SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies for Enable Future Building Blocks in Space Exploration and Development (3)

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A NOVEL PROCESS FOR THE PRODUCTION OF LUNAR AND MARTIAN PHYSICAL ASSETS AND ITS EXPLOITATION FOR FUTURE SPACE MISSIONS

Abstract

The goal of this work is the development of new processes useful for future manned space missions, in the framework of the so-called ISRU (In-Situ Resource Utilization) and ISFR (In-Situ Fabrication and Repair) concepts. Specifically, the approach to ISRU will focus on technologies necessary to extract consumables for human life-support system replenishment while ISFR is aimed to satisfy other human needs particularly related to the Fabrication Technologies, the Repair Non Destructive Evaluation Technologies and the Habitat Structures. In the framework of ISRU and ISFR applications, a novel recently patented process based on the occurrence of Self-propagating High temperature Synthesis (SHS) reactions potentially exploitable for the in-situ fabrication of construction materials in Lunar and Martian environments is described. The final purpose is to allow manned space missions to extract and utilize in-situ resources necessary for human survival without being equipped with huge amount of supplies and to utilize specific

technologies to repair Lunar and/or Martian platforms also using in-situ materials, otherwise transported from the Earth. As it is apparent, the possibility to increase mission-time and economic aspects represent the main direct consequences. Along these lines, the Self-propagating High temperature Synthesis (SHS) process represents a promising tool because of its low consumption energy and relatively-simple configuration equipments required. In this work, the mixtures to be reacted by SHS are prepared taking advantage of the composition of lunar and martian regoliths: Lunar regolith simulant JSC-1A , Martian regolith JSC-1A , and Mojave Martian regolith simulants are considered. In addition, Aluminum is used as reducing agent for all systems examined, whereas ilmenite and iron oxides, namely ematite, are added to the initial mixtures to be reacted in order to increase their exothermicity. It should be noted that both ilmenite and iron oxides are anyhow present in significant quantities on Moon and Mars, respectively. The effect of starting mixture compositions on the self-propagating behaviour is examined under different gas pressures of the environment (atmospheric or vacuum) and gravity level (terrestrial or microgravity) and the optimal experimental conditions are identified for each system investigated. The obtained products are characterized in view of their possible utilization as building materials.