NASA SBIR/STTR Technologies

Phase II For Improved Lunar and Martian Regolith Simulants

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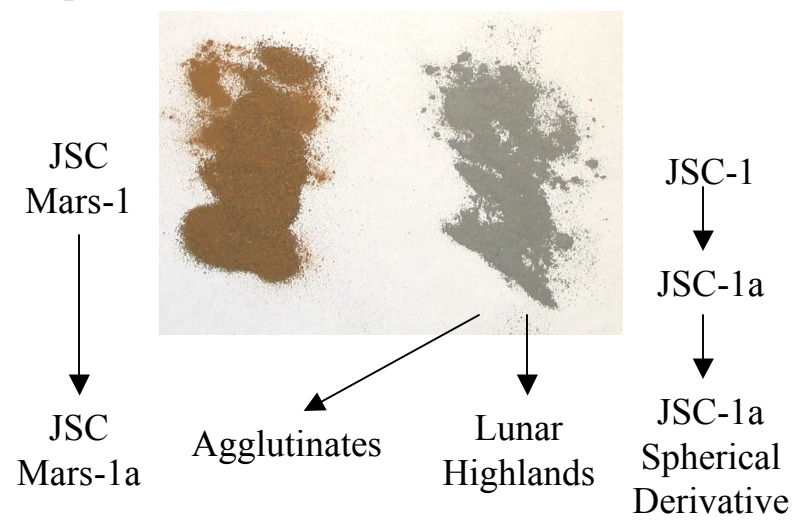
Proposal No:

Identification and Significance of Innovation

NASA's exploration initiative created immediate need for materials science and technology research to enable human travel and robotic work on future long-duration missions. To conduct this research, NASA must have lunar and Martian regolith simulant for extra-vehicular activity experiments, testing of transportation and habitation equipment, human health and advanced life support systems, and *in situ* resource processing. This work will not only lead to a safer course of exploration, but could lead to the use of Lunar and Martian regolith in oxygen production, radiation shielding, propellants, building materials, permanent landing platforms, vegetable growth systems, and other components still undefined. Additionally, the potential toxicity and respiration problems associated with the small size fraction of regolith poses one of the greatest risks to the entire human exploration program. These fundamental questions have created an immediate need for well-characterized simulants, and as missions grow closer to launch applications will require lunar and Martian regolith simulants of the highest fidelity possible.



Technical Objectives

The Phase II technical objective is to provide a more complete investigation of the simulants needed to meet long-term needs of the scientific community based on the updated NASA outline for exploration. The project will create several prototype simulants for characterization and analysis against actual regolith and NASA requirements. The current simulants to be addressed by the Phase II include:

- Spherical glass inclusion JSC-1a derivative
- Artificial agglutinate inclusion JSC-1a derivative
- Lunar highlands simulant
- Improved JSC Mars-1a simulant

Work Plan

- Complete Martian mining access permitting and produce prototype for analysis
- Produce three spherical glass derivatives, characterize and analyze
- Develop process for creating a lunar highlands simulant from the Stillwater, Montana complex
- Produce a highlands prototype, characterize and analyze
- Investigate requirements for agglutinate properties, then investigatepotential processes to create and study feasibility of each
- Produce an agglutinate prototype, characterize and analyze

NASA Applications

- *In situ* propellant production
- Human health studies
- Mitigation of dust and electrostatic accumulation for human and robotic systems
- Habitat construction (i.e. waterless concrete bricks from regolith)
- *In situ* oxygen production
- Autonomous robotic testing
- Planetary excavation equipment development

Non-NASA Applications

- Research material for universities, company R&D, testing
- Educational kits, school outreach, science fairs
- Centennial Prize, Commercial Space Tourism testing
- Museum displays of lunar and Martian landscapes

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