DEPOSITION AND CURING OF THERMOSET MIXTURES FOR THERMAL PROTECTION SYSTEMS

By

Kyle Johnson

ABSTRACT

NASA and the private aerospace industry require significant advancements to Thermal Protection System (TPS) manufacturing processes to achieve the goals of improved performance, quality, and reduced cost of spacecraft. Advances in additive manufacturing (AM) and high temperature materials provide an opportunity to develop a preceramic resin-based process to reduce the cost and complexity of TPS manufacturing. The proposed research will develop a high temperature, UV initiated and infrared post cure ceramic composite for AM directly onto underlying structures that meets performance requirements. A custom polysiloxane system will be explored for AM TPS structures using a novel extrusion process. To optimize the new material and process, test structures will be fabricated, tested, and evaluated to determine the best processing parameters, photoinitiators, additives, and processing temperatures to tailor working life to ensure a 3D printed part with crosslinking between layers. The design process will iteratively account for the interaction between constituent materials, architecture, and process until the design is optimized with respect to performance, weight, and cost. The thermal and physical properties of the developed TPS material will be characterized to ensure that the material is sufficiently cured to generate the desired material properties.