

DIRECTION DES SCIENCES DE LA MATIERE,  
INSTITUT RAYONNEMENT MATIÈRE DE SACLAY

SERVICE DE PHYSIQUE ET DE CHIMIE DES SURFACES ET DES INTERFACES

# SEMINAIRE \*

Jeudi 20 mai 2010 à 11h00

Bâtiment 466, salle 111 - CEA Saclay, 91191, Gif sur Yvette

## Efficient organic solar cells: in situ time-resolved structural/morphological monitoring approach to stability and durability issues

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*Invitée par Céline Fiorini*

The crucial requirement, in the development of organic electronics, of devices structural/morphological stability and durability is addressed.

Organic solar cells, although much less efficient than silicon cells, exhibit a unique combination of interesting properties, including: low cost, flexibility and the ability to cover large surfaces. Ultrafast photoinduced electron transfer from a donor to an acceptor material provided a molecular approach to high efficiency photovoltaic conversion, leading to the development of bulk heterojunction organic solar cell<sup>1</sup>. In particular, the highest efficiencies<sup>2,3</sup> have recently been reached using methanofullerene (acceptor) blended with poly(3-hexyl thiophene) as the donor. Nevertheless, further improvement of power conversion efficiency, stability and lifetime of such devices are the key-points to be addressed before commercial use can be considered.

First of all, the degradation over time of the organic film, the active component of the cell, is of particular concern. Furthermore, possible reaction or diffusion processes that may well occur at the interfaces between various layers constituting these 'sandwich-like' systems can be detrimental.

In this framework, a central role is played by the adoption of unconventional characterization techniques, aiming to better understand the various mechanisms involved in the devices aging. Here, the possibilities offered by a joint *in-situ* Energy Dispersive X-ray Reflectometry/Diffractometry (EDXR/EDXD) and AFM setup are presented<sup>4,9</sup>. The results indicate that such cross monitoring is able to provide direct information on the structural and morphological changes accompanying exposure to light, allowing to detect the occurrence of bulk, interface and surface degradation phenomena and to correlate them to the device aging.

### References

- [1] N. S. Sariciftci, L. Smilowitz, A. J. Heeger, F. Wudl, *Science*, 258, 1474, 1992.
- [2] J. Y. Kim, K. Lee, N. E. Coates, D. Moses, T.-Q. Nguyen, M. Dante, A. J. Heeger, *Science* 317, 222, 2007.
- [3] R. Gaudiana, C. J. Brabec, *Nature Photonics* 2, 287, 2008.
- [4] Paci, A. Generosi, V. Rossi Albertini, P. Perfetti, R. de Bettignies, M. Firon, J. Leroy, C. Sentein, *Appl. Phys. Lett.* 87 194110, 2005.
- [5] B. Paci, A. Generosi, V. Rossi Albertini, P. Perfetti, R. de Bettignies, J. Leroy, M. Firon, C. Sentein, *Appl. Phys. Lett.* 89 043507, 2006.
- [6] B. Paci, A. Generosi, V. Rossi Albertini, R. Generosi, P. Perfetti, R. de Bettignies, C. Sentein, *J. Phys. Chem. C* 112 (26) 9931, 2008.
- [7] B. Paci, A. Generosi, V. Rossi Albertini, P. Perfetti, R. de Bettignies, C. Sentein, *Chem. Phys. Lett.* 461 77, 2008.
- [8] B. Paci, A. Generosi, V. Rossi Albertini, P. Perfetti, R. de Bettignies, C. Sentein, *Solar Energy Materials & Solar Cells* 92 799–804, 2008.
- [9] B. Paci, A. Generosi, V. Rossi Albertini, P. Perfetti R. de Bettignies, *J. Phys. Chem. C*, 113 (45), pp 19740–19747, 2009.

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