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Editorial

Modeling, Characterization, and Processing of Advanced Composites

Philip Harrison,[1] Abbas S. Milani,[2] and Roham Rafiee[3]

[1] *School of Engineering, University of Glasgow, Glasgow G12 8QQ, UK*
[2] *School of Engineering, University of British Columbia, Kelowna, BC, Canada V1V 1V7*
[3] *Composites Research Laboratory, Faculty of New Sciences and Technologies, University of Tehran, Tehran 1439955941, Iran*

Correspondence should be addressed to Philip Harrison; philip.harrison@glasgow.ac.uk

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Over the past few decades, outstanding progress in the science and technology of composite materials has been made. Their unique characteristics make composites desirable for engineering applications across a wide variety of industrial sectors. New manufacturing methods are driving down costs, and emerging fields such as nanocomposites, green composites, 2D/3D textile composites, and multifunctional composites have been the focus of a great deal of exciting and innovative research activity. This special issue contains a snapshot of research, typical of this activity, and includes fifteen papers on topics such as structural and damage analysis, process modeling, fundamental mechanisms at the nano- and microscales in both nano- and biocomposites, and nondestructive test methods for advanced carbon composites.

Structural and damage analysis of composite structures is considered in four different articles. "*Analysis of the dynamic response in blast-loaded CFRP-strengthened metallic beams*" by Z. Wang et al. presents an analytical solution for the deformation and ultimate strength calculation of hybrid metal-CFRP beams subjected to dynamic loading. "*Micro-tomographic analysis of impact damage in FRP composite laminates: a comparative study*" by M. Alemi-Ardakani et al. presents a 3D microtomographic technique to visualize and compare modes of impact damage in a set of thermoplastic laminates. "*Optimum design of fibre orientation in composite laminate plates for out-plane stresses*" by R. Khandan et al. develops a new methodology to minimise plate thickness by optimising the fibre orientations for different load cases; a modified penalty function including the effect of transverse shear forces is used in the optimisation process. "*Stay-in-place formwork of TRC designed as shear reinforcement for concrete beams*" by S. Verbruggen et al. demonstrates the utility of textile-reinforced cement for improving structural stay-in-place formwork which is useful in civil engineering, through a preliminary analysis and feasibility study.

Process modeling is considered in six papers. "*Modelling the shear-tension coupling of woven engineering fabrics*" by F. Abdiwi et al. addresses the important effect of the coupling between shear compliance and in-plane tension during the forming of woven engineering fabrics and presents a new modeling framework to include this coupling in finite element simulations. Model predictions have been validated against experimental shear force measurements from a Biaxial Bias Extension (BBE) test. "*Numerical tools for composite woven fabric preforming*" by A. Cherouat and H. Borouchaki presents an optimisation-based method for the simulation of the forming processes of woven fabric reinforced composites. Two different approaches are proposed for the simulation of the draping of woven fabric onto complex geometries: geometrical and mechanical approaches. Numerical simulations of the forming process are proposed and compared with experimental results. "*Curing pressure influence of out-of-autoclave processing on structural composites for commercial aviation*" by V. M. Drakonakis et al. discusses a custom designed controlled pressure vessel (press-clave) and analyses the separated effects of pressure and temperature during prepreg consolidation. Specimens manufactured by the press-clave are analytically tested and compared with autoclaved specimens to demonstrate the

suitability of the press-clave in manufacturing high-quality composites at dramatically lower cost. "*Thermal and cure kinetics of epoxy molding compounds* cured *with thermal latency accelerators*" by C.-C. Su et al. characterises the reactivity and cure behavior of an epoxy molding compound with thermal latency catalysts. The authors use a kinetic model to investigate the influence of thermal latency catalyst on the curing process. "*A phenomenological thermal-mechanical viscoelastic constitutive modeling for polypropylene wood composites*" by X. Peng et al., decouples the effect of temperature from strain rate, in order to develop a nonlinear thermomechanical viscoelastic constitutive model for the high temperature compression of polypropylene wood composites. After validating the model using experimental data, the model is applied to the thermoforming simulation of an automobile interior part. "*Optimization of Ni-based WC/Co/Cr composite coatings produced by multilayer laser cladding*" by A. Angelastro et al. proposes a methodology for the optimum selection of parameters associated with a surface coating technique developed for improving wear, corrosion, and fatigue properties of mechanical components, using a mathematical model and experimental analysis.

Discussion of fundamental mechanisms operating at the nano- and microscales in both nano- and biocomposites is considered in four papers. "*Challenges of the modeling methods for investigating the interaction between the CNT and the surrounding polymer*" by R. Rafiee et al. is a review that critically assesses the various strategies that have been employed by other researchers in modeling the interaction between carbon nanotubes and polymer matrix. "*Improvement of dispersion and color effect of organic pigments in polymeric films via microencapsulation by the miniemulsion technique*" by D. Qi et al. discusses how a set of primary color pigment/P(BA+St) nanocomposites with improved particle size and self-adhesive properties have been prepared via miniemulsion polymerisation. These are applied to the film formation and the pigment printing of cotton fabrics. It is shown that the presence of adhesive shell on pigment surface can notably inhibit the extensive agglomeration of pigment particles and hence improve the adhesion efficiency of the binder to the pigment. "*Improved surface wettability of water by applying SiC/Ti6Al4V coatings on carbon/carbon composites*", by L.-L. Zhang et al. discusses how SiC/Ti6Al4V coatings are applied on carbon/carbon composites to improve their surface wettability by water. Carbon/carbon (C/C) composites can play an important role in biomedical applications; however, the surface wettability of the C/C composites has to be improved to promote protein absorption and cell attachment and thereby enhance osteoconductivity and bone regeneration. "*Effect of cobalt fillers on polyurethane segmentations investigated by synchrotron small angle X-ray scattering*" by K. Koyvanich et al. considers the effect of changing the loading of ferromagnetic cobalt (Co) powder (average diameter 2 μm) on the molecular structure of PU synthesized from a reaction between polyether polyol (soft segment) and diphenylmethane-4,4′-diisocyanate (hard segment). The authors conclude that higher Co loadings lead to large deviations in molecular structure, from predictions of all the theoretical models considered in the investigation.

An additional paper on nondestructive testing is included in the special edition. "*Terahertz wave approach and application on FRP composites*" by K.-H. IM et al. considers one of the most recently developed nondestructive evaluation techniques. A T-ray time-domain spectroscopy system is used to detect and evaluate the influence of fibre orientation on the electrical conductivity of carbon laminates.

Philip Harrison
Abbas S. Milani
Roham Rafiee