Efficient Semi-transparent Perovskite Solar Cells Prepared by the Hybrid Deposition Method

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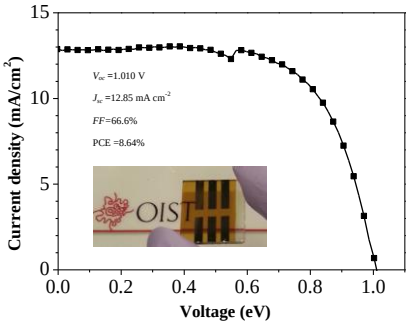
Perovskite materials $CH_3NH_3PbX_3$ [X=Cl, I or Br] have recently attracted increasing attention in the photovoltaic field due to their desirable opto-electronic properties and versatile fabrication methods. Among them, the vacuum evaporation method offers several unique advantages, such as the formation of high-purity ultra-smooth perovskite films, the capability to tune electronic properties of multi-layer interfaces of devices by doping, the compatibility with the well-established technologies of first- and second- generation solar cells. However, very few groups have successfully utilized vacuum-based deposition to fabricate perovskite solar cells. The main reason could be the small molecular weight of methylammonium iodide (CH_3NH_3I, MAI), which results in a random diffusion of molecules inside the vacuum chamber and causes difficulty in monitoring and controlling the MAI deposition rate using quartz crystal thickness monitor. Here, we provide details for the development of an instrumentation and methodology to overcome the common difficulties facing the vacuum-related techniques by precisely controlling the flow of MAI and the deposition rate of metal halide ($PbCl_2$ or PbI_2). Under the optimized conditions, PSCs with ～10% of power conversion efficiency (PCE) was achieved by employing a thin perovskite layer (<150 nm) (Figure 1).[1,2] We will also show some results when the hybrid deposition method is applied to another type of perovskite materials.



References:

[1] L. K. Ono, S. Wang, Y. Kato, S. R. Raga and Y. B. Qi*. "Semi-Transparent Perovskite Films with Centimeter-scale Superior Uniformity by the Hybrid Deposition Method", Energy Environ. Sci. (2014) 7, 3989.

[2] S. Wang, L. K. Ono, M. R. Leyden, Y. Kato, S. R. Raga, M. V. Lee and Y. B. Qi*. Submitted.