Abstract #3

Kinetic and potential sputtering enhancements of lunar regolith erosion: the contribution of the heavy multicharged (minority) solar wind constituents*

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We report preliminary results for H+, Ar+1, Ar+6 and Ar+9 ion sputtering of JSC-1A lunar regolith simulant at solar wind velocities, obtained at the ORNL Multicharged Ion Research Facility using quadrupole mass spectrometry. The multi-charged Ar ions were used as proxies for intermediate mass solar wind multicharged ions. Prior to the Ar beam exposures, the sample was exposed to high fluence H+ irradiation to simulate H-loading due to the dominant solar wind constituent. A x80 enhancement of oxygen sputtering by Ar+ over same velocity H+ was measured and an additional x2 increase for Ar+9 over same velocity Ar+ was demonstrated, giving clear evidence of the importance of potential sputtering by multicharged ions. This enhancement was observed to persist to the maximum fluences investigated (~10^16/cm^2). As discussed in a companion abstract by N. Barghouty, such persistent sputtering enhancement has significant implications on weathering and aging of lunar regolith. In addition, XPS measurements showed strong evidence of Fe reduction for those target areas that had been exposed to high fluence Ar+ and Ar+8 beams. Preferential oxidation of the Fe-reduced beam-exposed regions during transfer to the XPS system led to enhanced O concentrations in those regions as well. On the basis of these very promising preliminary results, a NASA-LASER project on more extensive measurements was recently selected for funding. The proposal expands the collaboration with NASA-MSFC for the simulation effort, and adds a new collaboration with NASA-GSFC for lunar mission-relevant measurements.

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