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Editorial

Special Issue "ECO-COMPASS: Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures"

Xiaosu Yi [1,2,*] and Konstantinos Tserpes [3,*]

1 Beijing Institute of Aeronautical Materials, Beijing 100095, China
2 Aviation Composite (Beijing) Science and Technology Co., Ltd., Beijing 101300, China
3 Laboratory of Technology & Strength of Materials, Department of Mechanical Engineering & Aeronautics, University of Patras, Patras 26500, Greece
* Correspondence: xiaosu.yi@nottingham.edu.cn (X.Y.); kitserpes@upatras.gr (K.T.)

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Today, composite aircraft structural parts are mainly made of man-made materials, such as carbon and glass fibres and epoxy resin. Renewable materials, such as natural fibres or bio-sourced resin systems, have not yet found their way into aircraft production. The project ECO-COMPASS [1] aims to evaluate the potential applications of ecologically improved composite materials in the aeronautics sector through an international collaboration between Chinese and European partners. Natural fibres, such as flax and ramie, are used for different types of reinforcements and sandwich cores. The substitution of bisphenol-A based epoxy resins in secondary structures by bio-based epoxy resins is currently under investigation. Adapted material protection technologies aiming to reduce environmental influence and to improve fire resistance are needed to fulfil the demanding safety requirements in aviation. The modelling and simulation of the chosen eco-composites aims to optimize the use of materials while a Life Cycle Assessment aims to prove the ecological advantages compared to the synthetic state-of-the-art materials.

This Special Issue provides selected papers from the project consortium partners. The Special Issue is partially based on the special session entitled "ECO-COMPASS: Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures" that was organized at the ICCS20 Conference (Paris, France, 4–7 September 2017, https://events.unibo.it/iccs20).

This Special Issue of Aerospace contains nine interesting articles, which cover a wide range of topics from production, experimental characterization and numerical simulation. The paper by Barbara Tse et al. [2] characterizes the flexural behavior and the morphological properties of wet-laid hybrid nonwoven recycled carbon and flax fibre composites in a polylactic acid matrix. Experimental data showed that the flexural properties increased with higher recycled carbon fibres (rCF) content. The intimate mixing of the fibres contributed to a lesser reduction of flexural properties when increasing the flax fibre content. Jens Bachmann et al. [3] measured flexural properties of hybrid epoxy composites reinforced with nonwoven flax and recycled carbon fibres. Experimental results show a potential increase in flexural properties after combining rCF and flax fibre in a nonwoven hybrid. Tserpes and Kora [4] proposed a multiscale modeling approach to simulate crack sensing in polymer fibrous composites by exploiting the interruption of electrically conductive carbon nanotube (CNT) networks. In the special issue, the second paper of a two paper series [4,5] was published. The numerical results highlight the prospect of conductive CNT networks to be used as a localized structural health monitoring technique in carbon fibre reinforced polymers (CFRP) and bio-composites. Wang et al. [6] studied the effect of ramie fabric chemical treatments on the physical properties of thermoset polylactic acid (PLA) composites. It was found that chemical treatments lead to an increase in tensile and flexural strength of PLA composites while they lead to a decrease in water absorption. The authors concluded that the ramie fabric-reinforced PLA composites can meet the standard requirements of aircraft interior structures and have favorable foreground application.

Dong et al. [7] performed cradle-to-gate life cycle assessment (LCA) study to demonstrate the possible advantages of ramie fibre on environmental impacts and to provide fundamental data for the further assessment of ramie fibre reinforced polymers (RFRP) and its structures. Guo et al. [8] studied the effect of plant-fibre paper or silver nanowires-loaded paper interleaves on the electrical conductivity and interlaminar fracture toughness of composites. Experimental data show an increase in electrical conductivity and a decrease in interlaminar fracture toughness. Zhang et al. [9] evaluated the sound absorption performance of flax fibre and its reinforced composite, as well as balsa wood, using the two-microphone transfer function technique with an impedance tube system. The sandwich structure with integrated natural materials was found to provide a superior sound absorption performance compared to the synthetic-materials-based sandwich structure composite. Yi et al. [10] reported on current R&D efforts to develop bio-sourced materials by an international joint project. Novel bio-sourced epoxies and biocomposites were developed, characterized, modified and evaluated in terms of the mechanical property levels. Quasi-structural composite parts were finally trial-manufactured and demonstrated. Finally, the paper of Ramon et al. [11] reviewed recent advances on new bio-based epoxy resins, which were derived from natural oils, natural polyphenols, saccharides, natural rubber and rosin.

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