EVALUATION OF ELECTRICALLY CONDUCTIVE STRUCTURAL ADHESIVES

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ABSTRACT

Many aerospace applications require electrically conducting polymer-based composites for static discharge, electromagnetic interference shielding, and electrical bonding (e.g. lightning strike protection). Although existing composite structural components are conductive, the conductive pathway between joined parts is often not robust enough to satisfy these requirements. A material that provides good electrical bonding between all joints is required to assist in controlling and shielding against electrical effects. Typical electrically conductive adhesives are highly loaded (>50wt%) with conductive fillers which provide the necessary conductivity levels, but dramatically reduce the mechanical properties compared to the base polymer [1]. To reduce the filler loading levels and improve mechanical properties, adhesives were prepared by formulating resins suitable for aerospace applications with various high aspect ratio conductive fillers. The effects of filler type, loading level, and processing method on the resulting rheological, electrical, and mechanical properties were examined and compared. Several formulations were identified that exhibit single lap-shear strength values greater than 27 MPa coupled with bond resistance values less than 0.1 Ohm.

1. INTRODUCTION

The use of composites in commercial and military aircraft has grown exponentially in the last 25 years. Composite use has risen from 1-3% in the 1980's, to 50% for the next generation of commercial planes under development [2]. Military aircraft have followed a similar trend with the F-22 Raptor being comprised of approximately 23% composite, and the F-35 Lightning is expected to be 35 to 40% [3]. With this increased use of composites, and the corresponding reduction in metallic components, maintaining skin conductivity has become a significant challenge for engineers and designers.

Non-metallic surfaces, such as organic composites, can be subject to damage and interference from a variety of electromagnetic sources. Exterior skin conductivity is needed to mitigate lightning strike and electrostatic discharge (ESD) damage as well as to protect the aircraft from unwanted electromagnetic interference (EMI). Composite panels can be made conductive by