Effects of ageing time on ion distributions in perovskite solar cells

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Hybrid perovskite has rapidly emerged as a promising candidate for the next generation photovoltaics with power conversion efficiencies (PCEs) up to 25.2%[1]. Compared to commercial silicon-based solar cells, it is price competitive thanks to the simple process and cheap materials[2]. Although these advantages are competitive, the electrical instability as known as hysteresis of the Perovskite Solar Cells PSCs is still an issue. The ion migration that causes this phenomenon still needs research.

We have observed phenomena caused by ion migration within a ITO / PEDOT:PSS / Perovskite / PCBM / Ag structured PSC device in various approaches. Using the GD-OES, mobile ions that move noticeably were identified, and mobile ions and even fixed ions were observed from a relative quantitative point of view[3]. Additionally, we confirmed that ions contribute to electric conduction according to the applied electric field in dark conditions beyond 263K[4].

In this respect we study the influence of ionic distributions in perovskite absorber layers upon ageing time in PSCs. Impedance Spectroscopy (IS) is the tool of choice to investigate material and interface transport properties. In particular, the IS analysis of the medium frequency (MF) and low-frequency (LF) region allows to analyse the detailed circuit part[5]. After 3 days ageing in air, these MF and LF regions showed the internal circuit change with additional parallel RC component as seen in Fig.1.

This result shows that the ageing phenomenon modify the distribution of ionic species in the halide perovskite layer, which could influence the charge carrier collection in PSCs.

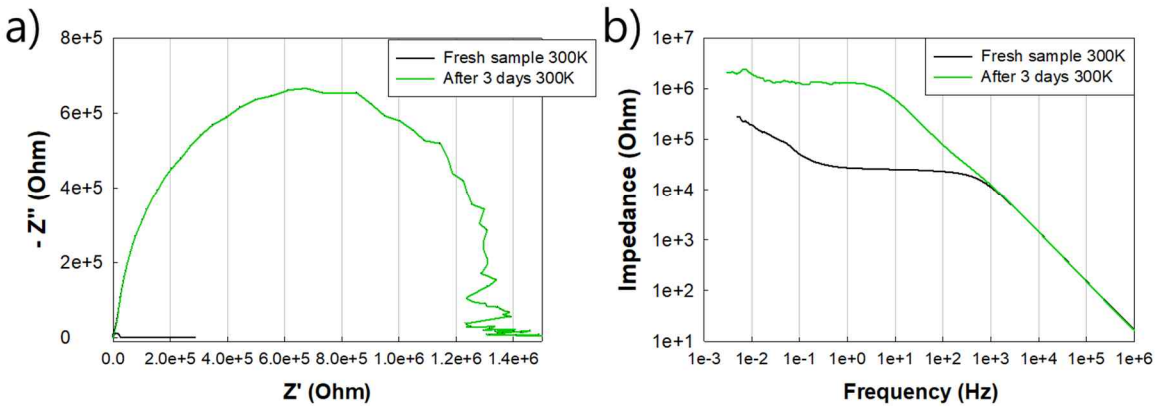

Figure 1. a) Nyquist plot and b) Bode plot of the impedance spectroscopy.

Keywords & Abbreviation: Perovskite Solar Cells (PSCs), ion migration, Impedance Spectroscopy (IS)

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