Characterization of Energy Conversion Behavior in Nanostructured PEDOT Polymer-Graphene Composite

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One of the major drawbacks for successful application of graphene in energy storage and conversion applications is its cone shaped band gap. Therefore, several ongoing researches are currently focusing on the opening of the graphene band gap by doping, patterning and applying electric field on graphene layers [1]. Accordingly, in this work, we study a new composite structure consisting of nanostructured conducting polymer deposited on the surface of graphene-Schottky-diode (Conducting-Polymer/Graphene/Pt/n-Si) for enhanced energy storage and opto-electrical energy conversion applications. Poly (3,4-ethylenedioxythiophene) (PEDOT) was selected as the organic semiconductor material because of its low band gap (1.5−1.7 eV), long-term stability as well as good electrical conductivity. Significant enhancement in the dark current from 99 µA for the bare graphene-Schottky devices to 20 mA for the PEDOT composite structures at −10V bias which corresponds to more than 196 times enhancement in current. The morphology of the composite electrodes (Fig. 1) shows very well dispersed particles of the deposited polymers on the graphene surface. Fig. 2 (a) shows the dark I-V characteristics of the composite electrodes as well as the bare material, which illustrates a distinctive increase in the current behavior for all the PEDOT composite samples with respect to the bare graphene samples. The current response was extensively increased upon the deposition of PEDOT reaching 4.7 mA for the 200 µl PEDOT volume.

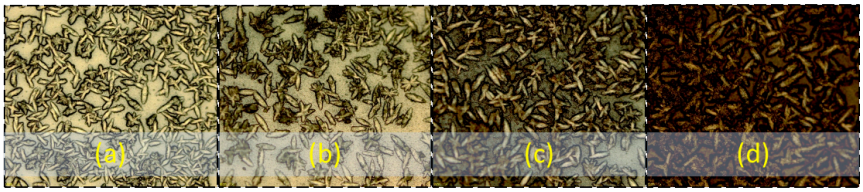

Fig. 1 Microscope images of the coverage of PEDOT over graphene substrate under different processing conditions, (a) 100 µl, (b) 200 µl, (c) 300 µl and (d) 400 µl volume of PEDOT over graphene substrate respectively.

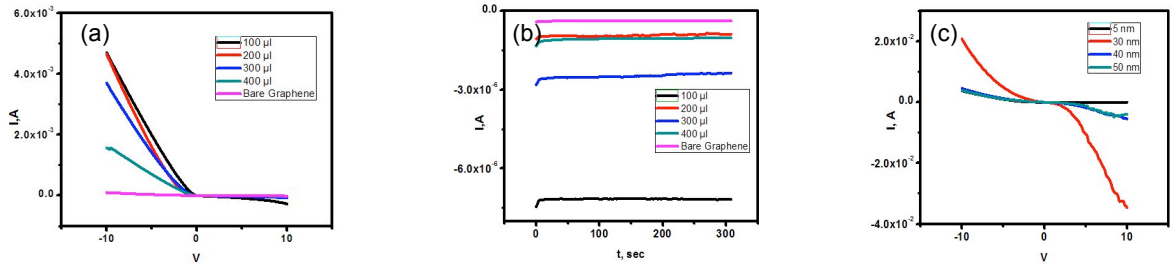

Fig. 2 (a) I-V (dark), (b) I-t (dark) characteristics of the hybrid electrodes and bare material at different PEDOT volumes, and (c) I-V (dark) characteristics at different graphene thicknesses at 100 µl PEDOT volume.

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[1] Meric, Inanc et al., Nature Nanotechnology **3**,11 (2008): 654–659.