In-Situ Resource Management (ISRU): Extraction of Lunar Oxygen Resources (ELOR)

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ABSTRACT

Extraterrestrial resources hold great potential for enabling humanity to build a permanent presence in Outer Space, moving beyond the Earth-Moon system and into the Solar System at large. The renewed opportunities for lunar exploration have rekindled interest in extraterrestrial resource utilization and thus have become a substantial topic interest in all space fairing leading nations. Oxygen is the major propellant for rockets. Oxygen depots on Moon will lead to more cost effective space missions, since its transport from Earth to Moon requires an extensive and costly mass transport and logistic. Lunar regolith consists of about 45 weight% of oxygen, which processing will be mandatory for future space exploration especially regarding propulsion aspects. The process is based on the reduction of Ilmenite ($FeTiO_3$) at a temperature of about T = 1000°C using solar heat. For the feedstock a volcanic lunar soil simulant is used, which will be collected with a robotic unit, facing the following challenges: a) lunar regolith consists of interlocking dust-like particles in a highly compacted soil, which requires high penetrating forces and special bearing techniques. b) The collection-unit has to be light-weight, energy-efficient and autonomously controllable. Currently the conception design process for the three modules of the plant is running: the regolith robotic collection unit, the process chamber and the oxygen post processing and storage unit.