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Effect of Organic Cation on Defect States of $CH_3NH_3PbI_3$ Perovskite Films Prepared by an Ultrasonically Sprayed- Nebulous Deposition Method

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Methyl ammonium lead iodine $CH_3NH_3PbI_3$ based perovskite with low degree of disorder is of great interest for optoelectronic and photovotaic applications.In this work, a layer of $CH_3NH_3PbI_3$ has been successfully deposited on fluorine doped tin oxide (FTO) coated on glass by an ultrasonically sprayed-nebulous method. Changes in their structural and optical properties along with details of photo-induced charge separation and transportation behaviors upon the perovskite conversions induced by the amount of organic cation are systematically examined by X-ray diffractometry (XRD), UV-vis spectroscopy and surface photovoltage spectroscopy (SPV), respectively. The SPV spectra reveal a significant reduction of the deep defect states when increasing the number of organic content, which is indicative on a passivation of the defects. The Urbach energy (E_u) related to the degree of disorder in the films is quantified from the absorbance spectra, from which the measured values of Eu decrease from 33.36 to 28.24 meV as the amount of organic content is increased to the optimum condition. We present that the utilization of ultrasonically sprayed-aerosols deposition has a potential for fabricating high quality of $CH_3NH_3PbI_3$ perovskite.

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