

The Role of Oxygen in the Degradation of Methylammonium Lead Trihalide Perovskite Photoactive Layers

Eric Pellereau, Matthieu Fregnaux, Chloé Dindault, Denis Tondelier, Bernard Geffroy, Jean Eric Bouree, Tiphaine Bourgeteau, Heejae Lee, Arthur Marronnier, Guido Roma, et al.

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Perovskite stability analysis studies using X-ray Photoelectron Spectroscopy

Eric Pellereau[1], M. Frégnaux[1], C. Dindault[2], D. Tondelier[2], B. Geffroy[2,3], J.-E. Bouree[2], T. Bourgeteau[4], L. Heejae[2], A. Marronnier[2], G. Roma[5], M. Bouttemy[1], D. Aureau[1], J. Vigneron[1], N. Steunou[1], A. Etcheberry[1], Y. Bonnassieux[2]

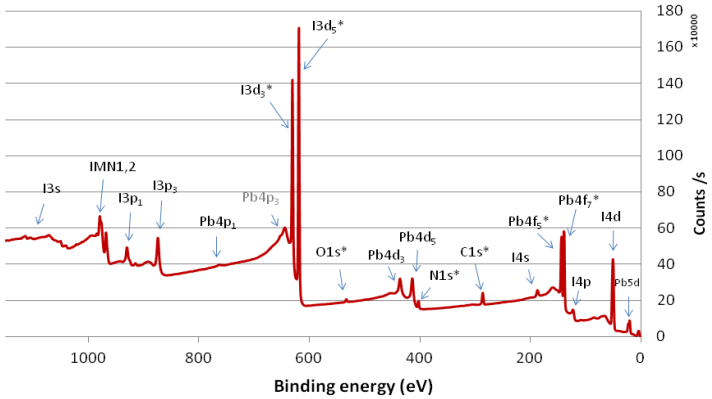
[1] UMR CNRS UVSQ 8180, ILV, 45 Ave Etats Unis, F-78035 Versailles, France
[2]Univ Paris Saclay, Ecole Polytech, CNRS, Lab Phys Interfaces & Couches Minces, F-91128 Palaiseau, France
[3] Univ Paris Saclay, CEA Saclay, LICSEN, NIMBE,CEA,CNRS, F-91191 Gif Sur Yvette, France
[4]Nara Institute of Science and Technology, 8916-5 Takayama, 630-0192 Ikoma, Japan
[5]Univ Paris Saclay, DEN Serv Rech Met Phys, CEA, F-91191 Gif Sur Yvette, France
Author contact information : Eric Pellereau, eric.pellereau@uvsq.fr, ILV-UVSQ 45 avenue des Etats-Unis Versailles

Perovskite materials have already proven their ability to reach photo-electric power conversion efficiencies higher than 22% in appropriate devices. If their instability against time could be solved, they could quickly compete with silicon since they benefit from low-cost manufacturing processes[2].

Our work is dedicated to this stability study using the benefit of X-ray Photoelectron Spectroscopy (XPS) as a main tool, and coupled with XRD and SEM-EDX analysis. Using XPS, it is possible to track the surface (10 nm) changes the perovskite undergoes, in terms of both composition and chemical environments, and is therefore efficient towards understanding the first steps of the degradation process.

At first, samples of spin-coated thin-film perovskite without capping on the top (glass/ITO/PEDOT:PSS/MAPI), were aged in different conditions (light with air and vacuum respectively), and analyzed using XPS at different times. The figure below presents the survey spectrum obtained for a fresh sample, and shows that all the expected elements can be identified with this spectrometry method. Starting from an initial known composition, the results obtained reveal interesting changes the material undergoes during the ageing. For example, it was observed that both nitrogen and iodine gradually escape the surface, and also, that metallic lead is observed in the final stages of the degradation process.

Then, other currently on-going experiments are designed to highlight the influence of oxygen and light as previously mentioned[3], but also to disentangle the influence of the bottom layers on the ageing. This will certainly provide other innovative results on the mechanisms governing the perovskite degradation.



XPS survey spectra of fresh perovskite sample

Références :

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