INDICTION OF WORK FUNCTION IN MINERAL ELECTROSTATIC MIGRATION

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Introduction:

Although electrostatic transport of lunar fine charged dust had not been detected in LADEE mission [1], fine dust grains charged by photoelectric emission (PEE) and secondary electron emission (SEE) are actually present on the lunar surface and have been verified by lunar surface exploration missions, such as Apollo missions with Dust Detector Experiments (DDEs) and Lunar Ejecta and Meteorite (LEAM) experiment [2-3]. With solar ultraviolet (UV) and X-ray irradiation, dust grains can be charged positively by photoelectric emission (PEE) and secondary electron emission (SEE). Accumulation of such charged dust particles would change surface potential of the Moon. Lunar Prospector mission detected the surface potential of the lunarsunlit side rised from several voltages to tens voltages [4-5]. Varieties of local surface potentials might form an electrical field and drive the charged dust grains migrating at the lunar surface. Such movement of charged dust might in-crease the risk of manned or unmanned lunar surface exploration, and it might also be the main cause of lunar horizon glow formation [6]. On the sunlit side, the dominant process charging the lunar dust grains has been identified as photoelectric emission induced by solar UV radiation [7-8]. Photoelectric emission is dependent on the UV photon energy and the work function (WF) of the dust grain. The WF is a character of physical properties of one mineral. Therefore, the WF of dust grains composed of different mineral may vary and play a key role controlling energy of the produced photoelectrons and consequently the grain dynamics.

In this study, we experimentally measured work function of several common minerals composed of the lunar dust and discussed their charging characteristics at the lunar sunlit surface. Different minerals have different WF values, which has been suggested to dominantly control the charging characters of one grain under solar UV radiation. Our preliminary experiments measured WFs of olivine, plagioclase, pyroxene, ilmenite using the SPM. The WF values are 7.90±0.35 eV, 5.58±0.38 eV, 5.14±0.36 eV and 4.29±0.11 eV, respectively. These mineral grains can be charged to several thou-sand positive electrons under solar UV irrdations. Also, under the same irradiation condition, different minerals might show different charging characters and consequently, a different electrostatic migration process at the lunar surface.

References:

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