High performance perovskite solar cells fabricated with dopant-free organic hole transporting materials

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This paper reports on the synthesis of three different hole transporting materials (HTMs) based on benzoselenadiazole-core unit, denoted as RSe-CF, RSe-TPA and RSe-R HTMs. Herein, the different acceptor/donor units like 3,5-bis(trifluoromethyl) benzene (CF), alkyl thiophene (R), and triphenylamine (TPA) in benzoselenadiazole were considerably influenced the optoelectronic, structural, thermal, and photovoltaic properties of HTMs. The optical and electrochemical studies of these HTMs reveals the alternation of energy levels thus, they employed to improve the charge conduction and mixed-halide ($Cs_{0.03}FA_{0.97}PbI_{2.9}Br_{0.1}$) perovskite solar cells (PSCs) performance. The highest power conversion efficiency (PCE) of ~17.3% recorded for RSe-TPA HTM without dopant than the PSCs fabricated with RSe-R and RSe-CF HTMs. The improvement in PCE of RSe-TPA HTM also credited to the highly quenched photoluminescence spectra of HTM/$Cs_{0.03}FA_{0.97}PbI_{2.9}Br_{0.1}$ thin film for efficient charge transfer beneficial for effective hole injection from valence band of perovskite to HOMO of HTMs resulting in high photocurrent-density and high PCE.