



HAL
open science

Damage-free depth profiling of organic LEDs: a tool for understanding degradation mechanisms

Olivier Renault, Claire Guyot, Jean-Paul Barnes, Tony Maindron

► To cite this version:

Olivier Renault, Claire Guyot, Jean-Paul Barnes, Tony Maindron. Damage-free depth profiling of organic LEDs: a tool for understanding degradation mechanisms. ECASIA 2024 - European conference on applications of surface and interface analysis, Jun 2024, Göteborg, Sweden. cea-04654013

HAL Id: cea-04654013

<https://cea.hal.science/cea-04654013>

Submitted on 19 Jul 2024

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.

Damage-free depth profiling of organic LEDs: a tool for understanding degradation mechanisms

Olivier Renault, Claire Guyot, Jean-Paul Barnes, Tony Maindron

CEA-Leti, Univ. Grenoble Alpes, F-38000 Grenoble, France

olivier.renault@cea.fr

Organic LEDs (OLEDs) are widely used in many types of displays, however understanding their degradation mechanisms to help improve electro-optical and lifetime performances remains a challenge. Recently, we developed a correlative analysis protocol that minimises damages related to analysis beams. It uses a shallow angle bevel crater fabricated inside a ToF-SIMS analysis chamber [1]. With this preparation method, the in-depth information is displayed over the surface of the bevel crater. XPS profiles and high-resolution spectra paired with ToF-SIMS images enable an easy identification of the organic layers and complete understanding of their chemistry. Here, we present the results of a study on OLEDs after constant-current electrical ageing, based on this methodology and combining XPS & ToF-SIMS, using the spectra of single layers as reference. The ageing of OLEDs is first characterized by the evolution of the profile and fragmentation of molecular ions analyzed by ToF-SIMS and tandem MS, while XPS brings details in terms of chemical changes and evolution of the energy band diagram. Both emissive and electron-transport layers are degraded the most during ageing, whereas other layers show virtually no changes. In the degraded layers, the observed fragmentation of the characteristic molecules upon ageing would create defect states in the HOMO-LUMO molecular gap and introduce non-radiative traps closely related to the decreased electro-optical performances of the devices.

Acknowledgements

This work, carried out on the Platform for Nanocharacterisation (PFNC), was supported by the "Recherche Technologique de Base" and "France 2030 - ANR-22-PEEL-0014" programs of the French National Research Agency (ANR) "

References

[1] C. Guyot, J.-P. Barnes, O. Renault, T. Maindron, *Surf. Interface Anal.* 2024; 56:129-135.