

# 1 Laboratory Measurements of Optical and Physical Properties of Individual Lunar Dust Grains

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The lunar surface is covered with a thick layer of sub-micron/micron size dust grains formed by meteoritic impact over billions of years. The fine dust grains are levitated and transported on the lunar surface, and transient dust clouds over the lunar horizon were observed by experiments during the Apollo 17 mission. Theoretical models suggest that the dust grains on the lunar surface are charged by the solar UV radiation as well as the solar wind. Even without any physical activity, the dust grains are levitated by electrostatic fields and transported away from the surface in the near vacuum environment of the Moon. The current dust charging and levitation models, however, do not fully explain the observed phenomena. Since the abundance of dust on the Moon's surface with its observed adhesive characteristics has the potential of severe impact on human habitat and operations and lifetime of a variety of equipment, it is necessary to investigate the charging properties and the lunar dust phenomena in order to develop appropriate mitigating strategies.

Photoelectric emission induced by the solar UV radiation with photon energies higher than the work function of the grain materials is recognized to be the dominant process for charging of the lunar dust, and requires measurements of the photoelectric yields to determine the charging and equilibrium potentials of individual dust grains. In this paper, we present the first laboratory measurements of the photoelectric yields of individual sub-micron/micron size dust grains selected from sample returns of Apollo 17, and Luna 24 missions, as well as similar size dust grains from the JSC-1 simulants. The experimental results were obtained on a laboratory facility based on an electrodynamic balance that permits a variety of experiments to be conducted on individual sub-micron/micron size dust grains in simulated space environments. The photoelectric emission measurements indicate grain size dependence with the yield increasing by an order of magnitude for grains of radii sub-micron size to several micron radii, at which it reaches asymptotic values. The yield for large size grains is found to be more than an order of magnitude higher than the bulk measurements on lunar fines reported in the literature.