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Editorial: Advancements in composite sandwich materials: fabrication, characterization, durability, modeling and applications

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Editorial on the Research Topic
Advancements in composite sandwich materials: fabrication, characterization, durability, modeling and applications

The concept of sandwich composites, hence, to modulate opportunely the strength and the specific properties of the materials in order to obtain tailored performance, is an ancient one, but it has been frequently revived and applied in multiform modes. Nature does normally apply it, in the contrast between the exoskeleton that ensures protection and the softer core, which permits various actions, including the judicious transmission of fluids, therefore implying environmental control over the whole system. Though a primordial idea for the development of adaptable materials, sandwich composites are increasingly modified and complexified to enhance their durability and fitness-for-function. This is the sense in which this Research Topic has been conceived: viewing the factual response to some Research Topic that are encountered in the application of this binomial connection between shielding skin and functional core.

This is reflected by the works collected, which do effectively represent the need for commingling the application of natural concepts with specific Research Topic that are specific to the performance of sandwich composites. One of the natural structures that frequently served as inspiration for the development of materials are seashells, which more specifically offer protection notwithstanding their curved and layered structure, while hindering crack propagation. Building on this model, in the work by Hu et al. a layered semiconducting structure does act as stimuli-responsive through the assembling of 2D nanostructures based on graphene oxide and molybdenum sulfide by increasing the properties of a transducer sensor. Vacuum suction filtration allowed reproducing as much as possible the high toughness behavior of biological shells reducing the effect

of inherent heterogeneity. The application of graphene oxide has recently proven to be suitable also for the mechanical and functional improvement in the context of more diffuse and traditional sandwich materials, as one of the most effective nanofillers. This is particularly of interest whenever one considers that monolayer carbon-based structures, such as graphene oxide, also in the reduced state, can also be obtained by the carbonization of any biomass, which also allow obtaining diverse properties according to the specific features of the species they originate from. However, the control of several process parameters is required for the successful integration of these tailored nanofillers into products of large use and that show much promise also for future development, such as fiberboards. A thorough investigation of a number of these factors is offered by Gul et al., namely connected to the production and service of medium density fiberboards, such as moisture content, and two molding velocities i.e., closing and pressurizing ones. Further information needs to be obtained though on the final performance of these boards when nanofillers are actually introduced in the boards: the relation between process parameters and material properties can be complex, due to the composite nature of the structure and to its sensitivity even to a limited variation of composition. This relation is the subject of further work from Gul et al., which extends investigation to mechanical and physical properties. The control of dynamical properties, such as impact resistance, even more so ballistic or blast impact, has always been an Achilles' heel of sandwich composites. Once again, nature can assist the improvement of this characteristic, as demonstrated by work by Wang et al. In this case, the inspiration from Royal Water Lily offered more insight into a judicious investigation of fluid-structure interaction during blast impulsion, considering both energy absorption and the extent and morphology of backface deflection.

To conclude, the works collected in this Research Topic confirmed the potential of sandwich structures, which represent one of the fundamental layouts of material engineering for their effective coupling between lightness, performance and potential integration of other feature, such as sensing capabilities. Moreover, some current trends are increasingly surfacing, which are interconnected among them, namely the introduction of nanofillers with prevalent 2D structure and the continuous reference to the nature's knowledge for enhanced design.

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