Electrochemical, Optical and Impedance Studies on Photoactive Assemblies Consists of Mixed TiO₂-CdS Particles Occluded in Poly 2,2' Bithiophene in Aqueous Acetate Electrolytes

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Amorphous nanoparticles of cadmium sulfide (CdS), titanium oxide (TiO₂), and 50/50 of TiO₂-CdS mixtures were prepared and immobilized in poly 2,2-bithiophene (PBTh) by occlusion electrodeposition method. X-ray studies indicated that a heterogeneous crystal structure of CdS (cubical-hexagonal) was formed. Optical studies indicated that occlusion of CdS or TiO₂ or both into PBTh significantly decreased the intensity of the inter band transition as revealed by the values of (E_d) dispersion energy. Photoelectrochemical (PEC) studies revealed evidence of fast charge recombination due to the hole accumulations at the interfaces. Furthermore, PEC studies indicated that, regardless of the method of the preparation of CdS-TiO₂ mixtures, CdS was the dominating factor in the photocurrent generation. . Electrochemical impedance spectroscopic studies (EIS) revealed that occluded assembly films possess a porous-type structure, with multiple phases as indicated by the generation of Nyquist plots with composite semi-circles. The study also shows that occlusion increased the frequencies of the dispersion and charge carrier hopping. The studied assemblies showed photostability for a long time of illumination. Photoelectrochemical, EIS, and optical outcomes did not follow monotonic properties of each component of these hybrid assemblies.

Keywords: CdS-TiO₂ mixtures, photoactive interfaces, optical, organic semiconductors, impedance

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