**Development of a Low Thermal Expansion Nanocomposite Resin for SLA 3D Printer**

**ABSTRACT**

Stereolithography 3D printing (SLA) is an additive manufacturing process that uses UV light source to selectively cure photosensitive resin, forming a three-dimensional object through successive layers cured upon one another. This additive manufacturing (AM) technique allows engineers to create extremely complex and detailed geometries. To increase part performance, a nickel coating can then be applied which enhances mechanical strength, heat deflection and chemical resistance. However, SLA-manufactured parts such as sensor housing, optical mount, antenna brackets etc. used in aerospace applications experience large thermal gradients causing the resin and the nickel to expand at different rates and develop high internal stress. To ensure minimum dimensional changes of these critical parts at elevated temperatures a low thermal expansion SLA resin is required. This addresses the need for research in additive manufacturing by bridging the gap between fully plastic or metal parts, enabling cost-effective fabrication of high-performance components. In this research, epoxy was used as a primary resin, modified with different nanomaterials such as Multi-Walled Carbon Nanotubes (MWCNTs), silica nanoparticles, and boron nitride at different loading levels to develop a low expansion resin system for SLA printing. The SLA printed samples will be subjected to materials characterization such as microstructural investigation via scanning electron microscopy, mechanical testing – tensile, flexure via UTM, and thermal analysis to evaluate CTE via TMA. Incorporating appropriate nanofillers with proper dispersion is anticipated to result in a resin exhibiting low coefficients of thermal expansion (CTE) at elevated temperatures, while simultaneously enhancing its mechanical properties. These outcomes will validate the primary objective of this research, demonstrating advanced thermal and mechanical performance in resin composites through nanotechnological interventions.