Ageing mechanism of triple cation perovskite solar cells based on GD-OES

[POSTER]

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Hybrid perovskite solar cells have rapidly emerged as promising candidates for the next generation photovoltaics with power conversion efficiencies (PCEs) up to 25.5%[1]. Compared to commercial silicon-based solar cells, they are price competitive thanks to the simple process and cheap materials[2]. Although these advantages are undeniable, short lifespan of the Perovskite Solar Cells (PSCs) is still an obstacle to commercialization.

Recently, we observed that halide ions diffused into the silver electrode by chemical reaction within a ITO / PEDOT:PSS / 3CP / PCBM / Ag structured PSC device {3CP: $(MA_{0.17}FA_{0.83})_{0.95}Cs_{0.05}Pb(I_{0.83}Br_{0.17})_3$, (MA: Methylammonium, FA: Formamidinium)}. Glow Discharge – Optical Emission Spectroscopy (GD-OES) is an effective tool to monitor the halide ions diffusing toward the silver electrode with ageing. Figure 1 shows monitored iodine and bromine in the PSC device GD-OES profile lines using Ar plasma gas. The amount of halide ions inside the 3CP layer is modified by ageing. As concerns the similar GD-OES profile lines showing iodide and bromide diffusions toward silver electrode (Figure 1), the migration of I inside $CH_3NH_3PbI_3$ observed through GD-OES at room temperature[3] is similar to the migration of Br inside $CH_3NH_3PbBr_3$ observed through synchrotron-based nano-XRF[4]. Several studies also support that halide ions pass through a thin layer (PCBM, Spiro-OMeTAD, or Molybdenum) and react with Ag[5-7]. GD-OES also observed a quantitative decrease, which supports studies that organic cations (MA^+ and FA^+) in perovskite are decomposed and disappear after degradation[8,9].

We will discuss how to analyze GD-OES data and deduce ageing mechanisms according to the results.

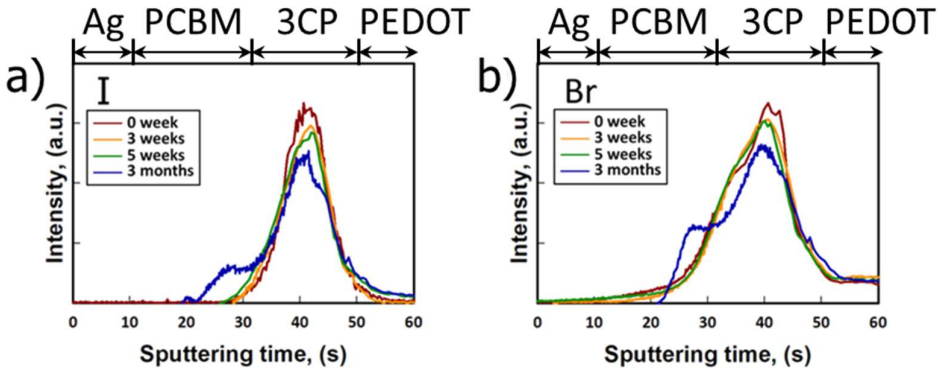

Figure 1. GD-OES profile lines showing a) iodide and b) bromide ion diffusion toward silver top electrode.

Keywords & Abbreviation: Perovskite Solar Cells (PSCs), Ageing, Glow Discharge – Optical Emission Spectroscopy (GD-OES)

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