

## Electrostatic Properties of Lunar Dust

Data from the Apollo program, as well as recent lunar missions, indicate that electrostatic charging and discharging phenomena take place on the moon. A horizon glow roughly one meter above the surface of the Moon was detected by Surveyor 5, 6, and 7 and more recently by the Clementine spacecraft. Experiments on Apollo 17 detected evidence of horizontal dust transport on the lunar surface. Dust dynamics such as these are thought to be the result of electrostatic charging of the dust particles due to their interaction with the photoelectron layer above the lunar surface.

Electrostatic charge is transferred between two surfaces whenever a contact potential exists between the surfaces. As the surfaces separate, the charge is driven back across the interface to prevent the potential from increasing. The maximum charge that can be acquired by an isolated surface is limited by electrical breakdown. The potential at which electrical breakdown occurs, as given by Paschen's law, depends on the pressure of the medium in which the solids are embedded. At the high vacuum conditions of the lunar environment, this potential could be large for certain separation distances.

The Electromagnetic Physics Laboratory is currently studying the extent at to which electrostatic charge can be generated and how it can accumulate on lunar soil and dust particles. Lunar simulant samples prepared by the Johnson Space Center from a volcanic ash deposit in the San Francisco volcano field near Flagstaff were received in our laboratory. A scanning electron microscope analysis of this simulant was performed to characterize its composition. The simulant has been exposed to high electric fields under extremely low humidity conditions to obtain values for its Gauss limit and to study its discharge characteristics. A typical decay curve is shown in figure 1. Charge to mass ratios for these materials are also being determined to understand the different electrostatic responses of individual dust particles, larger clumps of particulate matter, and sand-like particles. Several materials were also rubbed with the simulant to determine their electrostatic response. Typical voltages obtained are shown in figure 2.

The findings from this research effort will provide critical information and techniques for the successful operation of an extraterrestrial spaceport by eliminating potential hazards relating to dust accumulation on equipment surfaces, astronaut suits, solar panels, habitat filters, thermal radiators and other equipment that would degrade their performance or render them unusable. Commercialization potential of the technologies developed could have applications for the antistatic, paint and grain industries.

### Key Accomplishments:

- ?? Acquisition of an Environmental Chamber and a Charge-to-Mass System.
- ?? Scanning electron microscope characterization of lunar simulant particles.
- ?? Determination of the electrostatic response of lunar simulant particles exposed to insulating materials at low humidity and low pressure conditions.
- ?? Determination of the maximum charge and charge relaxation times of lunar simulant dust particles.
- ?? Determination of the charge to mass ratio of a distribution of lunar granular particles.

Key Milestones:

- ?? Experiments with actual lunar dust
- ?? Determination of the charge generated on dust particles by photoemission due to UV absorption.
- ?? Expose materials to charged and uncharged lunar dust under simulated lunar environmental conditions.

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**File: "Lunar Simulant Charge Decay.xls"**  
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**Figure 1**

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**File: "Insulator Charging with Lunar Simulant"**  
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**Figure 2**