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A STUDY OF SELF-HEALING COMPOSITES IN MICROGRAVITY WITHIN A CUBESAT

Abstract

Spacecraft are exposed to various loading conditions such as stress and vibrations during launch, extreme fluctuations of temperatures, and impacts from space dust such as atomic oxygens, micrometeorites and orbital debris travelling at hypervelocity speeds averaging 10km/s. These conditions cause the creation of several cracks and punctures within these spacecraft structures. Because of the expensive nature of spacecraft, it is important to prolong the operational life of the structure as much as possible. To circumvent these problems, we propose self-healing technologies as a solution, more specifically, a self-healing material. Polymer matrix composite (PMC) materials are widely used in spacecraft as structural materials and other components due to their light weight, high specific strength, high stiffness and low coefficient of thermal expansion. Currently, various research has been conducted on adding self-healing capabilities to PMCs, however, these technologies still require some external assistance to activate the process. The object of this proposal is a PMC that proposes a different method to self-healing. This invention proposes to embed within the epoxy resin of the composite, micro-pockets of a self-healing agent. The healing-agent can be releasable by a crack in the matrix and will able to bond to the matrix to repair any damages. The composite is an invention that has been under development for many years under the supervision of Dr. Suong Van Hoa of Concordia University in collaboration with MPB Ltd. [4]. It has been previously accepted for a grant [5] and is under continuous development. However, in order to complete its development, an orbital platform would be necessary. To further pursue our goal of launching this composite, Space Concordia (SC) has designed a 3U Cubesat (Aleksandr) that can house a sample of the specimen and expose it to the space environment. The main mission of this satellite is to study the mechanical properties and self-healing capabilities of this composite when in microgravity through a three-point bending rest. By sending a sample of this composite into low earth orbit and by providing it flight heritage, further research on the intended use of the composite can be achieved.