Interactions of Electrostatically Charged Dust Grains with Phospholipids: production and mobilization of charged grains. M.J. Schabile[1], T.M. Orlando[1] Affiliations: [1]School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, Georgia, 30332, United States

Introduction: Solar and cosmic radiation can damage and modify both biologic tissues and the surfaces of airless bodies in space. Radiation can erode the atomic surface layers of regolith grains through sputtering and stimulated desorption, thus creating reactive surface sites, emitting low energy secondary electrons, and electrostatically charging dust grains. Irradiated grains can themselves damage biologic tissues and sensitive electronics. Charged grain interactions with biomolecules can lead to chemical bond breaks which impair cell function and lead to adverse health effects. Toxic effects of dust are well known in Earth environments, and the energetic processing of regolith on airless bodies can create additional adverse effects due to unsatisfied surface bonds, potentially enhancing the reactivity. Mitigating the potentially harmful effects of dust is a crucial step toward sustained exploration activities on airless bodies. In particular, it is important to have a means of discharging and passivating regolith grain surfaces for safe exploration by both humans and robots.

The goal of this work is to characterize damage caused by irradiated and electrostatically charged dust grains brought into contact with molecular bi-layers of the phospholipid DPPC, the same molecule that makes up cell wall membranes within lung tissue. The results obtained in this study will help determine the potentially toxic effects caused in lung tissues when they come into contact with space weathered regolith dust grains.

Experimental: Through collaborations with the REVEALS, IMPACT, and LEADER (formerly DREAM2) SSERVI teams, a novel high vacuum system was constructed at Georgia Institute of Technology that can electrostatically charge grains either through vibrational tribocharging or exposure to electrons from a hot filament source. Interactions of charged grains with both biomolecule films and conducting polymer materials was studied by either placing the grains directly on top of the sample and vibrationally charging them, or by dropping the charged grains onto the samples. Charged grains can be mobilized (in decreasing order of efficiency) by vibrating the sample holder, by bathing the grains in electrons and applying a pulsed high voltage to the sample holder, or through electrostatically repulsive hopping following the patched charge model.

In this presentation, we share recent efforts to characterize the DPPC films before and after exposure to charged grains. Analysis will be carried out using atomic force microscopy (AFM), x-ray photoelectron spectroscopy (XPS) and infrared spectroscopy (FTIR). Preliminary analysis of charged dust grains with the DPPC films deposited on bare silica showed that the grains did not strongly adhere to the surfaces, but that discharge caused changes in the molecular bonding and film morphology.

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