Data Driven Tuning Of Perovskite Photovoltaics For Space Applications in Leonardo Innovation Labs

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Abstract:

Recent funding from public and private entities fueled the flourishing of the space economy. However, the development of a sustainable space economy requires affordable and reliable power systems, such as photovoltaics (PV), to provide electrical energy to global internet constellations, space missions and planet colonization. To be economically viable, photovoltaics for space application should have low manufacturing costs, high efficiency and specific power, and reliable long-term stability. Perovskite photovoltaics, one of the most promising emerging PV technologies, has proven to the scientific community to be an excellent candidate for space photovoltaics. Indeed, perovskite solar devices have significantly higher power to weight ratio than conventional semiconductor cells employed in space applications, and have also demonstrated high radiation hardness towards electrons, protons, and gamma-rays.[1]

Nevertheless, the research of perovskites devices for space applications is still at its infancy if compared to the state of the art for terrestrial applications. Therefore, for perovskites to be real contributors to the space economy, three macro-challenges need to be addressed: 1) the optimization of the device architecture towards high performances and long-term stability in the harsh space environment; 2) the development of innovative materials to reduce the overall device weight and to shield the sensitive components from UV-radiation and high vacuum; 3) the standardization of the manufacturing and certification procedures for high performance lightweight perovskite solar modules.

Leonardo is committed to the space domain, investing in fundamental research to produce solar panels as indispensable elements for the supply of energy to satellites and spacecraft, regardless of their mission. The aim is to realize lightweight and flexible perovskite solar module with high specific power, excellent long-term stability, and low manufacturing cost with the aid of a digital twin for perovskite solar cells. The goal of the digital twin is to help the industry to minimize the time-to-market of perovskite photovoltaics in space using data-driven insights, for e.g. understanding possible degradation pathways directly from the stability track using drift-diffusion. This will allow an indirect analysis of the solar cell while it's operating in space, effectively producing insights to optimize the performance of the next generation of perovskite solar modules.

Conflicts of Interest

The authors declare no conflict of interest.

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References

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