SSNN 15P PREPARATION AND PHOTOELECTRIC CHARACTERIZATION OF SWCNTs-P3OT NANOCOMPOSITES

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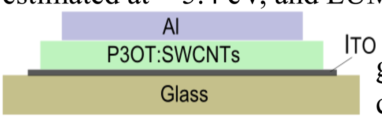
This work presents experimental results on single-walled carbon nanotubes (SWCNTs) and nanocomposite materials based on SWCNTs and conducting polymer with conjugated bonds poly-3 oxythiofene (P3OT). SWCNTs were synthesized in a novel custom design ablation chamber. The technology for obtaining SWCNTs was developed in the Centre for Surface Science and Nanotechnology, from Politehnica University of Bucharest, with application of excimer laser ablation in vacuum environment. The high quality of produced SWCNTs was proved by careful morphological analysis. The TEM imagines show that the obtained carbon single-walled nanotubes have a diameter ranging from 1.2 to 1.4 nm, which is confirmed also by micro-Raman spectroscopy measurements. More details of the synthesis process and electron microscopy investigations are given in [1].

The SWCNTs/P3OT nanocomposite was obtained by deposition of SWCNTs and P3OT solutions mixed in a solvent, compatible for both components. SWCNTs have been dispersed in the solvent and mixed together with the solution containing P3OT. In this way gel solutions with different ratio of SWCNTs:P3OT were obtained for experimental investigations. Deposition of thin layers of mixed solution was carried out on SnO_2 coated glass substrates by spin-coating or casting methods followed by drying them up. The thickness of prepared thin films varies depending on the condition of deposition from 0.3 to 2.5 microns with random orientation of carbon nanotubes. On the outer surface of Al layer an electrical contact was deposited. For manufacturing of organic photovoltaic cells (OPV) transparent glass substrates with ITO or SnO_2 coating have been used. Both ITO and SnO_2 layers are transparent for light, and serve as electrodes for solar cell element.

The samples SnO_2/SWCNTs/P3OT/Al with the structure as illustrated in Figure has been investigated and optical absorption spectra of the composites SWCNT/P3OT have been registered. The optical band gap (E_g) of the nanocomposite was estimated to be around 2.4 eV, which correlates with the values reported in the literature for the P3OT optical band-gap. At room temperature E_g for P3OT corresponds to the difference between the energy position of highest occupied molecular orbital (HOMO), which is estimated at ≈ 5.4 eV, and LUMO, respectively ≈ 3 eV.



The nanocomposit heterostructure Al/P3OT/SWCNT/ITO exhibits good photosensitivity in the visible spectrum. The current-voltage characteristics of the structures A1/P3OT/SWCNT/ITO have measured both in the dark and under light illumination through the ITO layer. Experimental results on optical, electrical and photoelectric data are interpreted in the framework of the theoretical model which considers the process of exciton formation in SWCNT as a result of photon absorption, with subsequent diffusion to the boundaries of the contact between P3OT/SWCNT, its further dissociation into an electron and a hole, and final transition of the hole to P3OT. At the final stage of the process the charge carriers move separately to the external electrodes, generating the contact potential difference.

Experimental results obtained from optical, electrical, and photoelectrical measurements indicate on promising perspective for integration of SWCNTs structure in fabrication of 3D generation solar cells. In this context we suppose that application of conductive polymer nanocomposites with low specific density resistance could be a good solution. Further experiments on SWCNTs nanocomposites and structures on their base are in progress in order to identify other conducting polymers for formation of SWCNT-based nanocomposites and optimal parameters for solar cell elements.

[1]. D. Dorobantu, P.-M. Bota, M.Badea, Iu. Boerasu, D. Bojin, M.Enachescu, High Quality and Reliable Carbon Nano Structures Used for 3rd Generation of Solar Cells. Proceedings of the 37th ARA Congress "Modernism and Progress in Arts and Sciences", June 04 - 09, 2013, Chisinau, Republic of Moldova, p. 551-553.