SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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BIO-ISRU: CONCEPTS USING MICROORGANISMS TO RELEASE O2 AND H2 ON MOON AND MARS

Abstract

Since space exploration missions begun, numerous spacecrafts were sent to space for examination of other planets. One limiting factor of the endurance of such missions is the unlasting energy supply to run devices and motors of the space crafts as well as for locally habitats. The high weight and volume of fuels makes embedding of local resources necessary to allow extension to long term missions. Nature demonstrates how to survive in extreme environments. Some more adapted microorganisms like *Chlamydomonas reinhardii* even release elementary hydrogen from water under special nutrition which might be used to run fuel cells and provide electric energy. The same organism release oxygen by photosysthesis under standard nutrition, the counterpart of hydrogen to operate fuel cells. Planets of interest are covered by potential toxic soil called "Regolith". Lunar regolith is known to be extremely aggressive and inhibit cells grows not only due to its sharp edges. First studies on lunar soil simulant tolerance of *Chl.reinhardii* have shown promising results. The single cells surround the substrate without any negative influence. A 3-dimensional tissue like matrix was build by the proliferating now adhering micro algae cells and the substrate. The photosynthesis rate was not negatively influenced by the soil. This enables *Chl.reinhardii* to become a first settler organism of the lunar surface. Maybe a first step of terraforming to allow the growth of higher organisms. Lunar soil regolith consists of several components. Especially in minerals bound oxygen plays an outstanding role for industrial use. Some microorganisms of the proteobacteria type are reducing ferroxides to gain oxygen under anaerobic conditions while they produce electric energy simultaneously. For a faster electron transfer a special group of proteobacteria built filamentous nanowire-like structures to connect one cell to the other. A bioreactor hosting specific microorganism might be run to provide oxygen to the life support system embedded in a permanent Moon or Mars base. This method demonstrates a low energetic oxygen release, a serious alternative to high the energetic oxygen separation of the ilmenite process, fluorination process, melting hydrolysis, vacuum distillation or photo dissociation, respectively. Not only oxygen production of the biological processes should be in focus of space application. Also the metal oxide reducing component of the process might run batteries to provide energy to devices of a Moon or Mars base.