

Organic Semiconductors: New Frontiers in Electronics

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Conjugated organic oligomer and polymer materials are being increasingly exploited as the active semiconductor elements in devices such as light-emitting diodes, photovoltaic cells, or field-effects transistors. In the operation of such devices, electron-transfer and energy-transfer processes play a key role, for instance in the form of charge transport, energy transport, charge separation, or charge recombination.

In this lecture, we will first provide a general introduction to the basic chemical/physical concepts that make conjugated oligomers and polymers so attractive, and to the operation of some of the devices into which they are incorporated. Then, we will give a theoretical description of the charge-transport phenomena based on Marcus electron-transfer theory and full quantum-mechanical extensions thereof such a description allows us to provide a molecular, chemically-oriented understanding [1]. In particular, we will discuss the parameters that impact the mobility of charge carriers, that is the electronic coupling within chains and between adjacent chains and the reorganization energy of the chains upon ionization. Materials under study include conjugated oligomers such as oligoacenes and oligoarylenes.

[1] J.L. Brédas, D. Beljonne, V. Coropceanu, and J. Cornil, “Charge-Transfer and Energy-Transfer Processes in π -Conjugated Oligomers and Polymers”, *Chemical Reviews* **2004**, *104*, 4971-5004.