Influence of Thermal Annealing on the Electrical Properties of Poly(3-hexylthiophene)-Based Thin Film Diodes

Zivayi Chiguvare[a], Jürgen Parisi[b], and Vladimir Dyakonov[c]

[a] Renewable Energy Programme, Faculty of Engineering, University of Zimbabwe, P. O. Box MP 167, Mt Pleasant, Harare, Zimbabwe
[b] Department of Energy and Semiconductor Research, Institute of Physics, University of Oldenburg, D-26111 Oldenburg, Germany
[c] Faculty of Physics and Astronomy, Bayerische Julius-Maximilians Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany

Reprint requests to Prof. J. P.; E-mail: parisi@ehf.uni-oldenburg.de

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The effects of thermal annealing on the bulk transport properties of poly(3-hexylthiophene) (P3HT) were studied by analyzing room temperature current-voltage characteristics of polymer thin films sandwiched between indium tin oxide/poly[ethylene dioxythiophene]:poly[styrene sulfonate] (ITO/PEDOT:PSS) and aluminum electrodes, before and after a thermal annealing step. It was observed that annealing takes place in two steps: (1) Dedoping of the polymer of impurities such as oxygen, remnant solvent, water, leading to a decrease in the conductivity of the film, and (2) thermally induced motion of the polymer chains leading to closer packing, thus, stronger inter-chain interaction and, consequently, increase in conductivity. It was also observed that the ITO/PEDOT:PSS/P3HT hole injection barrier increases on annealing the ITO/PEDOT:PSS/P3HT/Al thin film devices. The implications of impurity dedoping and closer packing on the output characteristics of bulk heterojunction polymer-fullerene thin film solar cells are discussed.

Key words: Space Charge Limited Currents; Thermal Annealing; Polymer Semiconductors.
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