

21st IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)

Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies
(2B)

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PYRITE BASED SOLAR PANEL IN-SITU PRODUCTION ON THE MOON FOR SPACE-BASED
SOLAR POWER

Abstract

ESA Director General Josef Aschbacher has defined Moon as the seventh continent and compared its exploration possibilities with discovering America. Establishing a lunar economy with lunar industry creates the need for power and one of the most ambitious energy sources on the Moon will be Space-Based

Solar Power (SBSP). This paper outlines a roadmap for establishing a sustainable presence on the Moon, by utilizing locally available resources and manufacturing solar cells for SBSP. Our team has defined pyrite as an absorber material in solar panels that will generate electrical power for lunar operations and in Solar Power Satellites (SPS). Pyrite (isometric FeS₂) is a mineral that can be extracted from the lunar surface, it has all the necessary electrical and optical properties for a solar cell absorber material, while the power conversion efficiency of such solar cell can reach 25%. The path of fabricating pyrite solar cells includes in-orbit detection of ores, mining the source material, solar cell manufacturing, solar panel assembly, and concludes with the usage of the panels for lunar sourced SPSs. The Polish Academy of Sciences and partner SMEs are developing the MIRORES far-IR orbital spectrometer to remotely map sulfide and oxide ores on the Moon's surface, helping to locate suitable landing sites for mining operations. The desired minerals can be extracted using Four Point mining technology, which specializes in electrification of mining equipment and development of autonomous machines for resource excavation and extraction. TalTech has developed a technology that enables the use of pyrite in the absorber layer of monograin layer solar cells produced from lunar iron and sulfur minerals, resulting in inexpensive and robust solar panels suitable for early lunar exploration and SBSP. Astrostrom GmbH is currently researching the feasibility of the Greater Earth Lunar Power Station (GE-LPS) concept, a crewed Solar Power Satellite (SPS) designed to provide power to lunar surface operations. This facility will be constructed primarily from lunar sourced materials, including basalt and metal products, and will use photovoltaics manufactured using monograin layer solar cell technology obtained from pyrite and robotically assembled at the Earth-Moon Lagrange point 1. By manufacturing SPS components from lunar materials and transporting them to GEO, the launch bottleneck for terrestrially produced SPS systems may be mitigated.