



HAL
open science

Effects of ageing time on ion distributions in perovskite solar cells

Denis Tondelier, Minjin Kim, Jean-Eric Bourée, Yvan Bonnassieux, Bernard Geffroy

► **To cite this version:**

Denis Tondelier, Minjin Kim, Jean-Eric Bourée, Yvan Bonnassieux, Bernard Geffroy. Effects of ageing time on ion distributions in perovskite solar cells. Journées Nationales du Photovoltaïque, Jan 2021, Dourdan, France. , 2021. cea-03123518

HAL Id: cea-03123518

<https://hal-cea.archives-ouvertes.fr/cea-03123518>

Submitted on 28 Jan 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Effects of ageing time on ion distributions in perovskite solar cells

Minjin Kim¹, Denis Tondelier¹, Jean-Eric Bourée¹, Yvan Bonnassieux¹, and Bernard Geffroy^{1,2}

1. LPICM-CNRS (UMR7647), Ecole Polytechnique, IP Paris, 91128, Palaiseau, France

2. Université Paris-Saclay, CEA, CNRS, NIMBE, LICSEN, 91191 Gif-sur-Yvette, France

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 materials². 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 view³. Additionally, we confirmed that ions contribute to electric conduction according to the applied electric field in dark conditions beyond 263K⁴.

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 part⁵. 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.

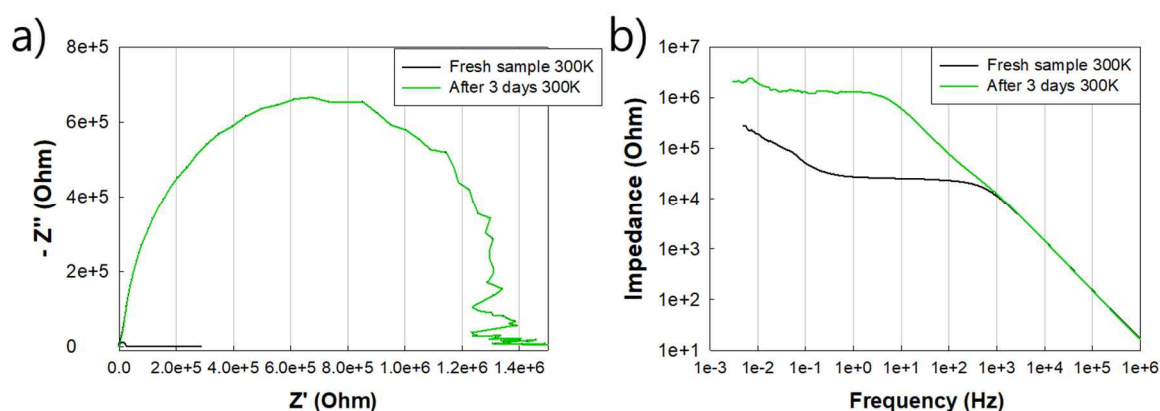


Figure 1. a) Nyquist plot and b) Bode plot of the impedance spectroscopy.

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

Reference

1. NREL. Best efficiency chart (2020).
2. Park et. al. Nat Energy, 1, 16152 (2016)
3. H. Lee, et al., ACS Energy Lett. 2, 943-949 (2017)
4. H. Lee, et al. J. Phys. Chem. C 123, 17728–17734 (2019).
5. A. Todinova, et al. ChemElectroChem 4, 2891 – 2901 (2017).