

Optimization of Photovoltaic Performance through the Integration of Electrodynamic Dust Shield Layers

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The viability of photovoltaics on the Lunar and Martian surfaces may be determined by their ability to withstand significant degradation in the Lunar and Martian environments. One of the greatest threats is posed by fine dust particles which are continually blown about the surfaces. In an effort to determine the extent of the threat, and to investigate some abatement strategies, a series of experiments were conducted outdoors and in the Moon and Mars environmental chamber at the Florida Solar Energy Center.

Electrodynamic dust shield prototypes based on the electric curtain concept have been developed by our collaborators at the Kennedy Space Center [1]. These thin film layers can remove dust from surfaces and prevent dust accumulation. Several types of dust shields were designed, built and tested under high vacuum conditions and simulated lunar gravity to validate the technology for lunar exploration applications.

Gallium arsenide, single crystal and polycrystalline silicon photovoltaic integrated devices were designed, built and tested under Moon and Mars environmental conditions as well as under ambient conditions. Photovoltaic efficiency measurements were performed on each individual cell with the following configurations; without an encapsulation layer, with a glass covering, and with various thin film dust shields. It was found that the PV efficiency of the hybrid systems was unaffected by these various thin film dust shields, proving that the optical transmission of light through the device is virtually uninhibited by these layers.

The future goal of this project is to incorporate a photovoltaic cell as the power source for the electrodynamic dust shield system, and experimentally show the effective removal of dust obstructing any light incident on the cell, thus insuring power production is maximized over time.

[1] C.I. Calle, C.R. Buhler, J.G. Mantovani, S. Clements, A. Chen, M.K. Mazumder, A.S. Biris, A.W. Nowicki, Electrodynamic dust shield for solar panels on Mars, Lunar and Planetary Science XXXV, 2004, p. 2014.