

Silica Dust Lofting due to Secondary Electron Emission and Surface Electric Field in the Vacuum Chamber Experiments

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Lunar dust grains can be lofted due to charge accumulation within the micro-cavities, and the repulsive force can overcome the forces of gravity and contact depending on several parameters such as particle size, dust density, surface cleanliness or packing density. In addition, dust particles can be charged simultaneously by the incoming electron current while receiving charge from the neighboring particles. Consequently, the charged grains can be mobilized due to electrostatic forces by the surface electric field and the repulsion between the particles, or any other external force. In our experiments, silica dust grains, which have sizes between <6 and $45\ \mu\text{m}$ in radius, are loaded on a graphite plate under $4 \times 10^{-3}\ \text{Pa}$ pressure, and the dust lofting is observed under the electron beam with 450 eV energy. In addition, a high-speed camera is used to record the transportation of the dust grains with a speed up to 500 frames per second with a microscopic telescope. It is observed that some grains carry smaller sized particles on their surfaces that can be detached after being mobilized. The first experiments are performed with the samples prepared without applying any pressure towards the graphite plate surface, and the experimental results of the initial vertical launching velocity and the maximum heights of the dust particles are in agreement with the estimated values. In the following experiments, the dust sample is prepared with various pressure levels to increase the packing density; hence it is expected to increase the contact forces between the particles. In the initial results, it is seen that several particles are launched simultaneously from the same location. Therefore, it can be due to particle-particle collisions in the vicinity of the surface, which can decrease the required charge to mobilize a dust grain.

Keywords: dust lofting experiment, secondary electron emission, dust charging