EIPBN technical scope: Nanostrcutred Organic Solar Cells

Probing Nanostructures of Aged Active Layer Materials for Organic Solar Cells

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Organic photovoltaics, also known as plastic solar cells, essentially comprise two electrodes and an active layer. Controlling of the active layer morphology in order to improve the device efficiency is a key challenge that is being addressed through a number of strategies, including thermal annealing, light soaking, and surfactant-like modifiers. The most commonly used active layer is a blend film of poly(3-hexylthiophene) and [6,6]-phenyl C_{61}-butyric acid methyl ester (P3HT/PCBM). Because the active layers undergo thermal and light cycling it is important to understand the morphological changes occurring in P3HT/PCBM thin films as a function of time. Our results show a number of circular patterns filled with dendrite-like morphologies in aged active layers. These patterns grow from initially featureless P3HT/PCBM blend film that is subjected to heat/light cycling for over two months (Fig. 1 a-c). A parallel study on the same system but in absence of light (thermally cycled only) shows no such microscopic circular patterns. In this presentation, we will show the aging effects of thermal and thermal-light cycled active materials that are deposited on various substrates. A comparison of bilayer versus bulk heterojunction active layers in presence of compatibilizers will also be discussed in detail. Studying these morphologies are indispensable for the understanding of opv failure modes, device performance and structure-property relationships under practical conditions.

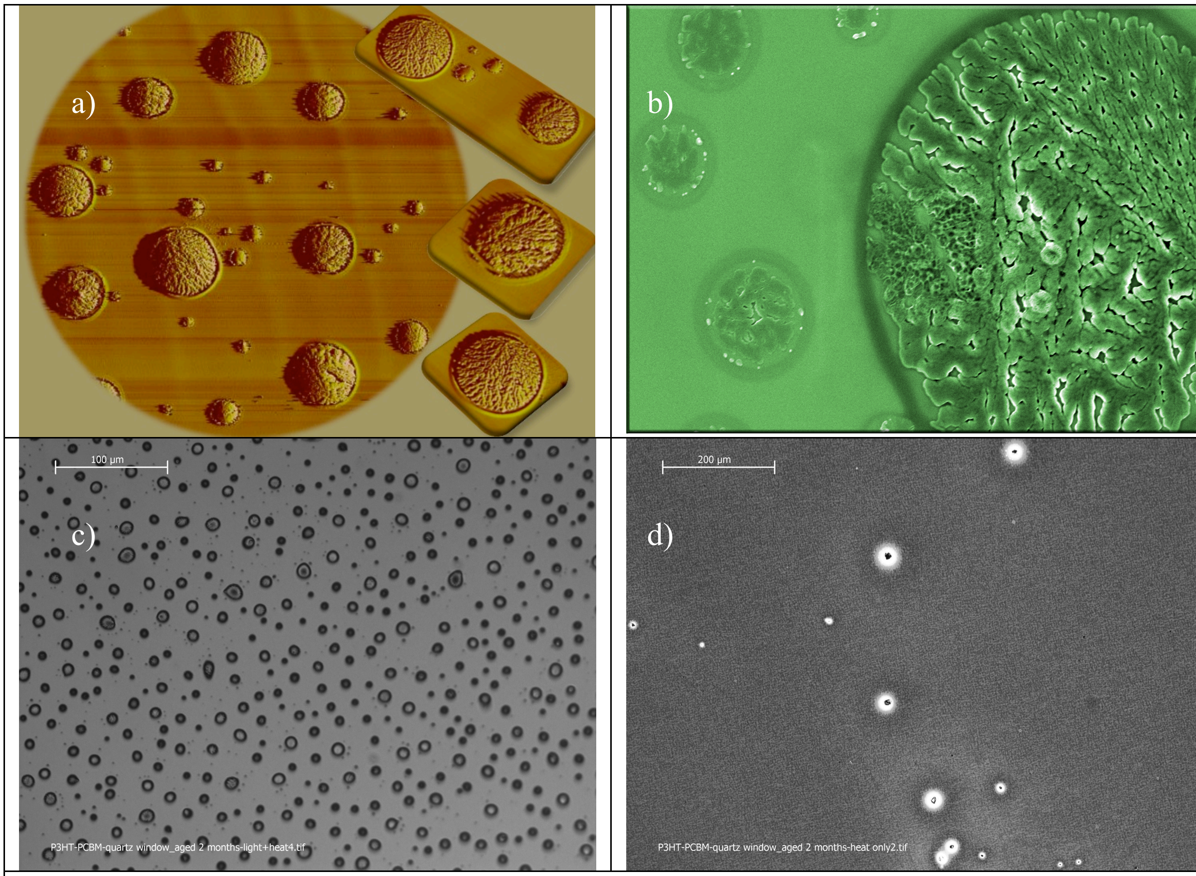

Fig 1: Circular patterns filled with dendrite-like morphologies grown in the active layer of organic (plastic) solar cells. These patterns appear in poly(3-hexylthiophene) and [6,6]-phenyl C_{61}-butyric acid methyl ester (P3HT/PCBM) film after subjecting them to heat/light cycling for over two months.

a) Tapping mode AFM image and **b)** False colored FE-SEM image, and **c)** Optical micrograph of aged P3HT/PCBM films on Si/SiO_2 surfaces. The samples were aged, under N_2 atmosphere using a thermal-light cycling protocol of 12 hrs.

Unlike in the heat/light cycling, Fig. 1d) shows no microscopic patterns when the active material is subjected to a thermal cycling in the absence of light.