All-perovskite tandem solar cells and modules on flexible multi-purpose photonic substrates

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Abstract:

The surge in satellite launches and in-orbit activities calls for breakthroughs in cost-effective solar energy harvesting technologies for space deployment. The EU-funded JUMP INTO SPACE project [1] envisions a high-efficient, lightweight and flexible, stable and sustainable alternative to currently available PV panels for in-space energy harvesting: all-perovskite tandem solar cells [2], targeting 30% power conversion efficiency. A pioneering, lightweight and flexible, multi-purpose photonic substrate embodies the dual function of environment shielding and light-coupling boost, while being remarkably stable against radiations, UV and ATOX erosion. Innovative light trapping methods, i.e. resonant wave-optical micro-structures integrated in the substrate, are pushed beyond the state-of-the-art to boost the light absorption in the perovskite layers, while reducing their thickness and improving mechanical flexibility. This approach also brings extra benefits for in-space operation, such as photonic protection against high-energy radiation [3]. JUMP INTO SPACE all-perovskite tandem solar cells on innovative multi-purpose photonic flexible substrates, featuring high efficiency and power-per-weight ratio, stability and to the possibility of being rolled or folded, will be game-changers for powering novel propulsion apparatus for in-space mobility, e.g. systems for active debris removal, micro- and cube-sats. They will also be deployed in Space-Based Solar Power (SBSP) plants, and, through novel, properly designed transmission technologies, will power various in-space applications, such as Moon or Mars human bases, or even provide Earth with continuous energy from space.

All these use cases are explored within the EIC Pathfinder “In Space Solar Energy Harvesting” Portfolio [4], funded by the European Innovation Council (EIC), a visionary initiative uniting 9 cutting-edge projects to revolutionize how solar energy is collected, transmitted, and used in space. The projects selected are from the Space Challenge call WP2023 Pathfinder “In Space Solar Energy Harvesting” on advancing concepts, methods and technologies for new types of antennas, rectennas, solar energy conversion and microwave or laser transmission and its use for in-space green propulsion. Addressing the increasing need for in-space mobility, the work is structured across 4 dedicated Working Groups (WG1: Solar Cells, WG2: Wireless Power Transmission, WG3: In-Space Green Propulsion, and WG4: System Engineering), each tasked with defining strategic plans and clear objectives for the coming years, ultimately strengthening the EU’s leadership and strategic autonomy in space innovation.

Conflicts of Interest

The Authors declare that there is no conflict of interest.

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