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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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LUNAR DUST AND ITS EFFECTS ON THE FUTURE LUNAR EXPLORATION AND A SMART DOUBLE MECHANISM SOLUTION TO REPEL FROM LUNAR SPACECRAFTS AND SYSTEMS

Abstract

In the next year, the lunar surface missions will increase exponentially thanks to Artemis missions (NASA, ESA, CSA, and JAXA). As was discovered during Apollo missions, the lunar surface imposes a challenging environment on space hardware. Especially the presence of lunar dust impacts the performance of functional systems and coatings. The lunar surface material is composed of small sharp-edged particles. The dust is fine, abrasive, and sharp, being dangerous for long-time lunar missions. Due to the incident radiation, the lunar dust becomes electrostatically charged causing an extremely complex electrostatic environment that can impact dramatically on mechanisms, habitats, and astronauts. This leads to a significant change in the operative properties of a variety of systems, such as vacuum seals, wires, optical lenses, solar panels, radiators, and windows. Additionally, lunar dust could trigger toxic responses, affecting to astronaut's lungs, nervous, and cardiovascular systems. Dust mitigation has been an issue for space agencies since the Apollo missions. A wide range of dust mitigation strategies has been studied in the state of the art for use in the Lunar environments such as passive, fluidal, mechanical, irradiation, electrodynamic, electrostatic, and filtration. The aim of this work is to make signs of progress for lunar dust-repellent strategies carrying out a smart surface-double mechanism based on an Electrodynamic Dust Shield (EDS). The EDS is based on the generation of a changing non-uniform electric field capable of accelerating the dust by dielectrophoretic force repelling the positive and negative charged lunar dust deposited in future lunar systems. The EDS is based on the generation of a changing non-uniform electric field capable of accelerating the dust by dielectrophoretic force repelling the positive and negative charged lunar dust deposited on future lunar systems. The EDS involves different materials to cover a wide range of applications and components such as solar cells, thermal systems, and spacecraft structures. Also, a dielectric patterned layer is proposed as a shielding coating, preventing the electric short-circuits of the EDS and providing an extra repellent passive functionality to the surface solution using special coatings and laser texturing. Finally, the mechanism integrates an electronic control system based on flexible electronics or/and component embedded electronics by using sputtering and laser scribing techniques. This will help in the integration and reduction of the system weight, being a reliable solution future lunar missions.