Resilience of flexible perovskite solar cells employing a novel PTAA-like HTM against atmospheric neutron irradiation

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Abstract:

Flexible perovskite solar cells (f-PSC) are excellent candidates for space applications, thanks to record efficiencies of 25.05% [1], and power densities as high as 30 W/g [2]. Here, we synthesized a new Hole Transport Material (HTM) in which PTAA is copolymerized with a phenothiazine, and studied degradation damages induced by atmospheric-like neutrons ($5*10^9$ n/cm^2, ~400 times the yearly fluence in LEO) in f-PSC employing PTAA and our HTM. Both HTMs showed good resilience against the radiation: devices based on our in-house synthesized HTM showed little to no loss in efficiency, while PTAA counterparts still retained ~80% of their initial efficiency. In all cases the V_{OC} of our devices remained stable, pointing to minimal non-radiative recombination losses induced by neutrons. Such observation was corroborated by microscopic photoluminescence mapping on perovskite samples, which showed minimal changes in the spatial distribution of photoluminescence over the observed areas. Crystallographic analysis showed that while the perovskite crystallinity in general remains high, unbound PbI_2 defects in PTAA devices increase upon radiation, while our in-house alternative showed a consistently lower PbI_2 peak before and after the irradiation, suggesting that the modified HTM can effectively passivate the perovskite interface and stabilize it against such defects formation.

Conflicts of Interest

No conflict of interest.

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