All-Inorganic Cesium Perovskites lead to Next Generation Solar Cells

Kyushu Institute of Technology ¹, The University of Electro-Communications ²

Teresa S. Ripolles¹, Shuichiro Fujino², Kengo Hamada¹, Takehide Sato¹, Taro Toyoda², Qing Shen²
and Shuzi Hayase¹

E-mail: teresa@life.kyutech.ac.jp

Recently, perovskite absorber materials have drastically paid attention in the photovoltaic field due to the impressive improvements in the photoconversion efficiencies of up to 20%. Numerous researchers pointed out their studies in the enhancement of photovoltaic characteristics due to these semiconductors are earth abundant, solution-processed active layers, and low-cost production. A key role in achieving good device performances is the device architecture including mesoporous or planar (regular or inverted structures). In particular, we studied all inorganic cesium lead triiodide, CsPbI₃, perovskite solar cells because this material is more thermal stable than the standard methylammonium lead triiodide CH₃NH₃PbI₃, but is still far from achieving their impressive power conversion efficiencies. The photoconversion characteristics exhibited poor cell performances in mesoporous TiO₂ scaffold layer CsPbI₃ perovskite solar cell. The reason was demonstrated by transient absorption spectroscopy which concluded that some recombination processes occurred from the electron injected on the TiO₂ and the hole photogenerated in the perovskite CsPbI₃. We suggested two options to reduce the charge loss by (i) planar TiO₂ structure, or (ii) cover the nanoparticles-TiO₂ with a thin film of alumina Al₂O₃. In both cases, an improvement of the overall cell performances were showed. These results offer insight into the promising direction for developing all inorganic cesium solar cells.