Flexible and rollable tandem perovskite/CIGS solar cells for space

Nikolai Oh*, InSu Jin, Shinyoung Noah

Flexell Space Co., Ltd., Republic of Korea
* *nikolai.oh@flexellspace.com*

Keywords: *Perovskite/CIGS tandem solar cells, space photovoltaics, flexible solar cells, stability*

Abstract:

As the space industry transitions into the New Space era, the demand for lightweight, high-efficiency, and cost-effective power solutions has significantly increased due to the increase need for multiple satellites. Conventional solar-grade photovoltaic technologies, such as III–V compound semiconductors, offer excellent stability and performance. However, their adoption is constrained by complex fabrication processes and the high cost of production.

Next-generation tandem solar cells, particularly perovskite/$Cu(In,Ga)Se_2$ (CIGS) architectures are emerging as promising alternatives to traditional III–V space photovoltaics, offering comparable efficiencies at significantly lower manufacturing costs. CIGS solar cells are particularly attractive compared to silicon-based counterparts due to their high efficiency potential, radiation tolerance, and the feasibility for flexible device fabrication, which is essential for applications such as NASA's Roll-Out Solar Array (ROSA).

However, CIGS cells exhibit lower performance in the blue region of the solar spectrum, limiting their overall efficiency. Its integration with perovskite top cell which is known for its strong absorption in the blue and visible range addresses this limitation. The resulting perovskite/CIGS tandem structure is thus a highly promising candidate for next-generation space photovoltaics.

Despite their advantages, perovskite solar cells still face challenges in stability, particularly under extreme space conditions. To address this, we have developed perovskite solar cells with passivated interfaces, significantly reducing degradation under intense light illumination and temperatures up to 110 °C. When integrated with CIGS in a 4-terminal tandem configuration, the device achieved a power conversion efficiency exceeding 20%.

The fabricated devices also exhibit mechanical flexibility, maintaining performance after multiple roll-in/roll-out cycles when integrated on flexible printed circuit boards. The low cost, light weight, and robust flexibility position this technology as a potential milestone in the development of space photovoltaics.

Conflicts of Interest

Please declare that there is no conflict of interest.