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Author: Mr. Andrea Zanin
Research Consortium Hypatia, Italy

Dr. Gildo Di Domenico
Fondazione E. Amaldi, Italy

POWER PRODUCTION IN SPACE WITH CIGS SOLAR CELLS

Abstract

Space-Based Solar Power (SBSP) is a sustainable alternative to fossil fuel-based energy supplies which can complement conventional renewable sources, by offering clean, continuous, and scalable baseload power. The fundamental concept of SBSP is to perform solar power collection in space with large Solar Power Satellites (SPS) which then distribute it wirelessly down to the ground. Collecting solar power in space is advantageous in many ways compared to ground-based collection. The solar flux received on space-based platforms is predictable and continuous (due to the absence of day-night cycles, seasonal variations, and local weather) and of higher intensity (due to the absence of atmospheric attenuating effects). Considering the sum of all typical reduction factors, the solar flux received in space can be around an order of magnitude greater than the best average available at most locations on Earth. The development of a photovoltaic generator for use in space satellites is presented. The generator is composed of copper-indium-gallium-diselenide (CIGS) thin film photovoltaic cells deposited on a thin, lightweight, and flexible titanium substrate. The study presents the possibility to create cells with a high power-to-weight ratio in the order of KW per Kg. The modules find numerous applications, including lunar bases and artificial satellites, with the object to Increase the power-to-weight ratio to achieve 1000 W/kg and make the module easily adaptable to satellites. High power-to-weight ratio is the crucial parameter in photovoltaic systems for space use where the space is a minor limitation, with photovoltaic conversion efficiency also being of minor impact in regards to the resistance to cosmic radiations or debris impact. The cells developed do not require heavy specific protections, such as glass or borosilicate, against ionizing radiation, especially thermal protons, micrometeoroids, and microdebris, while the polymer film used for encapsulation offers excellent transparency to solar radiation and protection against environmental physical agents. Considerable flexibility is a crucial factor, allowing adaptation to any surface, compact dimensions for launch, and even easy deployment. In addition to the photovoltaic energy generation system, also an electronic system for managing photovoltaic energy (MPPT), battery recharging (MBS), and output management for the payload is studied.