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Preparation of Poly(3-Hexylthiophene) Sensitized Ag Doped TiO_2-NTs and Its Carrier Density Determined by Mott–Schottky Analysis

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Poly(3-Hexylthiophene) (P3HT) has been widely used as an active material in fabrication polymer optoelectronic devices [1]. In this work, the synthesis of P3HT was successfully carried out by oxidative polymerization with $FeCl_3$. P3HT has been characterized using NMR, FT-IR, XRD and optical properties of P3HT are measured from Uv-Vis techniques. The result showed that the estimated optical band gap is 2.2 eV for P3HT. The deposition of Ag on TiO_2-NTs electrode fabricated by two-step anodization technique was performed with the galvanostatic technique. Then, the P3HT film was prepared on Ag-TiO_2-NTs by spin coating technique. The morphology, composition and structure of P3HT sensitized Ag doped TiO_2-NTs were determined by field emission scanning electron microscopy (FE-SEM) and X-ray diffraction (XRD).The electrochemical behaviors of P3HT sensitized Ag doped TiO_2-NTs in acetonitrile electrolyte contained I^-/I_3^- were examined by utilizing Electrochemical Impedance Spectroscopy (EIS) and Cyclic voltammetry (CV). The EIS results displayed that after the modification with P3HT, the value of charge transfer resistance at -0.4V decreases from 574 Ω cm^2 to 121 Ω cm^2, compared to pure TiO_2-NTs. This indicates that P3HT supplies better photogenerated electron-hole pairs separation and mobility. From the Mott–Schottky analysis, semiconductors of TiO_2-NTs and P3HT sensitized Ag doped TiO_2-NTs were found to be n-type conductivity and the carrier charge densities were determined to be $7.43.10^{21}$ cm^{-3} and $8.70.10^{21}$ cm^{-3}, respectively.

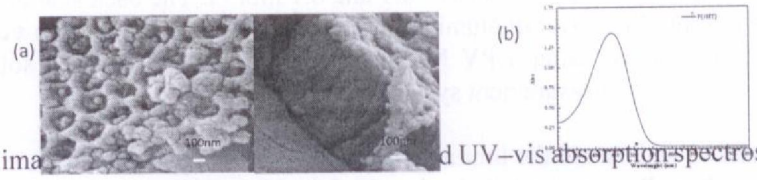


Figure 1. FE-SEM ima d UV–vis absorption spectroscopy of P(3HT) (b).

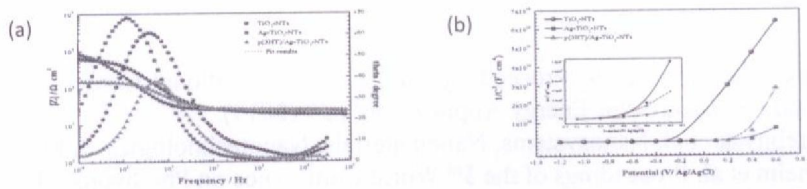


Figure 2. (a) Bode and phase angle plots recorded at -0.4V and (b) variations of ($1/C^2$) with applied potential (Mott-Schottky plot) for the electrodes in acetonitrile electrolyte contained I^-/I_3^- after 1h of electrode immersion.

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References

[1] Y.M. Chang et al., Sol. Energ. Mat. Sol. **C 92,** 761 (2008).