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Editorial

Nanocomposites: Foreword

The development activities in the area of nanoscience and nanomaterials is increasing at a tremendous speed for it can totally change the ways in which materials can be made with unusual properties. The ability to manipulate at atomic and molecular level is creating materials and structures that has unique functionalities and characteristics and is revolutionizing next-generation technology ranging from structural materials to smart structures, microelectronics to medicine. The impact is worldwide and in the past few year commercial applications nucleated through nanoscience and nanoengineering is already mushrooming and scientists anticipate even more in the coming decade.

One of the major reasons for bringing this special issue on *'Nanoscience and Nanocomposites'* is to bring further fundamental understanding that are important to the development of the new paradigm for developing practical application of nanoengineered materials and their innovative composites. Therefore, the basic premise of this special edition is that novel functionality (*mechanical/physical*) can be designed into advanced nano and innovative composites by employing a suitable nanoscale or other fine scale architecture to control the properties. We seek to address in this edition the design of nanostructured and innovative materials and composites not by just refining the polycrystalline microstructural scale, but rather by exploring novel processing routes for synthesizing, characterizing, and controlling the structure of novel materials and composites to achieve unusual mechanical and possibly other properties.

The development on new advanced composite materials that possess unique mechanical, thermal, thermal–mechanical, electrical and thermal–electrical properties with sustainability in different harsh environments for space, automotive, electronic and infrastructure elements will be an important future challenge in materials science and engineering industry. Due to this evolutionary change of materials science and engineering research focus, the integration of many conventional materials such as carbon, clay, ceramic, aluminium particles and etc. in their nanoscale, has been emerged to build new block of revolutionary structural materials with superior and optimized properties.

To successfully adopt these nanomaterials and nanocomposites into real-life applications, several fundamental aspects need to be addressed and explored with respect to

- Controlling and understanding their manufacturing process;
- Understanding their chemical and physical characteristics during mixing with other substances in different temperature and pressure conditions and their bonding mechanisms;
- Identifying their mechanical, thermal and electrical properties using different means and
- Theoretically and computationally anticipating the structural responses of composites subjected to different loads.

This special issue aims is to grouping up all recent significant research findings in different engineering, chemistry and physics areas from the world's leading researchers and scientists who are enthusiastically working on the nanocomposite area and to provide an opportunity to share their valuable achievements and explore ideas to our readers. Every single paper listed in this special issue provides valuable information in discussing the development, synthesis, characterization and applications of nanostructural composite materials.

1. Carbon nanotubes and nanocomposites

Paper 1 Wang X.
'Numerical Simulation for Bending Modulus of Carbon Nanotubes and Some Explanations for Experiment'.
The bending mechanical property of carbon nanotubes on the formation of rippling which is the appearance of wavelike distortion on the inner arc of the bent nanotubes, caused by the severe anisotropy of carbon nanotubes and a relatively large deformation

Paper 2 Yoon J., Ru C.Q., Mioduchowski A.
'Timoshenko-Beam Effects on Transverse Wave Propagation in Carbon Nanotubes'.
This paper presents theoretical model to study effects of rotary inertia and shear deformation on transverse wave propagation in individual carbon nanotubes with terahertz range. The model can be used to predict some terahertz frequencies at which the number of wave speeds change.

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Paper 3 Lau K.T., Chipara M., Ling H.Y., Hui D.
'On the Elastic Moduli of Carbon Nanotubes for Nanocomposite Structures'.
The Young's modulus of a multiwalled carbon nanotube can be calculated by treating the nanotube as a singlewalled tube with a diameter similar to its outmost diameter.

Paper 4 Ding J., Liu B.H.
'The Preparation of AL2O3 (Fe, Co, Ni) Nanocomposites by Mechanical Alloying and the Catalytic Growth of Carbon Nanotubes'.
Mechanical alloying led to the formation of Al_2O_3/M (M = Fe, Co, Ni) nanocomposites with small particle sizes. Large-scale fabrication of multi-walled and single-walled carbon nanotubes were achieved using the resultant nanocomposite powders as CVD catalysts.

2. Nanoclay and ceramic polymer composites

Paper 5 Wang Y., Chen F.B., Li Y.C., Wu K.C.
'Melt Processing of Polypropylene/Clay Nanocomposites Modified with Maleated Polypropylene Compatibilizers'.
The intercalated capability and composition of compatibilizers are two important factors that help the exfoliation and homogeneous dispersion of clay/PP composite structures.

Paper 6 Nah C.W.
'Intercalation Behavior Of Polyimide/Organoclay Nanocomposites During Thermal Imidization'.
This paper describes the intercalation behaviour of organoclay-filled polyimide nanocomposites. Two levels of intercalations are initially formed, and these are changed to only one level of intercalations after thermal imidization due to degradation of intercalated organic modifier of the clay

Paper 7 Zhang Y.Q., Lee J.H., Jang H.J., Nah C.W.
'Preparing PP-Clay Nanocomposites using a Swelling Agent'.
This study tested a new way to synthesize nanocomposites with the aid of swelling agents, reducing the PP-g-MA content in the nanocomposite and enhancing the comprehensive properties of the composite. The thermal stability and dynamic behavior of the nanocomposite synthesized are discussed

3. Materials characterization

Paper 8 Havel M., Colomban P.
'Rayleigh and Raman Images of the Bulk/Surface Nanostructure of SiC Based Fibres'.
Raman and Rayleigh micro-spectrometries appear to be the only efficient and non-destructive analysis methods allowing the imaging of the distribution of crystalline or amorphous nanophases. The technique is applied to compare the alkaline corrosion resistance of SiC fibre bulk and skin and provides information on the nature, structure, size and sometimes strain of the nanophases

Paper 9 Kumar D., Yarmolenko S., Sankar J., Narayan J., Zhou H., Tiwari A.
'Pulsed laser deposition assisted novel synthesis of self-assembled magnetic nanoparticles'
The paper presents a new technique to fabricate highly ordered self-assembled magnetic nanoparticles in thin film matrices. The paper also covers unique magnetic properties achieved in these systems by means of precise control on particle size uniformity and orientation. The technique employed by present authors is generic in nature and can be applied for the synthesis of various types of ordered self-assembled nanostructures.

Paper 10 Neralla S., Kumar D., Yarmolenko S., Sankar J.
'Mechanical properties of nanocomposite metal-ceramic thin films'
Authors have shown for the first time in this paper that pulsed laser deposition technique can very conveniently be used for the fabrication of thin film composites embedded with highly uniform Ni nanoparticles. The authors have shown that the hardness of resultant composites are considerably improved with almost unchanged fracture toughness suggesting potential applications of these materials in electronic devices where high hardness and fracture toughness is required.

Paper 11 Kvit A.V., Zhirnov V.V., Tyler T., Hren J. J.
'Aging effect and nitrogen distribution in diamond nanoparticles'
The paper is devoted to the fundamental understanding of aging behavior of diamond particles. Using advanced structural characterization techniques such as Z-contrast imaging using scanning transmission electron microscopy and electron energy loss spectroscopy, the author have shown for the first time that a single isolated diamond particle on a metal tip can substantially increases the emission voltage of field emission experiments.

Paper 12 Johnson C., Gemmen R., Orlovskaya N.
'Nano-structured self-assembled $LaCrO_3$ thin film deposited by RF-magnetron sputtering on a stainless steel interconnect material
This is a scientifically interesting and technologically important paper reporting the formation of the phase transformation assisted nanostructured self-assembled dendritic structure. The dendrite structure was obtained after annealing magnetron spattered amorphous La–Cr–O thin film which is a promising protective coating material on the metallic interconnect for solid oxide fuel cells.

4. Processing

Paper 13 Kumar, S.
'Processing and Properties of Poly(Methyl methacrylate)/Carbon Nano Fibre Composites'.
At 5 wt% carbon nano fibres, composite rods as well as fibres show over 50% improvement in axial tensile modulus as compared to the control PMMA rod and fibres, respectively

Paper 14 Lu M., Li M.K., Kong L.B., Li H.L., Guo X.Y.
'Synthesis and Characterization of Well-Aligned Quantum Silicon Nanowires Arrays'.
Well-aligned Quantum silicon nanowires arrays with perfect lattices and sharp tips are synthesized by chemical vapor deposition template method without catalyst, exhibiting unusual optical properties and superior field emission properties

5. Miscellaneous

Paper 15 Li H., Xiao H.G., Yuan J., Ou J.P.
'Microstructure of Cement Mortar with Nano-phase Materials'.
Nano-particles are effective to enhance the strengths of concrete and improve the microstructures of concrete, further present studies indicated that concrete mixed with nano-particles has self-sensing stress ability, which is similar with carbon fibre concrete'

Paper 16 HabibK., HabibA.
'General Model of Hydrogen Transport Through Nanoporous Membranes'.
Different analytical solutions were obtained of derived general model of hydrogen gas transport through membranes in the non-porous, nanoporous, microporous, and to macroporous Range

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