

Planar type trivalent bismuth based Pb-free perovskite-sensitized solar cells

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Perovskite solar cells has attracted attention as a promising candidate of replacing silicon solar cell. However, the highly efficient perovskite solar cell contains toxic lead, so it is necessary to develop Pb-free perovskite solar cell to minimize the impact on environment. There is a lot of candidate material for Pb-free perovskite solar cell. Especially, tin is nice choice of perovskite raw material instead of lead because it is divalent metal like lead. Besides, it has narrower bandgap than lead based perovskite materials. However, tin based perovskite materials are suffer from severe oxidation in air so it is big huddle to use it for stable solar cells. Alternatively, trivalent metal such as bismuth has good stability in air. So, we demonstrated stable planar type $\text{Cs}_3\text{Bi}_2\text{I}_9$ perovskite-sensitized solar cell (P-SSC) was verified by fabricating a glass/FTO/ TiO_2 / $\text{Cs}_3\text{Bi}_2\text{I}_9$ /PTAA/Au construction. The unencapsulated $\text{Cs}_3\text{Bi}_2\text{I}_9$ P-SSC maintained its initial efficiency for >500 h under continuous light soaking by 1 Sun at 65°C and 60-70% relative humidity. Its functional stability may be due to the Bi based perovskite structure being more robust than the divalent Pb based perovskite one.