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Author: Ms. Vishrutha Thyagarajan
VIT Bhopal University, India

Mr. DINENDRA ARCOT VISWANATH
Politecnico di Milano, Italy

# THERMALLY ACTIVATED DEPLOYMENT OF SPACE STRUCTURES USING GRAPHENE-INFUSED SHAPE MEMORY POLYMER COMPOSITES

**Abstract**

Deployable spacecraft structures often face trade-offs between reliability, mass and power consumption due to reliance on traditional electromechanical systems. This study proposes a graphene-infused shape memory polymer (SMP) composite that enable passive deployment through solar-induced thermal cycling. By modelling the composite's enhanced thermal conductivity and the SMP's temperature-dependent shape recovery, we simulate deployment driven solely by orbital heating. A compact geometry enables efficient stowage and predictable unfolding without motors or actuators. The material is tuned to a specific glass transition temperature (Tg) achievable during sunlit orbital phases, ensuring reliable actuation without active control. To address uneven heating across orbital cycles, particularly during eclipse phases, graphene's high thermal conductivity promotes rapid, uniform thermal response, enhancing deployment speed and repeatability. After cooling below Tg, the structure remains locked in its deployed configuration, unaffected by eclipse conditions. This work provides a foundation for lightweight, low-maintenance and sustainable deployable spacecraft supporting future long-duration missions.