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SHAPE MEMORY POLYMER COMPOSITE AND ITS APPLICATIONS IN DEPLOYABLE SPACE TRUSS STRUCTURES

Abstract

Shape memory polymer (SMP) composites are ideal for space applications due to their unique advantages such as variable modulus, large recovery rate and force, high stability and reliability, etc. An SMP composite deployable space structure could be easily heated and formed into a small volume, fitting into a launch vehicle. After being launched into orbit, it is then heated to deploy into its memorized operational shape. Such characteristics allow for space based structures to become larger and lighter than structures currently used in space. This paper presents some results obtained in the development of a three dimensional deployable truss using SMP composite material. The truss is constructed with carbon fiber reinforced plastic (CFRP) rods and the joints are made using shape memory polymer composite. Firstly, a type of SMP composite is prepared with a SMP matrix and carbon fibers. The recovery rates and recovery forces of the SMP composites are also tested. Secondly, the truss joints are designed and fabricated using the obtained composites. Flexible membrane heaters are integrated into the joints, which will heat the joints to achieve the glass transition temperature. Thirdly, A truss is designed and constructed using CFRP hollow rods and the developed joints. The truss is then tested and the results indicate the truss can be stowed in a small size and deployed to its original shape with a high recovery rate.