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Editorial

Editorial for the Special Issue on Characterization and Modelling of Composites

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The papers published in this Special Issue of the *Journal of Composites Science* will give the composite engineer and scientist insight into what the existing challenges are in the characterization and modelling for the composites field, and how these challenges are being addressed by the research community. The papers present a balance between academic and industrial research, and clearly reflect the collaborative work that exists between the two communities, in a joint effort to solve the existing problems.

Developing an advanced monitoring system for strain measurements on structural components represents a significant task, both in relation to the testing of in-service parameters and in the early identification of structural problems. Arena and Viscardi [1] provide a state-of-the-art review on strain detection techniques in composite structures. The review compares different novel strain measurement techniques. The challenges for the research community are discussed by opening the current scenario to new objectives and industrial applications.

Composites are susceptible to unnoticeable damage as they experience various loading conditions in-service such as fatigue, bird impacts, lightning strikes, etc., which can alter their dynamic characteristics ultimately leading to failure. The formation of cracks in a structure may lead to catastrophic events. Govindasamy et al. [2] present a novel technique called the node-releasing technique in Finite Element Analysis (FEA), whichis used to model the perpendicular cracks as well as slant cracks of various depths and lengths for unidirectional laminate composite layered configurations simulating the actual damage scenario. Furthermore, Saadati et al. [3] studied the interlaminar fracture toughness and delamination behavior of unidirectional flax/epoxy composite under Mode I, Mode II, and Mixed-mode I/II loading.

González and Fernández-León [4] have developed a supervised machine learning model to detect flow disturbances caused by the presence of a dissimilar material region in the liquid molding manufacturing of composites. The machine learning model can predict the position, size and relative permeability of an embedded rectangular dissimilar material region through the use of only the signals corresponding to an array of pressure sensors evenly distributed on the mold surface.

Additive manufacturing (AM) has continued to grow exponentially since its inception for its extensive benefits. Landes and Letcher [5] investigated an additive manufactured composite material that is a greener alternative to other composites that are not reinforced by natural fibers. A bamboo filled polylactic acid (PLA) composite manufactured by fused filament fabrication was evaluated to gather mechanical strength characteristics. Moreover, lattice cell structures can be easily manufacturing via 3D printing and have many scientific and engineering applications. Alwattar and Mian [6] studied the equivalent quasi-isotropic properties required to describe the material behavior of the body-centered cubic (BCC) lattice unit cell. Finite element analysis was used to simulate and calculate the mechanical responses of the BCC unit cell, which were the mechanical responses of the equivalent solid. In addition, cell specimens were fabricated on a fused deposition modeling 3D printer using acrylonitrile butadiene styrene (ABS) material and tested experimentally under quasi-static compression load demonstrating the validity of the proposed method.

Rouhana and Stommel [7] investigated a highly ordered, hexagonal, nacre-like composite stiffness using experiments, simulations, and analytical models. Polystyrene and polyurethane were selected as materials for the manufactured specimens using laser cutting and hand lamination. A simulation was conducted using material data based on component material characterization. Available analytical models were compared to the experimental results, and a more accurate model was derived specifically for highly ordered hexagonal tablets with relatively large in-plane gaps. Additionally, Kriwet and Stommel [8] have used the new developed Arbitrary-Reconsidered-Double-Inclusion (ARDI) model to describe stiffness and damping. A homogenization equation was used to derive the transversal-isotropic stiffness and damping tensors. By rotating and weighting these tensors using orientation distribution functions, it was possible to create a material database.

Singh et al. [9] present a model for the fiber-matrix interface in polymer matrix composites. Finite element models were developed to study the interfacial behavior during the pull-out of a single fiber in continuous fiber-reinforced polymer composites. It was determined that the force required to debond a single fiber from the matrix was three times higher if there was adequate distribution of the sizing on the fiber. It was observed that the interface debonded first from the matrix and remained in contact with the fiber even when the fiber was completely pulled out.

Geopolymer concrete (GPC), due to its capability to minimize the consumption of natural resources, has attracted the attention of researchers. Azarsa and Gupta [10] studied fly-ash based GPC and bottom-ash based GPC, which were exposed to harsh freeze-thaw conditions. The dynamic elastic modulus of both types of GPC was determined by resonant frequency testing. The results showed that bottom-ash based GPC had better freeze-thaw resistance than fly-ash based GPC. Moreover, the leachability of bottom-ash based GPC was also investigated to trace the heavy metals. The results showed that all the heavy metals could be effectively immobilized into the geopolymer paste.

The collection of papers in this issue may help advance technology and bring industry closer to understanding these approaches of the characterization and modelling of composites, and thus being able to confidently implement them into a variety of applications.

Conflicts of Interest: The author declares no conflict of interest.

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