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Effects of Accelerated Aging on Thermal, Mechanical and Shape Memory Properties of Cyanate-Based Shape Memory Polymer: I Vacuum Ultraviolet Radiation

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Abstract

Shape memory polymers (SMPs) are novel intelligent materials. Evaluation of the durability of SMPs in the complex environment of future space applications helps to optimize their incorporation in space-deployable structures. In this paper, we performed vacuum outgassing and ultraviolet (UV) radiation exposure tests on a cyanate-based SMP with a glass transition temperature of 206°C. The cyanate-based SMP shows 1.04% of total mass loss and 0.01% of collected volatile condensable matter, as determined by vacuum outgassing tests. Vacuum UV radiation deepened the color of the surface, shown little effect on the thermal stability of the SMP sample. The irradiation induced some instability of the molecular structure within the material, and this effect was gradually strengthened with the increase of exposure time. However, UV radiation did not detectably change the mechanical properties of the cyanate-based SMP; the tensile strength and elastic modulus remained essentially constant at 66±2 MPa and 1,940±80 MPa, respectively. The average shape fixity rate and average shape recovery rate before and after UV radiation were all above 97.6%, and the repeatability was satisfactory.

Keywords: shape memory polymer, ultraviolet radiation, thermal property, mechanical property, cyanate resin

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