Photon-enhanced thermionic energy converters for laser beaming in space

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Keywords: *Laser beaming, photo-thermionic energy conversion, high-power laser beams, harsh environments, lunar exploration*

Abstract:

The development of a compact, lightweight, scalable, and efficient power generation technology for mobile platforms and satellites is mandatory for planetary science and exploration missions. Laser beaming can be a versatile power carrier where no infrastructure is present. However, mobile platforms need lightweight and compact laser energy converters for an effective and practical usage. In order to meet such requirements, CNR proposes a scientific concept based on the novel solid-state photon-enhanced thermionic emission converter (PETEC) supplying energy to robotic systems from conversion of high intensity laser light. Under development for concentrated solar power, the advantage of PETECs is the capability to manage laser fluxes even higher than 200 W/cm^2 with a potential conversion efficiency outperforming photovoltaics in harsh environments. PETEC is able to surpass the historical limitations of thermionic energy converters (TECs) thanks to lower operating temperatures (<700 °C) and to the application of refined concepts and methods in materials science and engineering. Moreover, the operations in vacuum conditions typical of some extraterrestrial conditions, such as the lunar environment, significantly facilitates the device structure. The proposed technology can pave the way to sustainable planetary missions: it can operate in permanently shadowed regions and greatly reduce issues in thermal stresses of extra-terrestrial day/night cycles, that pose the biggest technical challenge for power supply of rovers, drones, and satellites. The technology specifically focusses on exploration of permanently shadowed regions on the moon with valuable resources for sustainable lunar missions and where the proposed compact power unit enables cheaper and less complex operations.

Conflicts of Interest

I declare no conflict of interest.

Funding

The activity is funded by the PRIN2022 TECHPRO “Thermionic Energy Conversion for High Power RadiatiOn” project no. 2022KXKR3S by the Italian Ministry of University and Research within the framework of the EU Programme Next Generation Europe.