Using Low Temperature Photoluminescence Spectroscopy to Investigate CH$_3$NH$_3$PbI$_3$ Hybrid Perovskite Degradation

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Investigating the stability and evaluating the quality of the CH$_3$NH$_3$PbI$_3$ perovskite structures is quite critical both to the design and fabrication of high-performance perovskite devices [1] and to fundamental studies of the photophysics of the excitons. In particular, it is known that, under ambient conditions, CH$_3$NH$_3$PbI$_3$ degrades producing some PbI$_2$ [2]. We show here that low temperature photoluminescence (PL) spectroscopy is a powerful tool to detect PbI$_2$ traces in hybrid perovskite layers and single crystals [3]. Because PL spectroscopy is a signal detection method on a black background, small PbI$_2$ traces can be detected, when other methods currently used at room temperature fail. Our study highlights the extremely high stability of the single crystals compared to the thin layers. Defects and grain boundaries are then thought to play an important role in the degradation mechanism.

Figure 1 Photography of a 800 nm thick CH$_3$NH$_3$PbI$_3$ layer deposited by spin-coating on a quartz substrate, just after the deposition (left) and 4 days after the deposition (middle). (Right) Photography of a millimeter sized MAPI crystal, 6 months after its growth.
References


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