Composites: Part B 43 (2012) 1–2

Contents lists available at ScienceDirect

Composites: Part B

journal homepage: www.elsevier.com/locate/compositesb

Editorial

Nanomechanics and Nanocomposites: Mechanical Behaviors

Nanomechanics and nanocomposites are two important disciplines of nanoscience and nanotechnology. The 2nd International Conference on Nanomechanics and Nanocomposites was held at the Friendship Hotel in Beijing, China from 10th to 13th October 2010. More than 200 participants from 23 countries/areas attended this conference and over 180 papers were presented. This conference provided a forum for the communications and discussions of state-of-the-art achievements and future trends by researchers in the fields of nanomechanics and nanocomposites.

An understanding of the mechanical behaviors via theoretical and experimental means is important for both the development of new materials and the selection of appropriate materials for particular end-use. Nanomaterials have received great attention by virtue of their excellent properties suited for applications in various fields. Thus, their mechanical property modeling and measurements are of great significance. Nanomechanics is one of the important branches of nanoscience and nanotechnology which is concerned with the simulations and measurements of mechanical behaviors of nanomaterials at nanoscale. An important application of nanomaterials is used as nanofillers for nanocomposites. In principle, the mechanical properties of nanocomposites depend critically on those of the nanofillers. The roles of nanofillers can be reflected by the macro-mechanical properties of nanocomposites that are made of these nanomaterials and a specific matrix. To transfer the excellent mechanical properties of nanofillers to the matrix, collaborations amongst nanomechaincs and nanocomposites researchers will be helpful. Further, nanocomposites containing nanofillers can be used as matrices for traditional fiber reinforced composites and the roles of nanofillers need more in-depth clarifications.

A major aim of this special issue which is entitled: "*Nanomechanics and Nanocomposites: Mechanical Behaviors*" is to bring together recent efforts by researchers from these two disciplines into one single volume. The selected papers in the special issue address many important state-of-the-art methodologies and technologies of nanomechanics and nanocomposites regarding molecular dynamic/statistical simulation, size and surface effects, measurement and determination of mechanical behaviors of nanomaterials, reinforcing effects of nanofillers on nanocomposites and traditional fiber reinforced composites, mechanical behaviors at extreme conditions, aggregation effect of nanomaterials in nanocomposites, hybrid effects of different nanofillers in nanocomposites, and crack propagation and creep behaviors of nanocompostes. In this special issue, 16 papers are chosen with their summaries given below:

Paper 1: Reinforcement Effects of MWCNT and VGCF in Bulk Composites and Interlayer of CFRP Laminates

Incorporating MWCNT and VGCF into the interface of conventional CFRP laminates can result in great improvement of Mode-I fracture toughness and tensile strength. VGCF performs better than MWCNT. In addition, adding MWCNT and VGCF in epoxy bulk composites can moderately improve the Young's modulus and tensile strength of matrix without big difference in the performance of these two nanofillers. However, for Mode-I fracture toughness, MWCNT works much better than VGCF.

Paper 2: Molecular Dynamics Simulation of Elastic Properties of CuPd Nanowire

The nanowire thickness has an important role in the mechanical properties of the nanowire. The molecular dynamics simulation technique is employed to investigate the influence of nanowire diameter on the elastic properties of pure Cu and Pd as well as Cu–*x*%Pd nanowires.

Paper 3: Determination of Tensile Strength of Electrospun Single Nanofibers Through Modeling Tensile Behavior of the Nanofibrous Mat

A special fiber bundle modeling method is developed and applied to model the whole damage process of electrospun nanofibrous mats. With the aid of the modeling results and the measured data of nanofibrous mats we were able to estimate the tensile properties of single nanofibers. The advantage of the method is that no expensive apparatus is needed nevertheless the results can be almost the same.

Paper 4: Cryogenic Mechanical Behaviors of Carbon Nanotube Reinforced Composites Based on Modified Epoxy by Poly(ethersulfone)

Multi-walled carbon nanotubes (MWCNTs) were employed to reinforce epoxy system modified by poly(ethersulfone) (PES) for enhancing the cryogenic mechanical properties. The simultaneous usage of PES and MWCNTs in a brittle epoxy resin is a promising approach for efficiently modifying and reinforcing epoxy resin for cryogenic engineering applications.

Paper 5: Size and Surface Effects on the Mechanical Behavior of Nanotubes in First Gradient Elasticity

The microstructure and the surface play important roles in the mechanical behavior of nanoscale tubes. Numerical results based on the first gradient elasticity show their main influences on the stress distributions of deformed nanotubes and the relationships between these two factors.

Paper 6: The Effective Properties and Local Aggregation Effect of CNT/SMP Composites

The effective properties of CNT/SMP composites are examined using a micro-mechanics method. The degree of CNT aggregation dramatically influences the effective properties of the CNT/SMP composites. What is more, a homogeneous microstructure leads to maximum levels of effective composite properties.

Paper 7: Electrical Resistance Change and Crack Behavior in Carbon Nanotube/Polymer Composites under Tensile Loading

This paper studies the electrical and mechanical responses of cracked carbon nanotube-based polymer composites under ten-

1359-8368/$ - see front matter
doi:10.1016/j.compositesb.2011.04.021

sion. Based on the theoretical and experimental results, the crack sensing functionality and fracture properties of the nanocomposites were discussed.

Paper 8: Hybrid Effect of NanoParticles with Carbon Fibres on the Mechanical and Wear Properties of Polymer Composites

The incorporation of nano-ZrO_2 particles with carbon fibers could effectively enhance the mechanical and wear properties of the PEEK composites. A synergistic effect between the nano-ZrO_2 particles and carbon fibers on the wear resistance of the PEEK/CF/ZrO_2 composites was discussed.

Paper 9: Preparation of Polystyrene–Polyisoprene Core–Shell Nanoparticles for Reinforcement of Elastomers

Latex-formed polystyrene–polyisoprene (PS–PI) core–shell nanoparticles were successfully synthesized by means of a two-stage emulsion polymerization. Latex compounding method was employed to prepare the filled elastomer compounds. The PS–PI nanoparticles exhibited excellent reinforcement to elastomeric matrix. The lower density, better interfacial interactions, and latex compounding process benefit the PS–PI nanoparticles reinforced elastomer nanocomposites in energy saving.

Paper 10: Molecular Statistical Thermodynamics – A Distinct and Efficient Numerical Approach to Quasi-Static Analysis of Nanomaterials at Finite Temperature

Molecular statistical thermodynamics is a distinct numerical approach to quasi-static analysis of nanomaterials and it is dramatically faster than molecular dynamics. Its applications to compression, tension and nanoindentation of nanosamples demonstrate its ability to characterize dislocation interaction, phase transformation and size effect of nanomaterials.

Paper 11: Surface Effects on the Vibrational Frequency of Double-Walled Carbon Nanotubes Using the Nonlocal Timoshenko Beam Model

The vibrational frequency of double-walled carbon nanotubes, while accounting for surface effects, is studied using the nonlocal Timoshenko beam model. The vibrational frequency is significantly affected by the surface material, nonlocal parameter, vibration mode and aspect ratio.

Paper 12: Measurement of Mechanical Properties of One-Dimensional Nanostructures with Combined Multi-Probe Platform

A multi-probe mechanical testing system for one-dimensional (1D) nanostructures has been developed and the clamping strength of electron beam induced deposition (EBID), Young's modulus retrieving for Si nanowires, and thermal fatigue behavior of nanoscale interconnect lines bearing alternating current have been investigated with this system.

Paper 13: Silicon Nanowire Reinforced by Single-Walled Carbon Nanotube and Its Applications to Anti-Pulverization Electrode in Lithium Ion Battery

The possibility of using carbon nanotubes (CNTs) for silicon reinforcement to minimize the volume expansion in high energy density lithium ion battery was elucidated. Molecular dynamics simulations were adopted to analyze the strength improvement of silicon nanowires (SiNWs) encapsulated by CNT. The results show that the smaller the SiNW is, the better the reinforcing effect is.

Paper 14: Creep Behavior of Injection Moulded Polyamide 6/Organoclay Nanocomposites by Nanoindentation and Cantilever-bending

Organoclay reduces the creep compliance, including the viscous terms, in polyamide 6 bulk by constraining its molecular motions. However, in the surface, where molecules have more degrees of freedom, the creep resistance is only enhanced by decrease of the initial compliance at zero time but the time-dependent creep is actually increased.

Paper 15: Improving Interlaminar Fracture Toughness of Carbon Fibre/Epoxy Laminates by Incorporation of Nano-particles

Mode I fracture toughness of carbon fiber laminates with nanoparticles modified epoxy matrix has been studied using double-cantilever-beam tests. The fracture behaviors of the composites can be improved by either rigid silica or soft rubber nanoparticles added to the matrices. However, the bulk toughness of nanoparticle filled epoxies cannot be fully transferred to the interlaminar toughness of composite laminates, being limited by the constraint effect imposed by the carbon fibers.

Paper 16: Role of Matrix Modification on Interlaminar Shear Strength of Glass Fibre/Epoxy Composites

The interlaminar shear property was investigated for glass fiber reinforced composites based on the modified epoxy resin by multi-walled carbon nanotubes and reactive aliphatic diluent named *n*-butyl glycidyl ether. Their individual introduction enhanced the interlaminar shear strength while their simultaneous introduction led to the highest interlaminar shear strength.

As guest editors, we would like to convey our sincere gratitude and thanks to all the authors for their scientific contributions to this special issue. Each paper was reviewed by two or more referees. We express our great appreciations to all the reviewers for their precious time, dedication and valuable comments which have maintained the high quality of the selected papers. Finally, many thanks go to Elsevier Science for their support and their staff for editing of this special issue.

Guest Editors
Shao-Yun Fu
Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Beijing 100190, China
Tel.: +86 10 82543752; fax: +86 10 82543752.
E-mail address: syfu@mail.ipc.ac.cn

Yiu-Wing Mai
Centre for Advanced Materials Technology (CAMT), School of Aerospace, Mechanical and Mechatronic Engineering J07, The University of Sydney, Sydney, NSW 2006, Australia

Shan-Yi Du
Centre for Composite Materials and Structures, Harbin Institute of Technology, Harbin 150080, China

David Hui
Department of Mechanical Engineering, University of New Orleans, New Orleans, USA