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Enhanced air stability of Tin-Based Perovskite Solar Cells with Quercetin

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As the most essential alternative materials for eco-friendly perovskite solar cells (PSCs), Tin-based perovskites have achieved an efficiency of 14.81%, which is far less than 25.7% of lead-based devices. The main reason is that it is easy to oxidize to Sn^{4+} in the presence of oxygen and water due to the low stability of the Sn^{2+} state. The oxidation of Sn^{2+} will form the Sn (IV) vacancies in the perovskite structure, leading to p-type self-doping and introducing additional defect states. These defects can enhance the device's leakage current and carrier recombination, limit the increase of open circuit voltage, and thus reduce the battery's efficiency. Here, we plan to introduce Quercetin, a phenolic derivative with antioxidation properties extracted from plants, as the additive to reduce the existence of Sn^{4+} and prevent the $FASnI_3$ film from degradation. We also use grazing-incidence wide-angle X-ray scattering (GIWAXS) to gain insight into the detailed steps of the growth and degradation progress of the active layer. Thereby, GIWAXS offers a way to gain information about the time evolution during the crucial steps of interface formation. The ultimate goal of our work is to design efficient and stable tin-based PSCs to develop a systematic and reproducible strategy for air stability and high-efficiency PSCs.

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