IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

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# INVESTIGATING THE DURABILITY OF ALUMINUM OXIDE COATINGS FOR LUNAR DUST MITIGATION

**Abstract**

Wear-resistant ceramic and ceramic composite coatings are significant to provide durability and support long-duration missions to the moon's surface for rovers, landers, robotic systems, habitats, and many other components. Besides their principal role of providing protection against abrasion and wear caused by lunar dust, materials such as aluminum oxide can help to improve the durability of structures used in lunar missions by providing electrical, chemical, and thermal protection. Lunar structural components are constantly exposed to high-velocity lunar dust projectiles that can cause delamination around the affected area, which may not be physically visible. The particulates of lunar dust are considered a corrosive material, leading to the degradation of structures. Aluminum oxide presents excellent resistance to different types of wear due to its high strength and hardness. Aluminum oxide coatings have been demonstrated to provide corrosion and thermal protection to metallic components used in the gas turbine industry. In our previous studies, the photoluminescent properties of alpha-phase aluminum oxide have been used to quantify stress within the material by monitoring spectral changes defined by a piezospectroscopic (PS) relationship. Air plasma sprayed (APS) aluminum oxide coatings are normally used to improve the resistance of the underlying metallic components against wear or corrosion. In this experiment, an Inconel 738 substrate was grit blasted, a 100 micron-layer bond coat, and a 200 micron-layer of aluminum oxide were deposited using APS. Artificial damage represented by indentations was introduced on the coating using a Rockwell indenter. PS measurements were taken to detect the underlying coating delamination. The peak shifts from the characteristic alumina peaks revealed the underlying damage quantifying the effect of the projectile on the overall coating integrity. Additional studies focusing on determining the coating resistance to wear, abrasion, and impact using regolith simulants are ongoing. The optical properties of aluminum oxide, utilized in the studies performed here, have offered a unique means for understanding the durability of a material with high spatial and stress resolution. Aluminum oxide has a demonstrated capability to provide structural protection and dust mitigation.