Paper ID: 45947
interactive

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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CARBON FIBER REINFORCED BENZOXAZINE FEATURING SHAPE MEMORY BEHAVIOR FOR TEMPERATURE-DEPENDENT SELF-DEPLOYING SPACECRAFT STRUCTURES

Abstract

Shape memory polymers (SMPs) and their composites (SMPCs) offer attractive materials properties with the ability to recover their original shape after applying an external stimulus e.g. temperature. The increasing interest in SMPs and SMPCs is displayed by a growing number of applications in both structural and nonstructural parts in space crafts, e.g. hinges, booms, solar panels, reflector antennas, morphing structures, expandable lunar habitat and mandrels. Polybenzoxazines are a class of thermosets which provide excellent properties regarding mechanical performance, chemical stability as well as good flame resistance and low water absorption representing a suitable material for the highly demanding applications in the field of astronautics. This contribution presents a benzoxazine based formulation for the use in carbon fiber reinforced polymers (CFRP) with a thermally controlled shape memory behavior. This is accomplished by benzoxazine formulations with varying amounts of a polyester based additive. Depending on the additive content processing relevant parameters such as the viscosity as well as curing temperatures can be adjusted improving thereby the manufacturing conditions. Moreover, the polyester part affects the materials performance by introducing shape memory behavior under certain conditions. Thus, with the right formulation it would be possible to manufacture space saving and self-deployable lightweight parts for space crafts.