Efficient and Thermally Stable Perovskite Solar Cells

[1]OPERA Kyushu Univ., [2]JST ERATO, [3]ISIT °C. Qin,[1,2] T. Matsushima,[1,2] T. Fujihara,[3] C. Adachi[1,2]
E-mail: cjqin@opera.kyushu-u.ac.jp, adachi@cstf.kyushu-u.ac.jp

Organic-inorganic halide perovskite solar cells (PSCs) are promising for next-generation clean energy because they can achieve high power conversion efficiencies and be fabricated with simple and low-cost methods. Although a certified efficiency of 22.1% has been achieved through state-of-the-art device engineering, the device stability is still not sufficient for widespread commercialization. Extrinsic factors such as moisture, oxygen, UV light, and temperature are known to limit the stability of perovskite materials and PSCs made from them, but intrinsic degradation mechanisms must still be further clarified to find new solutions for fabricating PSCs with excellent long-term stability.

Among the known intrinsic factors, carrier traps and defects that degrade the device performance and lifetime have already been observed in PSCs with methylammonium lead triiodide ($CH_3NH_3PbI_3$) perovskite absorbers. In our previous work, we found that hole traps are easily generated after exposure of $CH_3NH_3PbI_3$ perovskite films to the moisture in air, which accelerates the degradation of PSCs under continuous light irradiation.[1] Through systematic experimental studies, we showed that Frenkel defects are detrimental to the stability of PSCs and that metallic lead is a possible intrinsic origin of carrier traps. By virtue of the weak reduction properties of a benzoquinone additive, we were able to suppress the formation of metallic lead and effectively extend the lifetime of the PSCs.[2] Furthermore, we systematically studied thermal stability of planar PSCs and performed thermal cycling tests using standard ISOS-T-1 thermal cycling. Finally, both efficient and thermally stable PSCs was achieved by material and device engineering.[3]

References:

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