

Séminaire de Chimie Autour des Nanosciences

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SHEDDING LIGHT ONTO ORGANIC SEMICONDUCTORS & PHOTOCROMIC COMPOUNDS: A BRIGHT FUTURE?

Since the late '70s, organic semiconductors have been garnering scientific and technological interest as key active materials for low-cost, flexible and large-area electronics. To date, outstanding advances on both material and processing side are paving the way towards a mature technology which will ultimately meet the many expectations and efforts built up over the years. Unfortunately, Organic Electronics cannot compete by its own or complement the silicon-based electronics in integrating multiple functions in a small area unless novel solutions are brought into play.

Within this seminar, I will summarize some recent progress in combining small molecules, fullerene derivatives as well as polymer semiconductors with photochromic molecules as a most promising approach to fill this scientific and technological gap by developing multifunctional optoelectronic devices such as memories and inverters.

Photochromic molecules are small organic molecules capable of undergoing reversible photo-isomerization between two (meta)stable states which are associated with markedly different properties such as change in dipole moment, HOMO-LUMO gap, redox potential, tunneling barrier to mention some. The structurally controlled incorporation of photochromic molecules can be done at various interfaces of a device, including the electrode/semiconductor or dielectric/semiconductor interface or even as a binary mixture in the active layer, in order to impart a light responsive nature to the device by modulating via light stimuli fundamental physico-chemical properties such as charge injection and transport in the device.

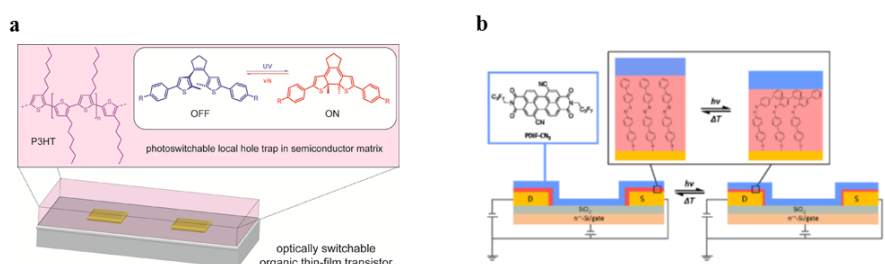
This talk will focus on some of our more recent attempts^[1-4] to bridge organic semiconductors and photochromic molecules worlds while outlining some future goals that are to be pursued to develop high-performing multi-gated devices.

[1] Orgiu, E. et al. *Nat Chem* **2012**, *4*, 675.

[2] Crivillers, N.; Orgiu, E.; Reinders, F.; Mayor, M.; Samori, P. *Adv Mater* **2011**, *23*, 1447.

[3] T. Leydecker, M. Herder, E. Pavlica, G. Bratina, S. Hecht, E. Orgiu*, P. Samori, *Nat Nanotech* **2016**, *11*, 769.

[4] M. El Gemayel, K. Börjesson, M. Herder, D. T. Duong, J. A. Hutchison, C. Ruzié, G. Schweicher, A. Salleo, Y. Geerts, S. Hecht, E. Orgiu*, P. Samori, *Nat Commun* **2015**, *6*, 6330.



(a) Scheme of a bottom-contact bottom-gate OTFT, using a bi-component blend as the active layer. The diarylethene (DAE) embedded in a polymer semiconductor matrix (P3HT) can undergo reversible isomerization upon irradiation at different wavelengths i.e. UV or visible light. The two distinct isomeric states (open and closed) feature different molecular HOMO and LUMO levels. Hence, the energetic interaction between the DAE molecule with P3HT changes depending on the irradiation wavelength therefore selectively modulating the charge transport within the film. (b) Schematic representation of the device structure showing the reversible isomerization reaction (trans ↔ cis) that takes place at the interface semiconductor/azobenzene-functionalized electrodes.

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