Project Summary

Phase II SBIR Contract NNX10CA47C

1.0 Purpose of Research

Problems related to lunar dust have been identified since the Apollo missions; however, no credible mitigation techniques have been implemented to date. The purpose of this SBIR research was to develop a multi-use coating system comprised of 1) highly wear resistant coatings for use in the space environment and 2) a conductive circuit when electrically activated, would repel fine lunar dust particles.

1.1 Brief Description of Research Conducted

In Phase II, coatings identified during Phase 1 as potential multi-use coating candidates were optimized, tested and manufactured in a coating architecture that could resist wear and abrasion, and when electrically activated repel dust. Electrical properties of candidate coatings were validated and modeled to aid in design of the multi-use coating. Abrasive wear resistance was demonstrated by pin-on-disk testing under vacuum using mare JSC-1A lunar regolith simulant. From computer modeling of the coating system and dust mitigation test results, a prototype for a multi-use sealing surface was developed.

1.2 Research Findings

Electrically conductive and non-conductive coatings that resist wear and abrasion by lunar dust simulant were produced. These coatings were deposited onto typical spacecraft substrates in an architecture that when electrically activated removed lunar regolith simulants, Mare JSC-1A and Highland NU-LHT, from their surfaces.

Functionality of the electrically conductive trace components was maintained after pin-on-disk wear testing conducted in vacuum with lunar dust simulant JSC-1A. It was found to be beneficial for the electrode traces to be flush or recessed into the dielectric alumina. During testing and modeling an electrical field normal to the surface lifts the particles off the test plates allowing for the use of sunken conductive traces into the dielectric. The ability to manufacture recessed traces has significant benefits for the coating system, i.e., the dielectric coating provides additional protection to the trace material further enhancing wear protection, abrasion resistance and durability. A null point in the center of two electrodes that presents itself when the coating is applied to a large conductive substrate can be circumvented by manipulating the power source that energizes the electrodes.