POLY(3-HEXYLTHIOPHENE) FIBRES FOR PHOTOVOLTAIC APPLICATIONS

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We present here a new polymeric composition with photovoltaic properties, its elaboration process and its performance in photovoltaic cells.
Recently, Yang and al. [1] have shown that the molecular order of the active layer of a solar cell, formed by an interpenetrated network of Poly(3-hexylthiophene) (P3HT) as donor material and [6,6]-phenyl C61 butyric acid methyl ester (PCBM) as acceptor is dependant to the process conditions (pristine/annealed film). The annealing of the active layer permits to control the morphology and the organization of the polymeric chains and the formation of fibrillar structures of P3HT leading to high performances.
More recently, Reyes-Reyes and al. [2] obtained 5.2% of Power Conversion Efficiency (PCE) by annealing the photovoltaic cell composed of P3HT/PCBM active layer.
However, the annealing process may be not compatible with the use of flexible substrates and alternative processing procedures leading to the required nanomorphology without thermal treatment may constitute a real step for the development of efficient and flexible solar cells.

In the work presented here, the fibrillar structures of P3HT have been obtained in solution and deposited on glass substrate or silicon (Figure 1). It was possible to separate the fibres from the well-dissolved polymeric chains and then to control the ratio of each material in new solutions.

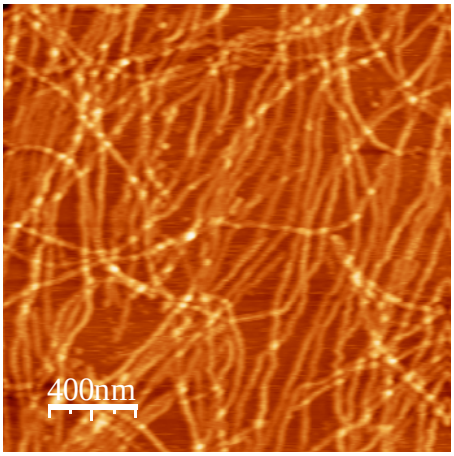

Figure 1: Atomic Force Microscopy image (tapping mode) of P3HT fibres deposited on silicon.

The effect on charge transport of the fibrillar P3HT percentage in a film was studied and showed a dependance. Photovoltaic performances obtained without annealing, with a fibrillar

P3HT/PCBM blend and with a controlled percentage of P3HT fibres in the active layer are also presented. Best cells reach a PCE of 3.59% without annealing under AM 1.5, 100 mW.cm^{-2} conditions (Figure 2) [3].

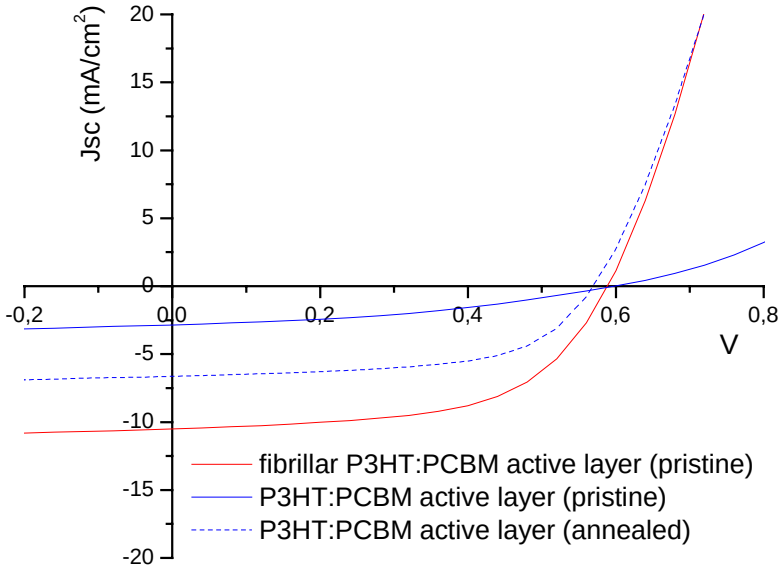

Figure 2: Current-voltage (J-V) curves of different composition of the active layer in the photovoltaic cell measured under AM 1.5 conditions.

References:

[1] X. Yang and al., Nanoletters, **5** (2005) 579
[2] M. Reyes-Reyes and al., Organic letters, **7** (2005) 5749
[3] S. Guillerez, S. Berson, R. De Bettignies, M. Firon, deposited patent