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PANI-CSA/Tio_2 - Fe_2NiO_4 Nanocomposite Films: Optical, Morphological, and Structural Properties

Inshad Jum'h
Basic Sciences Department, German Jordanian University (GJU), Amman 11180, Jordan
inshad.yousef@gju.edu.jo

Extended Abstract

Nanocomposite films were created by synthesizing protonated Polyaniline with Camphor Sulfonic Acid (PANI-CSA) and integrating them with Titanium Dioxide nanoparticles (TiO2 NPs) along with varying amounts of Iron Nickel Oxide nanoparticles (Fe2NiO4 NPS). These films were then deposited onto Silicon and glass substrates using a casting method. Fourier Transform Infrared Spectroscopy was employed to confirm the successful incorporation of TiO2-Fe2NiO4 into the PANI-CSA matrix.

The PANI-CSA film displayed a semicrystalline nature, characterized by a diffraction plane of (010). The introduction of TiO2 NPs and Fe2NiO4 NPs into the PANI-CSA film resulted in the appearance of TiO2 and Fe2NiO4 diffraction angles with varying intensities. PANI-CSA film exhibits a smooth nature with appearing of short rods on the film surface. Introducing TiO_2NPs-Fe_2NiO_4NPs into PANI-CSA film variate the surface morphology of the nanocomposite films. The bandgap energy of PANI-CSA film is 3.81 eV. Introducing TiO_2NPs into the PANI-CSA film decreases the bandgap energy to 3.75 eV, whereas introducing Fe_2NiO_4NPs into the PANI-CSA film decreases the bandgap energy to 3.66 eV. The minimum bandgap energy was 3.48 eV at PANI-CSA/TiO_2-Fe_2NiO_4 (0.6:0.4) nanocomposite film. The average electrical conductivity of PANI-CSA film is about 0.05 $S.cm^{-1}$. Introducing TiO_2 into the PANI-CSA matrix increases the electrical conductivity of the PANI-CSA/TiO_2 nanocomposite film to 0.09 $S.cm^{-1}$. Increasing Fe_2NiO_4NPs concentration with decreasing TiO_2NPs concentration increases the electrical conductivity continuously to 0.38 $S.cm^{-1}$. Thermal Gravimetric Analysis results show that PANI-CSA/TiO_2-Fe_2NiO_4 nanocomposite films are thermally stable in temperatures up to 300°C.

Objectives of this work:

- Fabricating novel nanocomposites based on the conjugated polymer PANI doped with CSA as protonation agent and the TiO_2 - Fe_2NiO_4 Nanocomposite as the second dopant.
- Investigate the effect of TiO_2 - Fe_2NiO_4 Nanocomposite content on the optical properties of PANI by using XRD, SEM, FTIR, UV-Vis characterization methods.
- Studying the optical properties of(TiO_2) by coupling with low amount of (Fe_2NiO_4).