuous impact loading by a freefalling steel ball. The concrete damaged plasticity constitutive model is utilized in numerical analysis to simulate the damage development of concrete beam under impact loading. The RMSD is used as a damage index to quantify and evaluate the variations in admittance signals measured by lead-zirconate-titanate (PZT) patches and compared to the damage volume ratio computed by numerical analysis. The results demonstrate that the RMSD index and the damage ratio of concrete have good agreement. The Electro-mechanical impedance (EMI) technique based on PZT patches can keenly detect the impact damage of concrete and the RMSD index can effectively quantify the damage degree of concrete caused by impact loading.

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Reinforcement of polymer composite with graphene; A review

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The replacement of heavy weight steel by other material stronger than steel but much lighter than steel is needed. Though some polymers meet this requirement to some extent, their strength has not been very satis-factory. Graphene with suitable polymer can satisfy various require-ments. An illustration of that is good mechanical, thermal, electrical, flame retardant properties, etc. However, these special properties of graphene composites with polymer largely depends on the distribution of graphene in the polymer matrix. It also depends upon the interfacial bonding between polymer and the graphene. Therefore, the properties of the composites depend upon the method of preparation. Researchers have found that adding graphene to epoxy composites may result in stronger/stiffer components than epoxy composites using a similar weight of carbon nanotubes. Graphene appears to bond better to the polymers in the epoxy, allowing a more effective coupling of the graphene into the structure of the composite. This property could result in the manufacture of components with high strength to weight ratio for such uses as windmill blades or aircraft components.

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Applications and prospects of graphene in oil and gas industry

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Graphene was attracted a widespread attention recently years because of its unique atom-thick two dimensional structure and excellent properties. Graphene materials have been applied in energy storage and conversion, catalysis, electronic, high strength material, chemical and biosensor and biotechnology fields. With the decline of conventional oil and gas resource, unconventional oil and gas resource and complex well increased gradually. The drilling technology encountered new challenge. We reviewed the research and application of graphene materials in oilfield based on the requirement of drilling technology, and discussed the prospect of graphene material in oilfield.

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Enabling distributed networks for connected vehicles

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Since last few years, Smart City and related projects are evolving rapidly so users are shifting from local server to community data centers. Therefore, smart city markets are desperately in need of solutions that can improve safety of people, security of vehicles, reduce the cost of ownership. This talk focus of the convergence of the distribute networks and automotive technology towards the visualization pattern and smart city services. However, Internet of Vehicle (IoV) is an emerging concept of computing technology which is a fast emerging as a successful extension to existing Internet in an embedded automotive sensor devices in recent years. Researchers have visualized interconnections of billions of smart embedded devices to change the way of life. Therefore, several IoV and M-2-M initiatives going on to the development of the sensing technologies for the automotive technologies especially in machine-to-real-world and machine-to-humans. The resultant of the IoV objects are to utilized embedded technologies to monitor, control for the comfortable and secure Driver and vehicles life.

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Tuneable and large area μ-patterns of reduced graphene oxide for flexible electronics

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Recently, two-dimensional (2D) layered materials such as graphene and analogous graphene oxide (GO), reduced graphene oxide (rGO) with novel functionalities have absorbed attention of scientific community for electronics applications such as such as sensing, supercapacitors, interconnects, ultra-fast photonics and flexible nano-electronic devices (FETs). Graphene based flexible devices is an emerging field, however the challenges such as large area, low cost growth and scale up synthesis restricts the use of graphene. Therefore the synthesis of graphene has evolved with time and several methods have been demonstrated. As an alternative, the solution processable rGO, obtained via reduction of GO was studied, although, the long term stable dispersion of aqueous rGO hinders its commercial scale applications. Therefore, in the present work we demonstrate a facile and swift and photo-catalytic approach for the preparation of rGO dispersion stable for ~160 days. The stable rGO dispersion may be useful as conductive inks for flexible electronics, conductive electrodes, interconnects. In addition we also present, a tuneable, site specific, scalable and low temperature pattering of GO-rGO films under UV illumination (λ ~365 nm) for circuit elements interconnects and all rGO based flexible FET applications The electrical measurements reveals that the conductivity of the completely exposed rGO is considerably (~150 times) higher than unexposed GO, suggesting the use of rGO in circuit elements, interconnect and flexible electronic applications. The tuneable GO reduction approach is adopted for the fabrication of all-carbon, metal free- rGO-FET, on flexible substrates. On tuning the intensity of UV illumination, the partially exposed rGO was used as a semiconducting channel, while the completely exposed rGO was used as source/drain/gate electrodes The low temperature, site specific, scalable and large area GO-rGO patterning is found to be advantageous wearable flexible and lighter electronics applications.

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