NC-AFM and KPFM applied to materials in organic electronics and photovoltaics

Benjamin Grévin

UMR5819 CEA-CNRS-UJF SPrAM, CEA-Grenoble INAC/SPrAM 17 rue des Martyrs 38054 Grenoble Cedex 9, France

Email: benjamin.grevin@cea.fr

Advanced near field microscopy techniques are essential tools for fundamental and technological research in the field of organic electronics and photovoltaics. Kelvin Probe Force Microscopy (KPFM) has become a very popular technique to map the electric surface potential of organic thin films and devices. KPFM can moreover be combined with non-contact atomic force microscopy (nc-AFM) under ultra-high vacuum (UHV) to record simultaneously the topography and contact potential difference (CPD) in single-pass modes with an improved level of resolution.

In this lecture, nc-AFM and KPFM investigations of model π-conjugated materials and organic (opto)electronic devices will be presented. Specific issues will be discussed, such as the nature of the damping contrast on "soft" materials or the lateral resolution of surface potential maps acquired over the channel of organic field effect transistors. The determination of the surface photovoltage by KPFM in the case of organic photovoltaic devices will be discussed in particular. An introduction to the basic concepts of charge generation at donor-acceptor interfaces and electronic transport in organic solar cells will be given. Technical issues (sample illumination, cantilever calibration, artifacts, interpretation of the SPV images) will be addressed in the context of recent literature.

Outline

1. Introduction to pi-conjugated materials, organic electronics and photovoltaics
2. NC-AFM investigations of pi-conjugated supramolecular self-assemblies
3. KPFM investigations of the local electronic transport under field effect doping (⇒ OFETs)
4. NC-AFM/KPFM investigations of donor-acceptor heterojunctions (⇒ solar cells)
5. Outlook