Title: Improved performance and stability of $CsPbI_3$ perovskites solar cells by dimensionality and precursor material regulating

Abstract: Inorganic $CsPbI_3$ perovskites have shown promising potential for achieving all-inorganic photovoltaic (PV) devices. However, the black perovskite polymorph (α-phase) of $CsPbI_3$ easily converts into yellow colour (δ-phase) in an ambient environment and it is only stable at high temperature (above 320 °C), which limits its practical application. In the report, we tailor the three-dimensional $CsPbI_3$ perovskite into quasi-two-dimension through adding a large radius cation phenylethylammonium (PEA^+). The incorporation of PEA^+ into the $CsPbI_3$ perovskite significantly improves the film morphology as well as the phase stability. An optimal $Cs_xPEA_{1-x}PbI_3$ perovskite film remains stable in the black phase from room temperature to 250 °C in air. Furthermore, we systematic investigation of $DMAPbI_3$ ("mythical" hydrogen lead trihalide, i.e. $HPbI_3$, also known as $PbI_2{\cdot}x$HI) as the starting material, and achieve high-quality $Cs_xDMA_{1-x}PbI_3$ perovskite films with uniform morphology, low density of trap states and good stability, leading to an optimized power conversion efficiency (PCE) up to 14.3%. Our findings offer new insights into producing high-quality Cs-based perovskite materials.