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Proton Beam Irradiation of CsPbBr3 Lead Halide Perovskites

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During the last decade Lead Halide Perovskites (LHPs) have been widely researched in the photovoltaic and light emission fields due to their outstanding optoelectronic properties and exceptional performance. Owing to their low cost and easy fabrication, tremendous achievements were achieved in solar cell, photodetector, light-emitting diode and laser research fields.

On the other hand, space application of PSCs is also anticipated, driving much research attention on the stability of PSCs in the space environment, as lightweight, large-area, high-efficiency solar cells are in high demand in the space industry. Because spacecraft weight restrictions directly affect the progress of space development, reducing the weight of solar cells is of main importance. To be applied in space environment, radiation resistance of such materials is critical. Charged particles, such as protons and electrons can penetrate the materials, cause structural deformations thus limiting the operation lifetime of devices. In this sence radiation resistance of perovskites is an important issue to deal, prior to its application in space.

In this work lead halide perovskite thin films were subjected to proton-beam irradiation (energy 18MeV, dose 1014 −1015p/cm2) in order to assess the durability and radiation tolerance of perovskite solar cells (PSCs) against space radiation. Proton-beam irradiation is chosen because proton beams significantly affect solar cell performance in the space environment. We evaluate the effects of proton beams by focusing on the absorption properties, crystal structure, and morphology by using optical spectroscopy, X-ray diffraction, and scanning electron microscopy. The results show that proton irradiation with energy 18 MeV and doses up to 1015p/cm2 does not significantly affect the absorption coefficient and crystal structure of the perovskite layer.

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