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ENHANCING SUSTAINABILITY IN LEO SATELLITE OPERATIONS: NANOCARBON-MODIFIED POLYIMIDE FOR INCREASED ATOMIC OXYGEN EROSION RESISTANCE.

Abstract

Present in the thermosphere, atomic oxygen poses a significant threat to longevity and operations of low earth orbital (LEO) satellites due to erosion-induced material failure. Polyimide (often known under trade name Kapton) is commonly used as a coating in space applications due to its insulation properties, and high temperature and chemical resistance. However, its resistance to atomic oxygen (AO) erosion is limited. This study investigates the effect incorporating graphene, has on AO erosion resistance of Kapton composites. Experimental investigations, including in depth material characterization and degradation testing under simulated space conditions indicate that graphene can significantly increase the resistance to AO erosion of Kapton. SEM analysis of the samples that were exposed to atomic oxygen bombardment under simulated space environment conditions suggest that the integration of graphene caused a substantial reduction in oxidation penetration into the polymer, evidenced by a decrease in the penetration depth from 8μm to 300nm. Furthermore, an evident decrease in the quantity of cones within the composites indicated a reduction in the deposition of volatile oxides. The outcomes of this study are expected to contribute to the development of more robust and durable materials, ensuring improved sustainability, longevity and reliability of satellite systems in the demanding LEO environment