# TITLE:
# Thermophysical and chemical evolution of lunar regolith during thermal processing

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**Abstract**

In-Situ Resource Utilization (ISRU) is about identifying, extracting, and utilizing local materials directly at their native site, providing a key pathway towards sustainable space exploration. For lunar exploration, lunar regolith is the main available resource. Its thermal processing underpins most ISRU technologies. These include solutions for storing thermal energy in lunar soil, extracting volatiles from regolith, and producing oxygen, which is vital for human respiration and is the best oxidant for use in a fuel cell or, if liquefied, as rocket propellant.

In all these processes, lunar regolith plays a critical role. Its composition and mineralogy control adsorption-desorption behavior, volatile retention, and vapor release dynamics. Particles' size distribution and porosity influence permeability, gas diffusion, and pore-scale vapor transport. Moreover, the regolith's thermophysical properties strongly affect heat transfer and thermal gradients. Overall, regolith properties can control processing efficiency during thermal treatment.

Although lunar regolith is often treated as a homogeneous granular material, it is an extremely complex, multi-scale system whose behavior under lunar conditions remains poorly explored.

Hence, the proposed project will build upon this gap. It aims at developing a fundamental understanding of the thermophysical behavior and evolution of lunar regolith during thermal processing. To accomplish this objective, advanced experimental activities will be carried out. Indeed, ASI has established an in-house laboratory equipped with scientific instruments for lunar regolith characterization. In this facility, researchers may use Raman spectroscopy to assess regolith's chemical fingerprint, Transient Plane Source (TPS) technology to evaluate its thermal properties, and thermogravimetric analysis to measure mass variation with temperature. Furthermore, density measurements (skeletal and apparent), optical microscopy and Dynamic Image Analysis will help to investigate regolith morphological features. Such experiments will also lay the groundwork for implementing numerical models in multiphysics simulations. These latter will serve to predict the thermophysical behavior of regolith under lunar conditions and evaluate possible optimization strategies for the thermal extraction processes.

We welcome enthusiastic and proactive candidates with a strong background in material science, planetary science, geophysics, physics, engineering, or a related discipline. Applicants may have a background in any one of these fields and should demonstrate a strong interest in interdisciplinary research. Experience in the characterization of granular materials, thermophysical property measurements, laboratory experimentation, data analysis, and/or numerical modeling is highly desirable. A genuine passion for lunar exploration and In-Situ Resource Utilization (ISRU) is essential.