

Master Thesis

Development and validation of an experimental method for space weathering gram-scale batches of lunar regolith simulant using pulsed laser irradiation

Experimental thesis

Start date: As soon as possible

Topic:

The Moon's surface is constantly bombarded by micrometeoroids, which drive "space weathering" and alter the properties of lunar surface materials. Nanosecond pulsed lasers have been used for more than three decades to simulate the rapid energy deposition associated with these impacts, producing grain fragmentation, melting, and vaporisation. Under suitable conditions, irradiation can also produce nanophase metallic Fe particles.

Commercially available lunar regolith simulants do not fully reproduce the effects of space weathering observed in returned lunar samples. Changes in grain morphology, glass content, and nanophase metallic iron may affect regolith thermal properties and interactions with water, motivating the development of weathered simulants for laboratory studies.

This study aims to develop and evaluate a method for treating gram-scale batches of lunar regolith simulant using an existing pulsed laser and vacuum chamber. The main challenge is to design a mechanism that repeatedly exposes fresh grain surfaces to the laser. Irradiated samples will be compared with untreated controls using scanning electron microscopy (SEM) to assess morphological and chemical changes consistent with space weathering.



Figure 1: Current laser and vacuum chamber setup.

Tasks:

- review and summarise previous studies using pulsed laser irradiation to simulate space weathering
- design and build a mechanism for irradiating gram-scale batches of lunar regolith simulant
- compare irradiated samples with untreated controls using SEM
- (*optional*) compare thermal properties of irradiated vs untreated samples, with relevance to studies of lunar water

Requirements:

- basic knowledge of and interest in lunar and planetary exploration
- basic knowledge of optics and spectroscopy
- interest in experimental work and willingness to learn sample preparation and instrument operation
- good command of the English language

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