Structured organic solar cells

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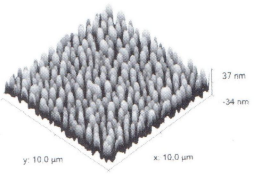
Organic electronics is emerging as a new paradigm and, among the various devices based on organic semiconductors, solar cells are attracting a wide attention. Organic solar cells have shown an impressive improvement of power conversion efficiency in the last years, which has just reached the long aimed threshold of 10%. Besides the opportunities that these new materials are offering as a result of their flexibility and solution processing, one of their strengths relies on our ability to modify molecular structures and, up to some extent, samples morphology. This has allowed us to improve photon collection and charge generation, as a result of excited state charge transfer between an electron-donor (D) and electron-acceptor (A) material. This need is specific to the organic solar cells and the way that donor (usually a conjugated polymer) and acceptor (such as fullerene) materials are combined within the active layer is one of the key parameters affecting their performance. The most successful approach relies on blends. However, it is difficult to control, in a reproducible way, the details of the phase separation and ensure effective pathways for the generated charges to reach the electrodes.

We have been exploring the fabrication of bi-layer organic solar cells with controlled D/A interfaces. In this communication we report on two different approaches: i) preparation of a cross-linked conjugated polymer layer with (nano)structured surface (see figure) on top of which a soluble C60 fullerene (PCBM) is deposited by solution [1,2]; and ii) fabrication of networks of conjugated polymer wires on top of which PCBM is thermally deposited. We present a review of various materials and achievable nanostructures relating them with the performance of the OPVs where they are used. The performance of reference devices based on blends is also presented and discussed. Though the maximum efficiencies so far achieved are lower than those of the devices based on blends, and which we partially attribute to the still too large pattern dimensions, this study is being used to get a deeper insight in the operation steps of such devices.



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References
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