Halide ion migration in hybrid perovskite based solar cells

Hybrid perovskite solar cells (PSCs) have rapidly emerged as a promising candidate for the next generation photovoltaics with power conversion efficiencies (PCEs) up to 23.3%[1]. Thanks to its outstanding properties[2,3] (high absorption, high carrier mobility, long carrier diffusion length, low cost raw material, weak sensitivity to intrinsic point defects) hybrid perovskite material works as an efficient absorber for solar cell. But one of the major obstacles for the commercialization of PSCs lies in the long-term stability of the perovskite films as well as current-voltage (J-V) hysteresis. In a previous study, we have shown that halide ions migrate under applied biases inside $CH_3NH_3PbI_{3-x}Cl_x$ or MAPI-based perovskite solar cell[4].

In this work, we have fabricated inverted planar structure perovskite solar cells (glass/ITO/PEDOT:PSS/3CP-perovskite/PCBM/Ag) following Saliba process[5]. We have chosen Triple Cation Perovskite (3CP: $(MA_{0.83}FA_{0.17})_{0.95}Cs_{0.05}Pb(I_{0.83}Br_{0.17})_3$) as the photoactive layer material since it is recently being shown to increase the stability of PSCs. The presence of Cs in perovskite is helpful to improve the device life-time[5]. The solar cells were characterized by Glow Discharge Optical Emission Spectroscopy (GD-OES by Horiba scientific) and the photovoltaic performance is determined by J-V measurement under 1 sun. The results are compared to the previous study on MAPI-based solar cells.

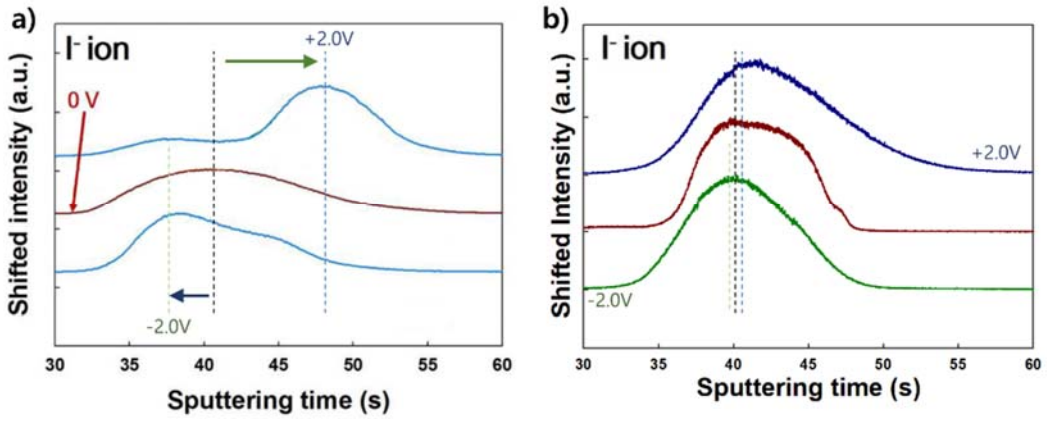

Figure 1: GD-OES profile lines versus sputtering time for Iodide ion. a) Profile of MAPbI, b) Profile of 3CP-perovsite.

As a result, the 3CP-perovskite cells showed slower degradation than MAPI by J-V measurement as well as negligible ion migration (Fig. 1).

Key words & Abbreviation: Perovskite Solar Cells (PSCs), Optimization, Triple cation, Cesium (Cs), Methyl ammonium (MA), Formamidinium (FA), Ion migration etc.

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