NANO-PARTICLE ENHANCED POLYMER MATERIALS FOR SPACE FLIGHT APPLICATIONS

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ABSTRACT

Recent advances in materials technology both in polymer chemistry and nano-materials warrant development of enhanced structures for space flight applications. This work aims to develop spacecraft structures based on polymer matrix composites (PMCs) that utilize these advancements. Multi-wall carbon nano-tubes (MWCNTs) are expected to increase mechanical performance, lower coefficient of thermal expansion (CTE), increase electrical conductivity (mitigate electrostatic charge), increase thermal conductivity, and reduce moisture absorption of the resultant space structures. In this work, blends of MWCNTs with PETI-330 were prepared and characterized. The nano-reinforced resins were then resin transfer molded (RTM) into composite panels using M55J carbon fabric and compared to baseline panels fabricated from a cyanate ester (RS-3) or a polyimide (PETI-330) resin containing no MWCNTs. In addition, methods of pre-loading the fabric with the MWCNTs were also investigated. The effects of the MWCNTs on the resin processing properties and on the composite end-use properties were also determined.

1. INTRODUCTION

Composites cross cut many of NASA mission directorates including: Aeronautics Research Mission Directorate (ARMD), Exploration Systems Mission Directorate (ESMD), Science Mission Directorates (SMD) and Space Operations Mission Directorate (SOMD). Composites with improved properties have applications to airframes, propulsion and spacecraft. The objective of this work is to advance materials technology by implementing nano-particulate enhanced polymer materials for NASA missions.

Advances in materials technology both in polymer resins [1-13] and nano-materials fabrication & characterization [14-29] warrant development of enhanced structural materials and structures for space flight applications. By leveraging experience and past successes in the area of nano-materials by researchers at NASA Goddard Space Flight Center (GSFC), NASA Langley Research Center (LaRC), NASA Glenn Research Center (GRC), M&P Technologies, Clark Atlanta University (CAU), and the Georgia Institute of Technology we aim to develop enhanced