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DEVELOPMENT OF COATINGS FOR PASSIVE MITIGATION OF LUNAR DUST AT CSIRO

Abstract

Lunar dust is the finest fraction of lunar regolith and has posed significant challenges for lunar operations since the first Moon landings in the 1960s. It consists of fine, electrostatically charged and abrasive particles. The hazards associated with lunar dust include accelerated wear on mechanical components, interference with thermal control systems, and health risks for astronauts, including via respiratory and skin exposure. With the rapid interest and development in lunar exploration, addressing this issue is crucial for the sustainability and success of future lunar missions. Ongoing research at CSIRO aimed at developing and testing innovative passive coatings designed to mitigate the adverse effects of lunar regolith will be described in this presentation. The primary objective is to create surfaces that effectively repel or reduce the adhesion of dust particles without the need for active intervention. These coatings offer a lightweight and energy-efficient solution, particularly advantageous for long-term lunar operations where payload mass and energy consumption are critical constraints. Our research has focused on engineering coatings with properties suited to the lunar environment, with characteristics including topographical structures and conductive properties. The development of advanced polymer composites and nanomaterials to meet these requirements will be discussed. This presentation will discuss laboratory testing protocols developed and used to simulate lunar conditions, as well as the limitations and challenges associated with earth-based testing. Preliminary findings demonstrate a significant reduction in dust adhesion to the developed coated surfaces. These developed coatings can be integrated with other active dust mitigation strategies or used independently in applications where active methods are not feasible, reducing energy and mass requirements. This has significant implications for protecting key systems on the lunar surface. Applying these coatings on habitats, surface structures, and vehicles could reduce the risk of dust contamination, enhancing crew safety and operation efficiencies. Addressing lunar dust adhesion onto surfaces is a key enabler for a safe and sustained human lunar presence.