

## Organic photovoltaics at CNR-ISOF Institute

Consiglio Nazionale delle Ricerche – Istituto per la Sintesi Organica e la Fotoreattività (CNR-ISOF)

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CNR-ISOF is an Institute of the National Research Council of Italy. Its mission is the development and investigation of novel high-performance materials for optoelectronic devices, for micro- and nano-electronics, and for drug delivery systems.

The research activity on organic photovoltaics is focused on the design, preparation, and evaluation of new materials for application in plastic solar cells. The main fields of expertise of CNR-ISOF are:

- **Design and synthesis of thiophene-based oligomers.** New oligothiophenes with pre-defined enhanced functionalities are prepared. Presently attention is focused on (i) *high electron affinity oligothiophenes* and (ii) *high charge-carrier mobility liquid-crystalline oligothiophenes*.
- **Morphological/structural characterization.** *Atomic force microscopy* (contact, non-contact and tapping modes), *Kelvin Probe microscopy* and *X-ray analysis* are used to study the morphology of thin-film electroactive organic materials.
- **Optical spectroscopy.** *UV-vis-NIR steady-state spectroscopy* and time-resolved photoluminescence with nanosecond resolution (a *Time-Correlated Single-Photon Counting* apparatus is available).
- **Electrical and electrochemical characterization.** Current-voltage characterization (*SCLC method*), *Impedance Spectroscopy* and, recently, *Time-Of-Flight* method are used to study the transport properties of the investigated materials. *Cyclic voltammetry* experiments are performed for the evaluation of HOMO/LUMO levels.
- **Preparation and characterization of prototype devices.** The characterization of prototype devices completes the characterization of the active materials. Bulk heterojunction solar cells are realized with the usual structure ITO/PEDOT:PSS/active layer/LiF/Al and characterized under simulated solar irradiation. A system for device preparation/characterization in controlled conditions (two glove boxes equipped with high vacuum coating and spin coating equipments) will be soon available.

The main achievements of CNR-ISOF Institute within the research activity on organic photovoltaics are:

- Early investigations of the effects of thermal annealing of polymer/fullerene solar cells (*J. Mater. Chem* 12, 2002, 2065; *Adv. Mater.* 14, 2002, 1735)
- A record power conversion efficiency for solar cells based on molecular systems in which fullerene is tethered to an electron-donor moiety (*Chem. Commun.* 2002, 202; *Appl. Phys. A*, 79, 2004, 51)
- Oligothiophene-S,S-dioxides proposed as novel electron acceptor materials (*Appl. Phys. Lett.* 84, 2004, 1901; *J. Mater. Chem.* 15, 2005, 2220)

Currently, CNR-ISOF is extending the research programme to the investigation of hybrid (organic/inorganic) nanostructured active layers for low-cost photovoltaic cells.