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Effects of Annealing Temperature on Stability of Methylammonium Lead Iodide Perovskite Powders

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The methylammonium lead iodide ($CH_3NH_3PbI_3$ or MAPbI) material is currently investigated as active material in perovskite solar cells. Its stability, high optical band gap, low processing temperature and abundant elemental constituents provide numerous advantages over most powder absorber materials. In this work, the stability of MAPbI perovskite powders under different annealing temperature conditions was examined. X-ray diffraction (XRD) measurement demonstrated that the direct mixing synthesis method was able to produce a highly crystalline MAPbI material in a tetragonal phase structure. Thermal stability measurement based on the Simultaneous Thermal Analyzer (STA) indicated that the MAPbI was stable below 275°C. The optical properties were characterized by employing refraction spectroscopy, which confirmed a direct bandgap of 1.53 eV in MAPbI perovskite powders. FT-Raman and XPS spectra confirmed the existence of organic groups. The annealing affected significantly the phase formation and stability of MAPbI. A small amount of lead iodide (PbI_2), a product of the degradation, was observed with increasing annealing temperature. Therefore, a suitable annealing temperature should be chosen to produce MAPbI powders, which in turn will result in a high performance perovskite solar cell.

Keywords: methylammonium lead iodide; perovskite; XPS

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