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Co-additive Engineering of Lead free Perovskites Solar cells for Enhanced Photovoltaic Performance and Improved Stability

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Sn-based perovskite solar cells (PSCs) have attracted tremendous attention to the scientific community due to their low toxicity and superior optoelectronic properties in comparison to Pb-based perovskites. In spite of favorable photovoltaic properties, power conversion efficiency (PCE) of Sn-based PSCs remains far below as compared to Pb based system. The reasons for their inferior device performance are the facial tendency of oxidation from Sn^{2+} to Sn^{4+} which leads to unwanted p-type doping and to form films with lots of pin-holes. Here in this work, we find that the introduction of longer carbon chain as a coadditive in $FASnI_3$ precursor solution with SnF_2, significantly improves the stability of $FASnI_3$ films and increases the PL life time. From our Kenvin Probe Force Microscopy measurement, we observed that the addition of this coadditive minimized the contact potential difference between the grain interior and the grain boundaries, rendering the material more uniform under the solar cell operating condition. These remarkable enhancement of the $FASnI_3$ film boots the PCE of Sn-based PSCs from 2.5% to 6.95%. Moreover encapsulation the devices are highly stable under maximum power condition up to 100 h without any loss of efficiency. This study presents a simple and effective approach for enhancing performance and stability of Sn-based PSCs.