Development of Shape Memory Polymer Nanocomposites for Aerospace Applications

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This study explores the integration and characterization of shape memory composites designed for aerospace engineering, with a focus on Cyanate Ester (CE) as the shape memory polymer (SMP). CE-based SMPs are recognized for their exceptional high-temperature properties, stemming from the Cyanurate network formed during curing, which enhances their resilience in harsh environments. The shape memory properties of CE are further improved by introducing flexible modifiers into its highly crosslinked structure. Cyanate Ester/Polyethylene Glycol (PEG) composites are highlighted as sustainable SMPs for space applications due to their high glass transition temperature, superior mechanical properties, and durability. This work examines how varying PEG content influences the glass transition and curing temperatures. Characterization techniques, including SEM, FTIR, DSC, TGA, and mechanical testing, are employed to evaluate the performance of these composites. The study aims to optimize mechanical strength, thermal stability, and shape memory behavior, advancing the development of aerospace materials for deployable structures, hinges, antennas, and morphing components, particularly in high-temperature environments.

Keywords: *Shape Memory Polymer Composites, Cyanate Ester, Glass Fiber Reinforced Composites, Aerospace Applications*