

## Scanning Droplet Cell Microscopy for Electrochemical Characterization of Semiconducting Polymers

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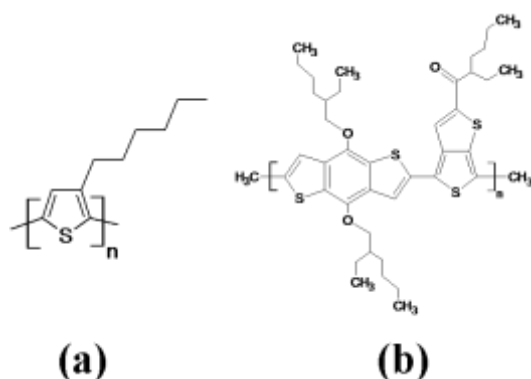
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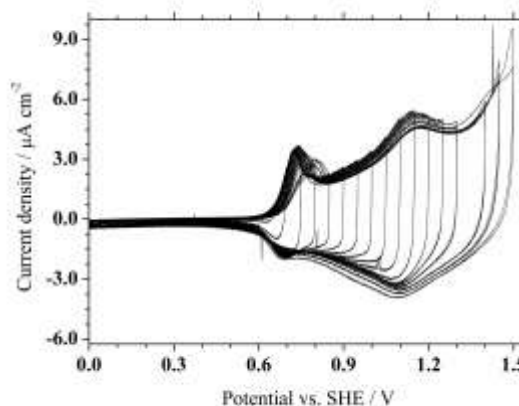
The need for cheap, easily processible electronics has led to the development of polymeric, organic semiconductors and recently a lot of effort has been put in the processing optimization for tuning their physical and chemical properties. Especially electrochemistry of organic materials is of high interest since it provides easy and flexible variation of redox parameters which allow studying material properties at different doping conditions.

The scanning droplet cell microscopy (SDCM), where only a very small electrolyte droplet at the tip of a capillary comes in contact with the working electrode, represents a particularly interesting technique for being used in organic semiconductor studies since it provides the means for localized investigations in a confined small volume with high reproducibility. One clear advantage of using the SDCM is represented by the very small amounts (~ ng) of organic materials which can be quickly and inexpensively applied in various electrochemical studies with a high reproducibility.<sup>1</sup>

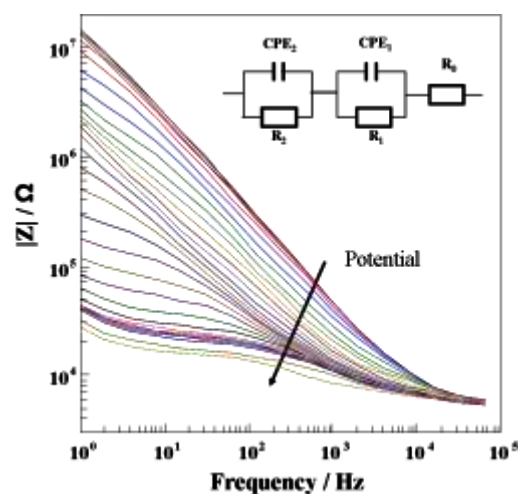


**Figure 1** Chemical structures of the P3HT (a) and PBDTTT-c (b)

In the present study, thin layers of different semiconducting polymers: poly(3-hexylthiophene) (P3HT) (Fig. 1a), which is the model donor material for organic solar cells and the newly developed poly[4,8-bis-substituted-benzo [1,2-b:4,5-b']dithiophene-2,6-diyl-alt-4-substituted-thieno[3,4-b] thiophene-2,6-diyl] (PBDTTT-c) (Fig. 1b), were deposited on ITO/glass and used as working electrodes in SDCM studies.<sup>2-3</sup> 0.1M tetra(n-butyl)ammonium hexafluorophosphate (TBAPF<sub>6</sub>) dissolved in propylene carbonate was used as electrolyte solution for the electrochemical characterization of these two polymers.



**Figure 2** Cyclic Voltammogram of P3HT



**Figure 3** Impedance as a function of frequency measured in Mott-Schottky regime for P3HT layer

The redox reactions in both materials were studied by cyclic voltammetry (Fig.2). Electrochemical impedance spectroscopy was applied to study conduction properties. The doping level was quantitatively determined by Mott-Schottky analysis during the oxidation process and a decrease by a few orders of magnitudes of the film resistance was observed due to the electrochemical treatment (Fig.3). The photovoltaic properties of both polymers were studied by comparing the resistance of a sample kept in the dark with the resistance of the same sample irradiated by a laser with a wavelength comparable to the maximum absorption of the studied material. Due to the surface localization on a single sample various parameter combinations can be studied quantitatively and reproducibly.

## REFERENCES

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