Advanced Materials for Space Sustainability

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Abstract:

Advanced materials for space applications mainly involve the development of advanced composites, nanomaterials, and smart materials. They need to be innovative, highly functional, sustainable and tailored to meet the specific requirements of space travel and exploration.

In this context, Shape Memory Polymer Composites (SMPCs) are remarkably interesting for their properties and behaviour. They are sustainable materials not for their chemical nature, but for their functionalities. In fact, SMPCs allow the use of solar energy by deploying solar panels and solar sails, and the communication systems by deploying antennas, and can clean space by removing space debris. Moreover, as tested, they are low weight and durable in the harsh space environment.

For evaluating their application in space environment, SMPC samples have been designed and tested on the Materials International Space Station Experiment Flight-Facility (MISSE-FF) and in a suborbital space flight in microgravity condition. Commercial CFR prepregs have been used for samples fabrication (HexPly/M49/42%/ CHS-3 K by Hexcel). These prepregs are 0/90 fabrics with high performance epoxy matrix. The functional shape memory behavior is added to the composite laminates by using an uncured epoxy resin in the form of fine powder (Scotchkote 206 N by 3 M).

In this work, the achievement in SMPC design and testing in Space and on ground is discussed, also considering new generation photovoltaic systems for space and space sustainability.