Improved Stability of Perovskite Solar Cells via Metal Oxide Buffer Layers

Chathuranganie A. M. Senevirathne and Toshinori Matsushima*

Advance Energy Conversion Systems Thrust

International Institute for Carbon-Neutral Energy Research (WPI-I2CNER),
Kyushu University

Halide perovskite materials have emerged as a promising candidate for photovoltaics with devices reaching record efficiencies of above 25% [1]. Their compatibility with low-temperature solution processing leads to the fabrication of large-area perovskite solar cells (PSCs) at a lower cost compared to conventional silicon photovoltaics. However, commercialization of PSCs is still limited by their inferior stability towards thermal stress, moisture, and light illumination.

Here we investigate the PSCs in terms of power conversion efficiency and device stability by incorporating a metal oxide as a buffer layer in between organic hole transport layer (2,2′,7,7′-tetrakis(*N*,*N*-di-4-methoxyphenylamino)-9,9′- spirobifluorene (Spiro-MeOTAD) and gold electrode. Out of many metal oxides studied, MoO_3, V_2O_5, ReO_3, and MoO_2 incorporated PSC showed high power conversion efficiency of ~20%, which is comparable to the reference device. Both room temperature and high temperature stability were also improved with the incorporation of MoO_2 to the PSC. Further characterization of PSC with time-of-flight secondary ion mass spectroscopy confirmed that gold ion and iodide ion migration happen at high temperature. Ion migration forms deep trap states within the perovskite and enhances the non-radiative recombination resulting poor device performances. The MoO_2 incorporated PSC could mitigate the gold ion migration and improved the high temperature stability significantly compared to the reference device. Finally, we confirm incorporation of MoO_2 thin layer improved both high temperature and room temperature stability without diminishing PSC performance.

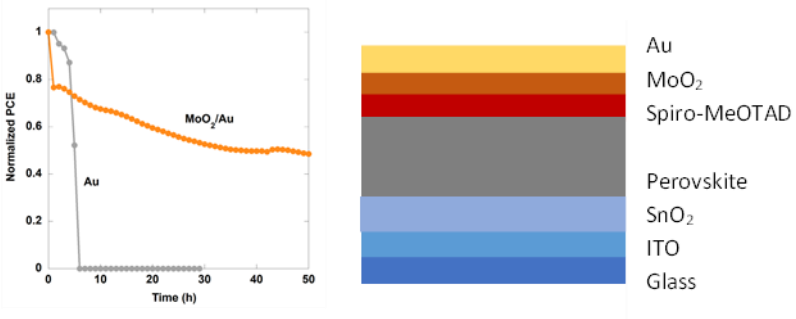

Figure 1. High temperature stability graph of Au only (reference) and MoO_2 incorporated device and the PSC device structure.

Reference

[1] Interactive Best Research-Cell Efficiency Chart | Photovoltaic Research | NREL.