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Moisture-Induced Degradation in Perovskite-Based Photovoltaics

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Hybrid organic-inorganic halide perovskites $CH_3NH_3PbX_3$ ($X = I, Br, Cl$) are promising novel materials for the application in future photovoltaics (PVs), with a tunable absorption characteristic and efficiencies comparable to silicon. Since solution-based fabrication techniques and the use of flexible substrates are possible, perovskite PVs are potentially low-cost and could find application in new fields, where conventional silicon is unfeasible. However, perovskite is sensitive to moisture, which seems to primarily drive the degradation of the crystal structure. Some of the typically used contact layers also show long-term degradation. Achieving long-term stability of perovskite and of its contact layers would therefore open a wide range for future applications.

We will analyze the moisture-induced morphological changes of typically employed contact layer materials and in mixed halide perovskite with X-ray diffraction techniques, UV/VIS spectroscopy, scanning electron microscopy, and photoluminiscence. Especially grazing incidence scattering techniques allow us to trace the degradation across the sample on an area relevant for devices. The characterization and understanding of the degradation process will help us to select suitable materials with an improved long-term stability. Designs with a promising stability will be subjected to in-situ measurements, to directly assess the nano-morphological changes which drive the degradation of perovskite PVs.

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