

The study of glass transition temperature measured on P3HT:PCBM thin films using spectroscopic ellipsometry

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Poly (3-hexylthiophene) P3HT (Fig.1a), as an organic semiconductor and (phenyl-C61-butiric acid methyl ester) PCBM (Fig.1b) as a fullerene derivative are the base for bulk organic solar cells with high efficiency. Typical efficiency of the P3HT:PCBM bulk solar cells, where P3HT is donor and PCBM is acceptor, is contained in the range 1-6%.

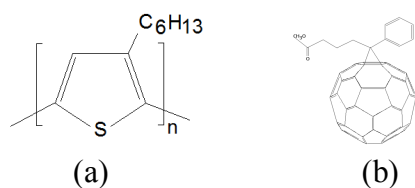


Fig. 1 The chemical structures of P3HT (a) and PCBM (b)

Spectroscopic ellipsometry is a non-destructive method, commonly used to obtain the physical parameters, like optical and dielectrical constants, thickness, roughness etc. In this work the SENTECH SE 850E, the spectroscopic ellipsometer, working in the spectral range 240-2500 nm, with the thermal cell equipment was used. This thermal cell, connected with the temperature controller, gives us the opportunity to perform the measurements under low vacuum, during heating or cooling. The aim of this work is the study of influence of P3HT:PCBM thin films composition on its glass transition, using spectroscopic ellipsometry. The A.J. Pearson at al., in [1], have observed one or two glass transitions of the P3HT:PCBM blends. They showed the thickness dependence on temperature, where it is necessary to use of proper ellipsometric model with very low MSE (Mean Square Error). Additionally, the T.T. Ngo at al. [2] have showed the changes of glass transition temperature of the P3HT:PCBM in quenched state, basing on DSC technique. They have observed just one glass transition temperature for every sample. In this work we can observe the glass transition temperature, basing just on Psi and Delta measurements, where the physical model is not necessary for use. The P3HT:PCBM thin films were deposited on the glass substrates from the polymer-chlorobenzene solutions, using spin-coating method. The ratio of P3HT to PCBM weight concentrations in the solutions were changed from the pure P3HT to pure PCBM.

[1] A.J. Pearson, T. Wang, R.A.L.Jones, D.G. Lidzey, P.A. Staniec, P.E.Hopkins, A.M. Donald "Rationalizing Phase Transitions with Thermal Annealing Temperatures for P3HT:PCBM Organic Photovoltaic Devices", *Macromolecules*, 45 (2012) 1499-1508

[2] T.T. Ngo, D.N.Nguyen, V.T. Nguyen "Glass transition of PCBM, P3HT and their blends in quenched state", *Advances in Natural Sciences: Nanoscience and Nanotechnology* 3 (2012) 045001, 1-4

This work has been supported by the NCN grant (Poland) No. UMO-2013/09/B/ST8/01629