Relation between surface structure and performance of bulk heterojunction organic solar cells

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The application of organic materials for the photovoltaic conversion corresponds to the third generation of solar cells. These systems are gaining ground to the classical silicon-based ones, due to their mechanical flexibility, low weight, low cost and eco-friendly potential.

Among the organic materials, poly- and oligothiophenes are two of the most used and studied systems for optoelectronic applications. They present high stability in neutral state as well as in excited states. The advantage of the oligomeric (or small molecule) approach is that they are defined, monodispersed molecules able to crystallize: the structure-properties relationship of the photovoltaic devices employing oligothiophenes can be thus univocally established.

The solar cell devices based on small molecules are recently attracting increasing attention because of their advantages above conjugated polymeric systems in terms of easiness of purification, higher homogeneity between batches, and therefore higher reproducibility concerning efficiency of the devices. Power conversion efficiencies (PCE) up to 6.9% have been reported for oligomers based on vacuum-processed[1] and 7.4% for solution-processed single junction devices[2]. For this type of devices, probe microscopy can give insights into the distribution of the donor and acceptor within the blend of the photoactive layer. This is necessary to understand the relationship between structure and cell performance, and for a rational design of the cells.

In this contribution, the surface properties of solar cell devices based on DCV-capped quinquethiophene derivative as a donor part have been studied with Atomic Force Microscopy (AFM). Intriguing results correlating the solar cell performance and the surface characteristics will be discussed [3].

References:

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