Stability enhancement of metal halide perovskite thin films via vapor-phase passivation

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Enhancement of structural stability of metal halide-based perovskites (MHPs) is an essential requirement for commercial device applications because their optoelectronic properties and device performances are interrelated with the crystal lattice integrity. Several approaches have recently attempted to prevent the degradation by introducing surface passivation agents or fabricating two-dimensional (2D) perovskite phases on the outer surfaces of three-dimensional (3D) MHP lattices where a majority of studies are focused on the solution-based methods. Here, we present an in situ approach to passivate the MHP thin films with vapor-phase agents to improve their stability. Specifically, thin films of methylammonium lead iodide ($MAPbI_3$) prepared via the chemical vapor deposition (CVD) method are treated with phenethylammonium iodide (PEAI) in the vapor phase to accommodate the formation of passivation layers. Changes in the grain size and surface roughness of the as-treated $MAPbI_3$ films confirm the emergence of the 2D passivation layer on top of $MAPbI_3$. The stability difference between treated and untreated $MAPbI_3$ films is also presented.