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What is the initial stage of degradation mechanism for perovskite solar cells?

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Mixed organic-inorganic hybrid perovskite solar cells have shown a promising future because of their outstanding photoelectric performance. The power conversion efficiency (PCE) of perovskite solar cells (PSCs) reached the champion value of 24.2 %, making this technique competitive with commercial silicon solar cells. Despite all these advantages, the application of PSCs is currently limited by combining high performance and operational stability because PCE of PSCs can degrade due to the presence of temperature, light, humidity, and oxygen. In addition, the rapid developing progress in the fabrication of PSCs has not accompanied the development of start-of-the-art characterization methods. Current degradation research on PSCs is performed by simple current-voltage measurement. Therefore, it is necessary to introduce new characterization tools for analyzing the degradation mechanisms of PSCs. We investigated initial-stage degradation processes of different device architectures of PSCs under illumination condition with in-situ grazing incidence wide-angle X-ray scattering (GIWAXS) and grazing incidence small-angle X-ray scattering (GISAXS). With this approach, we are able to follow the evolution of characteristic structures and of the inner morphology under illumination. After understanding the degradation mechanisms for different device architectures, potential solutions could be found to suppress degradation.

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