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PYRITE FES2 SOLAR CELLS FABRICATION FOR LUNAR BASE ENERGY PRODUCTION

Abstract

Establishing a sustainable lunar outpost will require using as many locally available resources as possible. One of the more important issues will be the availability of energy sources. Solar panels are a very promising option because some areas around the lunar South Pole are constantly illuminated by sunlight. Instead of bringing the solar panels from Earth, it would be more sustainable to find a way to produce them *in-situ* on the Moon. The lunar regolith holds several iron-bearing minerals and we have identified pyrite FeS2 as one possible candidate for the solar cell material, as it has all the necessary electrical and optical properties, the power conversion efficiency of such solar cell could reach 25%.

Our research team has proposed to use monograin layer (MGL) solar cell technology for the in-situ solar panels production on the moon. The MGL solar cell has a superstrate structure: back contact/absorber/buffer/conductive oxide layer/transparent substrate, where the absorber is a monolayer of nearly unisize, with a typical diameter of 50 μm, semiconductor powder crystals. The production of monograin layer solar cells involves simpler manufacturing steps and less material refinement steps, compared with standard silicon solar cell technology that has been proposed before for *in-situ* solar cell production from the lunar soil.

From our perspective, there are three options to produce pyrite microcrystals for MGL solar cell, if we consider using resources available on the Moon as much as possible. Option one is to use elemental Fe and S to grow pyrite microcrystals. Advantage for this approach is that it is relatively simple to control the composition and synthesis procedure for pyrite microcrystals growth but the main disadvantage is that there is no elemental Fe and S on the Moon. For that reason, it is needed to use extensive extraction methods to extract materials from the lunar ore *in-situ*. Option two to grow pyrite microcrystals is to

use troilite FeS and add sulfur that is extracted from the troilite. According to the literature, troilite is available on the Moon, nevertheless it is still necessary to extract sulfur or bring it from the Earth. Third option is to use pyrite directly, grind the source material and resynthesize it in the suitable microcrystalline form. It is reported that pyrite can be found in the lunar highland area in small quantities. In the current work we present the results of growing pyrite microcrystals from three different source materials, from elemental iron and sulfur; binary compound FeS and elemental sulfur; and finally, from pyrite FeS2 itself by grinding and recrystallization. We characterize grown crystals' electrical and optical parameters and use these crystals for monograin layer solar cell fabrication. We also propose the most promising option for *in-situ* "lunar" solar cell fabrication for powering the lunar base.