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Selection Committee. HQ follow up is not required.

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Title

“PowerCell”: the interface between Mars resources and human exploration

Abstract:

The barriers to forming human settlements on Mars are high but surmountable within our lifetime. While the Apollo astronauts carried their life support with them, our success in exploring and forming settlements on Mars depends on our ability to use local Martian resources to generate the materials and conditions humans need to survive, so-called *in situ* resource utilization (ISRU). On Earth, biology provides us with food, shelter, oxygen, and other materials. Off-planet, synthetic biology will enable numerous parallel productions: optimized food production, water treatment, air treatment, environmental monitoring, regolith biomining, waste management, cell based biomaterial production, biocementation, and *in situ* synthesis based on received DNA sequences. How will the organisms responsible for these synthetic production systems obtain organic carbon and fixed nitrogen in the hostile Martian environment? We envision a synthetic-biology enabled Martian colony and introduce here the critical intermediate component – a biological “power” source – needed to transform the *in situ* resources found on Mars into biological feedstocks to enable growth of production organisms. Here, we present our first “PowerCell”, a photosynthetic and nitrogen-fixing filamentous cyanobacterium engineered to provide a carbon-rich fuel source for a biological life support system on Mars. We provide a vision of how the PowerCell system will operate in a Martian colony based on ground experiments and preparations for testing in space as a NASA secondary payload aboard the upcoming DLR Eu:CROPIS satellite mission experiments.

Key Words: Mars (planet), Life Support Systems; In Situ Resource Utilization