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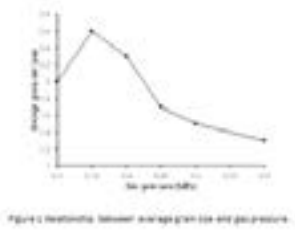
Konatsu Kamimoto, Nano Res Appl 2019, Volume 05

Rapid sintering of unique material of LNT (Li_2O-Nb_2O_5-TiO_2) with periodical structure by air pressure control

Konatsu Kamimoto

Toyohashi University of Technology, Japan

In the Li_2O-Nb_2O_5-TiO_2 system, $Li_{1+x-y}Nb_{1-x-3y}Ti_{x+4y}O_3$ ($0.05 \leq x \leq 0.3$, $0 \leq y \leq 0.182$) (LNT) forms with a superstructure known as the M-phase, which is formed by the periodical insertion of an intergrowth layer in a matrix with a trigonal structure. To apply this unique structure as a host material of phosphor, new phosphors have been investigated based on LNT or related structures made by a conventional electric furnace. However, the synthesis of a homogeneous M-phase required treatment at 1373 K for over 24 h. The sintering time depended on the Ti content, and annealing was repeated in an electric furnace for 24–264 h until a homogeneous structure was formed by the insertion of periodical intergrowth layers. Accordingly, a fast sintering technique that uses lower energy is required for the practical application of this material as phosphors and electro ceramics. This time, we pioneered a new rapid sintering technique, which uses a simpler furnace that only requires the control of air pressure. The LNT solid solution material, with various Ti content of 15-30 mol%, was sintered at 1273 K-1373 K for 30 min-1 h under various air pressures (0.35 MPa–0.60 MPa) using the newly developed an air-pressure control atmosphere furnace (FULL-TECH FURNACE CO., Ltd., Osaka, Japan). To clarify the mechanism of the rapid sintering, various microscales to nanoscale characterization techniques were used: X-ray diffraction, a scanning electron microscope, a transmission electron microscope (TEM), a Cs-corrected scanning TEM equipped with electron energy-loss spectroscopy and X-ray absorption fine structure spectroscopy. As a result, the biggest grain of LNT with Ti 20 mol% could be synthesized at 1373 K for 30 min under 0.35 MPa. It was confirmed that a homogeneous phase was obtained from the TEM image and selected area electron diffraction (SAED) patterns from the [010] axis. We concluded that through the control of air pressure, the interstitial oxygen enabled rapid sintering with a combination of vacancies, and that accordingly, grain growth and the distribution of Ti ions improved somewhat surprisingly.



Recent Publications

1. H Nakano, K Kamimoto, T Yamamoto and Y Furuta (2018) Rapid sintering of Li_2O-Nb_2O_5-TiO_2 solid solution by air pressure control and clarification of its mechanism. Materials 11(6):987.
2. H Nakano, K Kamimoto, N Yokoyama and K Fukuda (2017) The effect of heat treatment on the emission color of P-doped Ca_2SiO_4 phosphor. Materials 10(9):1000.

Biography

Konatsu Kamimoto is a pursuing her Graduation in the Department of Environmental and Life Sciences of Toyohashi University of Technology. She entered Toyohashi University of Technology in 2016. She belongs to the Inorganic Materials Laboratory, and she is doing synthesis and physical property evaluation of phosphors. Currently, she is focusing on elucidating the relationship between the crystal structure of the phosphor and the luminescent properties and analyzing the mechanism.

k163413@edu.tut.ac.jp

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Andrea Cacciatore et al., Nano Res Appl 2019, Volume 05

Thermochromic cement-based envelopes as dynamic cool materials for buildings' energy efficiency

Andrea Cacciatore, Claudia Capone, Tiziana De Marco and **Flavio Rampinelli**

HeidelbergCement Group, Italy

This paper reports a selection of results achieved in the framework of the Italian funded project "COOL-IT". The study evaluates thermal/optical characteristics of experimental cement-based thermochromic envelopes for buildings energy efficiency applications. In Europe, 50% of the energy consumption of the building sector, and related GHG emissions, concerns heating and cooling systems consumptions, with cooling energy demand expected to rise significatively by 2050. The design and use of selected cool concrete building envelopes for future sustainable cities can contribute to decrease buildings energy loads - mainteining indoor thermal comfort too-as well as to mitigate urban heat island phenomenon. Within this context, the use of thermochromic cementitious materials for buildings energy saving has been investigated. Experiments with cement-based coatings and mortars have been performed, incorporating microincapsulated thermochromic pigments (commercially available) of organic nature having a selected transition temperature of 31°C. At lower temperatures, the thermocromic products appear grey (Dark Phase) while, when exposed to higher temperatures, they enhance their solar reflectance becoming whiter (White Phase). Higher values of total solar reflectance result in lower surface temperatures, thus building cooling loads and urban overheating are decreased too. An accelaretd test method has been set up to evaluate aging of thermochromic coatings. The results show a good compatibility of some selected pigments with cementitious matrix and their poor stability over time (few hours), due to phtodegradation under UV and VIS radiations.

Biography

Andrea Cacciatore is a Senior Researcher in GPI (Global Product Innovation)-Italcementi SpA, where he has been working since 2007. He has completed his MSc in Materials Engineering from Università del Salento studying hydrothermal and mechanochemical synthesis of titania-graphitic composites materials. His R&D work focuses on smart materials for building applications, taking into account in particular photocatalytic, cool, and Graphitic Related Materials. Since 2007 he has been involved in the concrete applications of dynamic and static cool materials in the freamwork of the Italian founded Project COOL IT.

a.cacciatore@italcementi.it

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Grazvydas Kazokaitis et al., Nano Res Appl 2019, Volume 05

Spherical piezoelectric drive

Grazvydas Kazokaitis and **Vytautas Jurenas**

Kaunas University of Technology, Lithuania

Piezoelectric magnetic drive is a device which uses two piezoelectric actuators for precise 3 degrees of freedom (DOF) rotation of sphere-shaped rotor. Mechanical part of this drive described further: sphere-shaped rotor inserted between two piezoelectric actuators. These ring-shaped piezoelectric actuators have polarization in axial direction and one of the electrodes is devided into three equal sectors. Each segmented electrode is excited by separate harmonic signal. All three electrodes can be excited independently i.e. three channels generator is used to drive actuator. Amplitude and duration of the applied signal depends on rotation velocity and motion trajectory of the sphere. The out-of-plane bending and radial vibrations of the piezoelectric rings are excited to obtain elliptical motion of the contacting points and to rotate magnetic sphere in desired direction. In addition, it must be mentioned that actuator can be driven by burst type signal in order to achieve positioning of the sphere with very high resolution. Described system could be used for applications, where precise 3 DOF rotational control of the sphere-shaped rotor is needed. Few examples of such applications: space and attitude control of the satellites, laser beam control, precise mirror deflectors and etc.

Recent Publications

1. Bansevičius, Ramutis Petras, Mažeika Dalius, Jūrėnas Vytautas, Kulvietis Genadijus and Bakanauskas Vytautas (2016) Development of traveling wave actuators using waveguides of different geometrical forms. Shock and Vibration. New York: Hindawi publishing corporation. 2016 (4101062):1-9.
2. Grybas Ignas, Bansevičius Ramutis Petras, Jūrėnas Vytautas, Bubulis Algimantas, Janutėnaitė Jūratė and Kulvietis Genadijus (2016) Ultrasonic standing waves-driven high resolution rotary table. Precision engineering. New York, NY: Elsevier. 45:396-402.
3. Sakalys Rokas, Janusas Giedrius, Palevicius Arvydas, Cekas Elingas, Jurenas Vytautas and Sodah Amer (2016) Microstructures replication using high frequency excitation. Microsystem technologies. Berlin: Springer. 22(7):1831-1843.
4. Ostasevicius Vytautas, Markevicius Vytautas, Jūrėnas Vytautas, Žilys Mindaugas, Čepėnas Mindaugas and Kižauskienė Laura Gylienė Virginija (2015) Cutting tool vibration energy harvesting for wireless sensors applications. Sensors and actuators A: Physical. Lausanne: Elsevier. 233:310-318.

Biography

Grazvydas Kazokaitis has experience in design and R&D fields developing small and precise mechanisms for ultra-fast laser beam control and machining apparatus. This experience allows provide solid foundation and knowledge creating possible solutions for laser beam orientation mechanisms between small units in space, attitude control and other control tasks.

grazvydas.kazokaitis@ktu.edu

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Sonia Norouzi Esfahany et al., Nano Res Appl 2019, Volume 05

Tunning switch temperature of shape memory polyacrylamide hydrogel

Sonia Norouzi Esfahany, Mehrdad Kokabi and **Ghazaleh Alamdarnejad**

Tarbiat Modares University, Iran

In this work, chemically cross-linked polyacrylamide (PAAm) hydrogel prepared by free radical polymeriztion. The effect of water content on glass tarnsition temperature (Tg) of hydrogel, as switch temperature of shape memory system, was investigated using dynamic mechanical analysis (DMA). The transition temperature, i.e. the desired switch temperature for our work, was chosen around ~ 30°C by tunning the water content of hydrogel at 25%, Fig. 1. Shape memory behaviour of chosen hydrogel was investigated for a full cycle, i.e. four steps, by DMA. The four steps procedure performed at a constant heating/cooling rate of 5°C.min-1. First, the sample was heated to 50°C (above the switch temperature) and stretched to a certain strain (ε) under a constant force (Step 1). Then, the deformed sample was cooled to -50°C under the fixed force (Step 2). The force then removed and the temporary strain was measured (Step 3). Finally, the sample was reheated to 50°C and kept for 50 min in this temperature, then the recovery strain recorded (Step 4). The shape fixing ratio and shape recovery ratio as the main characteristics of shape memory polymeric system calculated from Fig. 2. The results indicated that the shape fixing ratio and shape recovery ratio of the system were 96% and 78%, respectively. Recovering to orginal shape was started around 10°C. The sample showed good shape fixity because of existence the hydrogen bonds between PAAm and water. Hydrogen bonds as physical cross linkers could improve structural strength of the sample.

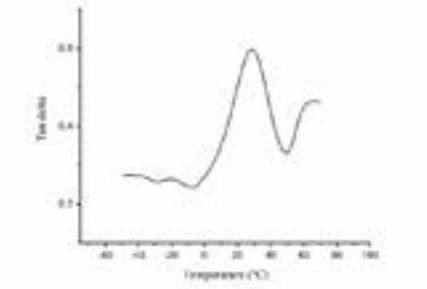

Fig 1. DMA curve PAAm with 25% water.

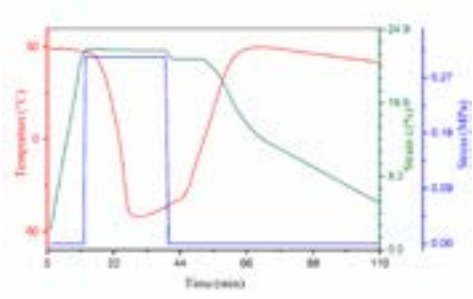

Fig 2. Shape memory behavior of PAAm with 25% water.

Biography

Miss S. Norouzi Esfahany has just completed her MSc from Tarbiat Modares University. This article is a portion of her MSc thesis.

Snes.69@gmail.com

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Synthesis of novel perovskite materials $NaNbO_3$ doped with sulfur

Adnan Ali, Brahim Aissa and **Fadwa El Melluohi**

Qatar Environment & Energy Research Institute-Hamad Bin Khalifa University, Qatar

The study herein reports the synthesis of $NaNbO_3$ powders doped with sulfur. Sulfur doped $NaNbO_3$ was synthesized by mixing precursors $NbCl_2$, $Na_2S_2O_3$ and sulfur in PTFE chamber of stainless steel hydrothermal unit and heated at 200°C for 20h. Powdered obtained after centrifugation was calcinated was at 400°C for 2h in N_2 controlled environment in a tube furnace. The morpho-structural and optical properties of the obtained materials were analyzed by X-ray diffraction (XRD), scanning electron microscopy (SEM)/electron probe microanalysis (EPMA) and ultraviolet-visible (UV-Vis) spectroscopy. Electron probe microanalysis has confirmed 12.6% (atomic) of sulfur doping into $NaNbO_3$. Compared to pristine $NaNbO_3$; energy band gap widening and XRD peaks shifting and broadening have observed for sulfur doped $NaNbO_3$ powders. This energy band gap widening is vital and could be a novel Pb-free candidate for Perovskite Solar Cells and other applications. This study opens the doors for further investigations of sulfur doping into $NaNbO_3$ perovskite structure to optimize the doping concentration which results in optimum opto-electrical properties and open a broad spectrum of applications for this novel material.

adali@hbku.edu.qa

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Direct fiber feeding injection molding technology for the production of long-fiber reinforced plastic composite materials

Ahmed Khalil

Donghua University, P R China

It is a new technology developed by our research group which is a modified form of already existing injection molding technology however, it is capable of producing long fiber reinforced composite plastic structures for the first time in the history. It is a unique technology which enables the incorporation of continuous filaments directly into the injection molding machine through a vent hole provided above the machine's barrel, rather than feeding chopped fibers through the hopper. The vent provides an additional feature to exhaust the toxic and unwanted gases produced inside the barrel zone during the resin melting process as well. Similarly, screw has also been redesigned to avoid material from spilling out of the vent hole during screw's rotation process inside the machine barrel. Until now, numerous tests have been conducted on the polymer composites produced by this new technology and nearly all the results have clearly shown a remarkable improvement in the material's properties from various perspectives molded by DFFIM than that by conventional injection molding machine.

khalil.textile11@gmail.com

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Next generation smart infrastructure using shape memory alloys

M Shahria Alam

University of British Columbia, Canada

Shape memory alloys (SMAs) are special materials with a substantial potential for various structural engineering applications. The novelty of such materials lies in their ability to undergo large deformations and return to their undeformed shape through stress removal (superelasticity) or heating (shape-memory effect). In particular, SMAs have distinct thermomechanical properties, including superelasticity, shape-memory effect, and hysteretic damping. These properties could be effectively utilized to substantially enhance the safety of civil infrastructures against seismic hazards. This presentation examines the fundamental characteristics of SMAs, the constitutive material models of SMAs, and the factors influencing the engineering properties of SMAs. Some of the potential applications of SMAs in buildings and bridges are discussed, including the reinforcement and repair of structural elements, and the development of kernel components for seismic devices such as piston based self-centering devices, dampers, restrainers and isolators. The presentation synthesizes existing information on the properties of SMAs, presents it in concise and useful tables, and explains different alternatives for the application of SMAs, which should motivate researchers and practicing engineers to extend the use of SMAs in novel and emerging applications.

shahria.alam@ubc.ca

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A low-cost, high-performance, high-durability fuel cell

Liang An

The Hong Kong Polytechnic University, Hong Kong

In this work, we propose to create the cathode potential by introducing a redox couple to the cathode while to use hydrogen peroxide to chemically charge to redox ions, as illustrated. The introduction of the redox couple to the cathode brings the following striking features. First, the absence of hydrogen peroxide in the reduction reaction eliminates the mixed-potential issue. Second, the presence of the redox couple in the reduction reaction significantly improves the electrochemical kinetics, thereby resulting in a high-performance fuel cell. Lastly, the use of the catalyst-free carbon materials for the reduction reaction makes this fuel cell system more cost-effective. It has been demonstrated that the fuel cell running on ethanol with a redox couple of V (IV)/V(V) yields a peak power density of 450 mW cm^{-2} at 60°C, which is 87.5% higher than that of the conventional cell with direct reduction of hydrogen peroxide.

liang.an@polyu.edu.hk

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Nanotechnology science to convergence innovation

Akbar S Khan

Defense Threat Reduction Agency, USA

All things, both living and non-living, are constructed of atoms. The nano-scale sparks so much interest because when a substance is artificially created, structured atom by atom, it can have different or enhanced properties compared with the same substance as it occurs naturally, which includes increased chemical reactivity, optical, magnetic, or electrical properties. Nanotechnology aims to exploit these properties to create devices, systems and structures with new characteristics and functions. For example, researchers hope to construct from the very 'bottom' (that is to say, atom by atom) a substance as strong as diamond, but more flexible and far less expensive. It would also be possible to manufacture a substance in the shape and size needed such as a thin string as strong as steel. Nanotechnology Convergence in nanotechnology happened at three levels-namely, convergence in the sources of knowledge for research, convergence in organizational forms to enable technology development, and convergence at the product level with the embodiment of knowledge in complementary products. While nanotechnology research has been shown to have a dominant focus on material sciences, additional analysis has demonstrated that nano-based research increasingly draws its knowledge from other areas. Specifically, Porter and Youtie reveal that while nano-based publications center on materials science (including chemistry and physics) nano-based research also quite significantly applies in many other fields, including biomedical sciences, computer sciences and mathematical sciences, environmental sciences, and engineering. Consequently, at this level of convergence, the sharing and absorption of research across the involved disciplines will be necessary for downstream value creation.

Akbar.s.khan.civ@mail.mil

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Tungsten oxide based hybrid fibers and thin films for chromogenic applications

Esra Zayim

Istanbul Technical University, Turkey

A novel procedure develops to prepare tungsten oxide thin films and microfibers of the organic/inorganic blend of tungsten hexachloride and polyvinylpyrrolidone. Herein, we report on developed procedure offering several advantages over previously known procedures in the literature. First, it allows fabrication of films and microfibers, exhibiting reversible color change. Secondly, tungsten oxide as nanofibers, microfibers and thin films, fabricated via this procedure can be applied to numerous types of surfaces (e.g. paper, glass, metal and so forth) with different techniques (such as electrospinning, spin coating, droplet drawing, casting and writing ink). Lastly, these materials have large optical modulation and possess long memory with superior life-time. In overall, we believe that this procedure is a novel avenue to prepare reversible chromic materials, with superior properties.The electrospun microfibers represent color alteration under UV lamp acting as a UV detector and return to their original state after a while when the UV lamp is witched off. It is worth noting that reversible fully coloration process takes about 3 minutes while the bleaching process takes about 3 hours, which indicates that the photochromic fiber has a good memory effect. More importantly, the color- cycle of the material is reversible and it retains its durability and reversibility over long period of time (i.e., several months). Further studies were performed to understand the behavior of the WO3 thin film as electrochromic device. In order to fabricate the device, Li based electrolyte was chosen. In overall, tungsten oxide coating present new opportunities for non-destructive writable optical memory. Their long-term stability and environmental durability leads to develop new organic/inorganic chromic materials that can be processed from microfibers to large-area solid films displaying excellent chromic properties.Another advantage of this blend is applicable to various types of substrates, such as glass, ITO glass, metal and paper. The mechanism of reversible color change is presently elucidated.

ozesra@itu.edu.tr

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Reactor pressure vessel steel smart behavior as cause of instability in kinetics of radiation embrittlement

Evgenii Krasikov

National Research Centre "Kurchatov Institute", Russia

Influence of neutron irradiation on reactor pressure vessel (RPV) steel degradation are examined with reference to the possible reasons of the substantial experimental data scatter and furthermore-nonstandard (non-monotonous) and oscillatory embrittlement behavior. We suppose that the main factor affecting steel anomalous embrittlement is fast neutron intensity (dose rate or flux), flux effect manifestation depends on state-of-the-art fluence level. At low fluencies radiation degradation has to exceed normative value, then approaches to normative meaning and finally became sub normative. Data on radiation damage change including through the ex-service RPVs taking into account chemical factor, fast neutron fluence and neutron flux were obtained and analyzed. In our opinion, controversy in the estimation on neutron flux on radiation degradation impact may be explained by presence of the wavelike component in the embrittlement kinetics. Therefore flux effect manifestation depends on fluence level. At low fluencies radiation degradation has to exceed normative value, then approaches to normative meaning and finally became sub normative. As, hypothesis we suppose that at some stages of irradiation damaged metal have to be partially restored by irradiation i.e. neutron bombardment. Nascent during irradiation nanostructure undergo occurring once or periodically evolution in a direction both degradation and recovery of the initial properties. According to our hypothesis at some stage(s) of metal nanostructure degradation neutron bombardment became recovering factor. So, material smart behavior is a cause of instability in kinetics of radiation embrittlement of the reactor pressure vessel steel. As a result oscillation arise that in tern lead to enhanced data scatter.

ekrasikov@mail.ru

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The convergence of technologies, generates convergence in the regulations

Guillermo Valdes Mesa

Havana University, Cuba

The convergence of nanotechnologies generates synergies among different technologies to say, nanotechnologies, neurotechnology, computers and biotechnology, these technologies must converge itchier 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 2019 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.

guillermo@biomat.uh.cu

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Improve spectroscopic structural and AC electrical conductivity of PC/PEO blend using graphene

Hind Alghamdi

University of Jeddah, Saudi Arabia

Nanocomposites of polycarbonate (PC) and polyethylene oxide (PEO) embedded with graphene oxide (GO) nanopowder have been prepared using casting method. Prepared nanocomposites are studied and investigated using different characterization techniques. The X-ray diffraction (XRD) pattern reveals the semi-crystalline nature of PC/PEO blend. There are no significant peaks characterizing pure graphene. The intensity of the main X-ray peak characterizing the blend is decreased with the increase of graphene content confirming a modification in the blend due to an addition of graphene oxide. The FT-IR spectra display the main characteristic IR bands due to vibrational function groups for the components. The Optical absorption spectra are measured as a function of wavelength in the range of 190–1100 nm. The UV/V spectra show two absorption bands at 290 and 620 nm due to electronic transitions. The value of Eg is obtained using indirect transition and its decrease with increasing the amount of graphene. The behavior of ε' and ε" decreased with the increase of frequencies is observed. After adding graphene, the frequency is increased due to the dipole moment. The decrease of ε" with increases of both the frequency and the temperature attributed to the origin of ε" is the conduction losses. The decrease of dissipation factor (tan δ) is ascribed to the internal polarization mechanism related to applied frequencies. The maximum value of the peak at M" relation explained as being the result of the distribution of relaxation time.

halhusiki@kau.edu.sa

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Low temperature nanocluster carbon growth and characterization for field emission electrical propulsion application

Nirupama M P and **Satyanarayana B S**

BML Munjal University, India

The cathodic arc system can be used to grow nanocarbon thin film and its many facets by varying deposition parameters. The Nanocluster Carbon (NC) thin films are one of the interesting and novel material of interest in the research work. It contains sp2 and sp3 carbon bonds, unique mixed phased material. It finds application in large area flexible microelectronics, vacuum nanoelectronic devices, spacecraft and many more. The carbon nanotubes are extensively studied and demonstrated for space related applications. The Nanocluster Carbon thin films in space related applications are not reported. To study and understand the feasibility of nanocluster carbon thin films, cathodic arc system was used to grow nanocluster carbon under various process parameters and characterized for its various properties inclusing its field emission properties. The continuous cathodic arc system was used in the study for lesser amorphous phase leading to distinct G and D peaks and better clustering. The focus of the research is to study the feasibility of nanocluster carbon in the Field Emission Electrical Propulsion System (FEEP) for a small satellites.

dr.nirupamamp@gmail.com

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Modification of structure and properties of magnetorheological elastomer via heat treatment

Nur Azmah Nordin[1], Alif Azizi Ayub[1], Siti Aishah Abdul Aziz[1, 2], Mumtaz Hana Ahmad Khairi[1,2], Saiful Amri Mazlan[1, 2] and **Hafizal Yahaya[1]**

[1]Malaysia-Japan International Institute of Technology-Universiti Teknologi Malaysia, Malaysia
[2]Universiti Teknologi Malaysia, Malaysia

Modification of structure via heat treatment in different temperatures is known to result in a change of properties of Si-based magnetorheological elastomer (MRE). In this research, three different temperatures particularly 100, 125 and 150°C have been applied to MRE contained of 70 wt% CIP for 24 hours, individually and the resultant rheological changes of MREs were investigated. It was found that the MRE treated with 125°C exhibit the highest MR effect, about 88% respective to non-treated MRE. Furthermore, the corresponding initial storage modulus present the lowest, 0.284 MPa compared to 0.298 MPa of pure MRE indicating the improvement of an MRE's modulus elasticity. Meanwhile, at temperature of 150°C, it can be seen that the MR effect of the MRE started to drop up to 50%. However, the storage modulus for all non-heat treated and heat-treated MREs increased exponentially as the frequencies and currents increased, respectively for both off- and on-state conditions. In fact, the increment trend of storage modulus as a result of frequency is followed by the increased of heat treatment temperatures; 20% for 100°C, 27% and 32% for 125 and 150°C, respectively compared to non-heat treated MRE, at 3A. The result shows that the heat treatment on the MREs enhanced the inter-particles bonding between the magnetic particles and rubber matrix that subsequently improve the structure and rheological properties of the MREs.

nurazmah.nordin@utm.my

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Molecular recognition via hydrogen bonding in glycine with α/β-glucopyranosoide complexes: A DFT and Fourier transform infrared spectroscopy

Sara Ahmadi

Islamic Azad University, Iran

Molecular recognition by specific targets is at the heart of the life processes. It has been shown that the interactions between carbohydrates and proteins mediate a broad range of biological activities, starting from fertilization, embryogenesis, and tissue maturation and extending to such pathological processes as tumor metastasis. Glycine is one of the amino acid which fuels cancer cells and rapidly dividing cancer cells require the amino acid glycine but proliferating noncancerous cells did not show this reliance, suggesting that inhibiting cells' ability to take up or metabolize glycine or extracting the glycine from cells may be an effective anticancer strategy. The physicochemical nature of sugar-protein interaction has been a matter of debate for years. Herein, we undertake the DFT calculation to optimize the geometry of n-octyl-α/β-d-glucopyranosid with glycine and used the atoms in molecules (AIM) approach to characterize the nature of the intermolecular hydrogen bonds. Interactions between n-octyl-α/β-d-glucopyranosid and glycine were analysed by temperature-dependent FTIR spectroscopy as well. Our results show that the complex of glycine with glucopyranoside has proved to contain many of the molecular features associated with protein-carbohydrate interactions. All OH groups and the ring oxygen atoms of the bound sugar are involved in the formation of hydrogen bonds. Most of the hydrogen bonds exhibit nearly optimal geometries. The CHs of the sugar chain participate in the formation of the CH…π interactions with the nitrogen of the glycine molecule. Indeed, in the complexes of sugar-binding proteins, all the polar groups (OHs and ring oxygen) of the bound monopyranosides are involved in the formation of hydrogen bonds. We have provided experimental and theoretical evidence on the formation of complexes between glycine with glucopyranoside by arrays of multiple hydrogen bonds. Whilst the hydrogen bonds formed between O-H4 group and the Glycine in these complexes seem to be the strongest in this work, the presence of multiple hydrogen bonds may help stabilise of the complexes.

s.ahmadi@iauf.ac.ir

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Photosensitive inverters and light-to-frequency conversion circuits based on transistion metal dichalcogenides field effect transistors

Sung Hun Jin

Incheon National University, South Korea

Recently transisiton metal dichalcogenides (TMDCs) such as MoS_2, WSe_2, $MoTe_2$, WS_2 and others haved been emerged and actively researched as one of next generation semiconductors for extending Moore's law. Among a variety of novel properties for TMDCs, one of interesting properties is to modulate energy bandgap (Eg) in variation of number of layers. In this study, for the improvement of noise immunity for IoT sensor systems, photo sensitive inverters and their light-to-frequency conversion circuts (LFCs) are proposed and experimentally demonstrated by using the platform comprised of an enhancement MoS_2 driver with light-shield layers (LSLs) (or GaN FET drivers) and MoS_2 depletion load. Moreover, for energy efficient circuits, complementary photo- sensitive inverters based on p-type $MoTe_2$ and n-type MoS_2 FETs are demonstrated. For the better understanding on performance of LFCs, we systematically studied basic design rules on LFCs via experimentally measured voltage transfer characteristics of photo-sensitive inverters and their spice simulation with their extracted model parameters based on RPI model (i.e., SILVACO, Smart-spice; level 36). The simulation results illustrate that key parameters of ring osciallators (ROs) such as oscillation frequency (fosc) and peak-to peak voltage (Vp-p) can be systematically controlled by inverter parameters such as noise margin, voltage gains associated with electrical parameters (i.e., Vth, SS, current on/off ratio, field effect mobility, etc). In the present study, experimental implementation of photosensitive inverters based on MoS_2, $MoTe_2$, and GaN FETs, etc. and their systematic validation on performance via spice simulation yield insightful design rules required for reliable operation of LFCs, potentially contributing to emerging IoT security systems.

shjin@inu.ac.kr

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ATP by mitochondria induced UV radiation supersedes chemiosmosis based on H^+ gradient across inner membrane

Thomas Prevenslik

QED Radiations, China

Chemiosmosis in mitochondria is thought supported by the acid-bath chloroplast experiment to show a change in bath pH from 4 to 8 produces an H^+ ion gradient across the thylakoid membrane to synthesize ATP. However, pH change is accompanied by a release in metabolic heat that increases bath temperature. In chloroplasts, the thylakoid membrane contains submicron stacks of grana, the heat locally conserved by simple QED creating EM radiation beyond the UV instead of an increase in temperature. Simple QED relies on real photons and differs from the virtual photons in Feynman's QED. Hence, chemiosmosis by H gradients does not occur, and instead ATP is synthesized from oxidation of food molecules by UV radiation.

thomas@nanoqed.org

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Machine learning-based optimal control for Y-shape tube hydroforming processes

Van-Tuan Dang, Pascal Lafon and **Carl Labergère**
ICD/LASMIS/UTT Troyes, France

Manufacturing of complicated components encountered industrially associated with the control of the process are similar to those relating to optimization. In fact, the control of a hydroforming process requires a precise determination and adjustment of the operating parameters so that the product obtained satisfies precise criteria of shape and/or mechanical properties and at the lowest possible cost. In the automotive industry, the experimental trial and error process is replaced by the numerical procedure, so the production time and costs can be decreased drastically. As the result, the engineering guidelines and finite element software would be used in the optimal control for tube hydroforming processes. We present a methodology of optimal control for Y-shape tube hydroforming processes by using the machine learning technique. The main study is to use the coupling of the optimization method and finite element simulation at each time step to optimize the load paths that consist of internal pressure and the axial feeds. An optimization strategy is based on the Gaussian processes combined with dimensionality reduction method to build the approximation of optimization problem of the tube thickness versus process parameters during processing. By this way, the optimal command curves are constructed to obtain a better quality component. The result obtained showed an efficiency in improving the quality of the final form of a tube. These results achieved from numerical control can help the designers in manufacturing a product formed. As a result, the proposed approach has an ability to replace the traditional methods and to use in tube hydroforming processes.

van_tuan.dang@utt.fr