Multifunctional Additive for Stable and Efficient Perovskite Solar Cells

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Organic-inorganic halide perovskites possess huge potential for use as light absorbers in solar cells because of their high conversion efficiencies and low-cost solution process ability. However, the conversion efficiency and long-term stability of perovskite solar cells (PSCs) still need to be improved for practical applications. Previously we found that a large density of hole traps is formed in PSCs degraded using a thermally stimulated current technique after continuous solar illumination and that the formation of hole traps is strongly related to the stability. The exposure of mositure could accelerate the formation of carrier traps.[1] Here, we introduced a multifunctional additive into a precursor solution containing methylammonium iodide (MAI) and lead iodide used for the fabrication of perovskite films.[2] The morphology and crystal quality of the perovskite films were improved because intermolecular interaction between MAI and additive slowed the rate of perovskite crystal formation. Electron transfer from perovskite to additive reduces charge recombination losses, and the oxidizing ability of additive effectively suppresses the formation of metallic lead, a source of carrier traps, under continuous solar irradiation. Through additive addition, conversion efficiency was enhanced from 10.7% to 15.6%. We greatly extended the lifetime of PSCs under standard laboratory weathering testing (ISOS-L-1 Laboratory) without using a UV filter from 150 hours to 4000 hours as shown in Figure 1 by suppressing the formation of carrier traps.

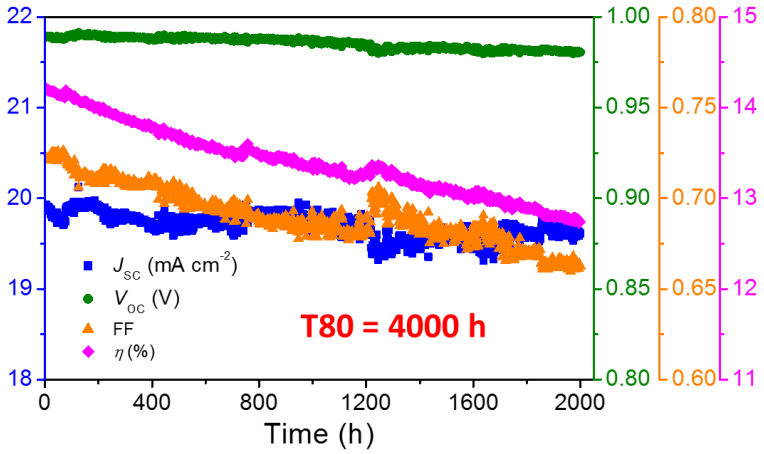

Figure 1. Typical evolution curves of J_{SC}, V_{OC}, FF, and η of PSC under continuous irradiation (100 mW cm^{-2}, AM 1.5G). Each parameter was measured by a computer-controlled sourcemeter every 2 h.

Reference:

1. C. Qin, T. Matsushima, T. Fujiahara, W. J. Potscavage, Jr., C. Adachi, *Advanced Materials* 2016, 28, 466-471.

2. C. Qin, T. Matsushima, T. Fujiahara, C. Adachi, submitted.