Elemental, Optical, and Electrochemical Study of $CH_3NH_3PbI_3$ Perovskite-Based Hole Transport Layer-Free Photodiode

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In the present work, we have fabricated and characterized in the development of methylammonium lead iodide ($CH_3NH_3PbI_3$) perovskite-based hole transport layer (HTL)-free photodiode with configuration (FTO/$CH_3NH_3PbI_3$/$PC_{60}BM${[6,6]-phenyl-C_{60}-butyric acid methyl ester}/Al. The one-step spin coating technique has been used for the deposition of the precursor solution including methylammonium iodide and lead iodide with molar ratio 3 : 1 to prepare the perovskite thin films onto FTO-substrate. The elemental study has been done by EDX spectroscopy. Furthermore, surface morphology of $CH_3NH_3PbI_3$ thin film has been characterized with the importance of photovoltaic parameters such as charge carrier mobility, saturation current, and barrier height, by $I(V)$ measurements. The expected rectification and photo response behavior has been analyzed from energy level diagram of the materials. The device demonstrates good photo response and exhibits saturation current in the value of $4.5 \cdot 10^{-4}$ mA and mobility of $5.27 \cdot 10^{-4}$ $cm^2 \cdot V^{-1} \cdot s^{-1}$, respectively. Moreover, the charge carrier lifetime has been calculated of $7.81 \cdot 10^{-4}$ s by electrochemical impedance spectroscopy (EIS).

Keywords: hybrid perovskites, spin-coating, charge carrier mobility, XRD with lattice parameters, resistance, capacitance, lifetime, electrochemical impedance spectroscopy.

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