

Toward high open circuit voltage: MACl-assisted Germanium doping to organic-inorganic hybrid perovskite solar cells

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Although the high power conversion efficiency (PCE) over 25% has been reached for organic-inorganic hybrid perovskite solar cells (HyPSCs), many research groups still have difficulties realizing high efficient and stable HyPSCs.¹ The reasons behind this lie on the poor reproducibility due to extreme sensitivity to environmental conditions during fabrication. Obtaining stable open circuit voltage (Voc) is the hardest compared to other parameters such as short circuit current density (Jsc) and fill factor (FF) as the interfaces at each layer critically affect the degree of recombination of electron and holes. Here, we modified perovskite/hole transport layer (HTL) interface using Germanium (Ge) doping in lead-based HyPSCs.² Unlike the application of Ge in all-inorganic perovskite solar cells, Ge in lead HyPSCs has not been reported presumably due to the poor solubility of GeI₂ during the preparation of perovskite precursor. The addition of methylammonium chloride (MACl) substantially increase the solubility of GeI₂ in the precursor, resulting uniform Ge-Pb based organic-inorganic hybrid perovskite films. The PCE over 22% has been realized for Ge-Pb HyPSCs with high Voc (1.18V) despite relatively low content of bromide (Br). Here we also introduce the efficacy of MACl-assisted Ge-doping to Tin (Sn)-Pb perovskite. The resulting Ge-Sn-Pb triple B cation perovskite solar cells show high PCE, which is in accordance with Ge-Pb based HyPSCs.

Reference

- 1) <https://www.nrel.gov/pv/cell-efficiency.html>
- 2) G. M. Kim, A. Ishii, S. Oz, T. Miyasaka, *Adv. Energy Mater.* **2020**, 1903299