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SYNTHESIS AND CHARACTERIZATION OF NOVAL POLY-(3, 4 - ETHYLENEDIOXYTHIOPHENE) (PEDOT)/ZNO COMPOSITES

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Abstract:
Herein, we have successfully prepared Poly (3,4- ethylene dioxythiophene)/ZnO composites by in-situ polymerization method . Initially, the as prepared metal oxide nanoparticles were dispersed in the monomer using co-precipitation & hydrothermal process. Ferric chloride was used to initiate the polymerization reaction in aceto nitrile medium. The prepared nanocomposites were studied for its structural, microstructural, thermal, optical properties.X-ray diffraction (XRD) study confirmed the formation of the PEDOT/ZnO nanocomposites. SEM micrographs showed an increasing trend of the particle size with the increase in Zinc oxide content.

Keywords: *PEDOT/ZnO Nanocomposite, X-ray diffraction, SEM, UV-Vis Spectroscopy*

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INTRODUCTION:

Polythiophene and its derivatives have been studied because of their excellent chemical and physical properties [1-6]. PEDOT has been extensively investigated by various research groups, mainly for the exploitation of its interesting physicochemical properties, such as high conductivity, humidity/gas sensing, redox potential, ion-exchange, excellent environmental stability and ease of preparation from common chemicals [7-12]. Though PEDOT possess excellent properties still in order to make it suitable for various other applications modification of the properties by doping with nanoparticles have been suggested [13-16].

Incorporation of nanoparticles (NPs) into polymers has long been established as an effective, controllable and reliable method of tuning and tailoring the mechanical, magnetic, electrical, optical, thermal and other properties of polymers. The obtained composite materials have superior properties, such as magnetism and conductivity. Nano-inorganic particles were usually coated by polymers to prevent agglomerating due to their high surface activity [17,18]. Nanoparticles ZnO has attracted a lot of attention since it is having wide range of applications such as in magnetic storage devices, sensors, catalysis and high-sensitivity biomolecular magnetic resonance imaging for medical diagnosis and therapeutics. Due to these vital roles, various attempts have been made to synthesize ceramic-polymer nanocomposites.

In the present work the PEDOT/ZnO nanocomposites were prepared. The material was studied for its structural, microstructural, thermal, optical and magnetic properties by using various characterization techniques [19,20].

EXPERIMENTAL PROCEDURE:

Synthesis of ZincOxide (ZnO) Nanoparticles:-

The reagents were used for chemical synthesis as $Zn(NO_3)_2.6H2O$,NaOH and distilled water. 0.594 Gm of zinc nitrate was dissolved in 50 ml of distilled water & 1M Sodium hydroxide was added drop wise till the formation of white precipitate, Then a white colored precipitate was transferred to 200 ml Teflon-lined autoclave & it was treated hydrothermally for 12 hrs at 80^0C The resulting product was filtered and washed with water and ethanol and then dried at 60^0C for 6 hrs to obtain wet ZnO nanoparticles.

Synthesis of ZnO/PEDOT Nanocomposites:-

0.1g of above prepared ZnO nanoparticles were dissolved in 40 mL of acetonitrile by agitation and ultrasonic treatment and then transferred into a flask. Moreover, a certain number of EDOT monomers (0.0035 M) were added and stirred with reflocculated ZnO for 1 h to ensure complete mixing. Additionally, a given amount of oxidizing agent (2 times of EDOT monomers in molar ratio) FeCl3 (0.007 M) was dispersed in 40 mL of acetonitrile, then added drop wise and kept under refluxing condition at 80 °C for 12 h. Then the products were washed repeatedly with ethanol and deionized water and the powder was dried at 60 °C for 12 h.

Characterizations:

The Zink oxide nanoparticles were analyzed for phase composition using X-ray powder diffraction (XRD, Bruker-axs, D8 Advance) over the 2θ ranges from 20–70°, using Cu-K_α radiation (1.5408 A˚). The surface morphology of the samples were taken by using JEOL JSM 6480 LV scanning electron microscope (SEM). Optical properties were studied by using UV CARY 100 Scan UV-Visible Spectrophotometer. Magnetic properties (M-H curve) were measured with a vibrating sample magnetometer (VSM, Quantum Design) at room temperature,Humidity sensing by Keithley electrometer.

RESULTS AND DISCUSSIONS:

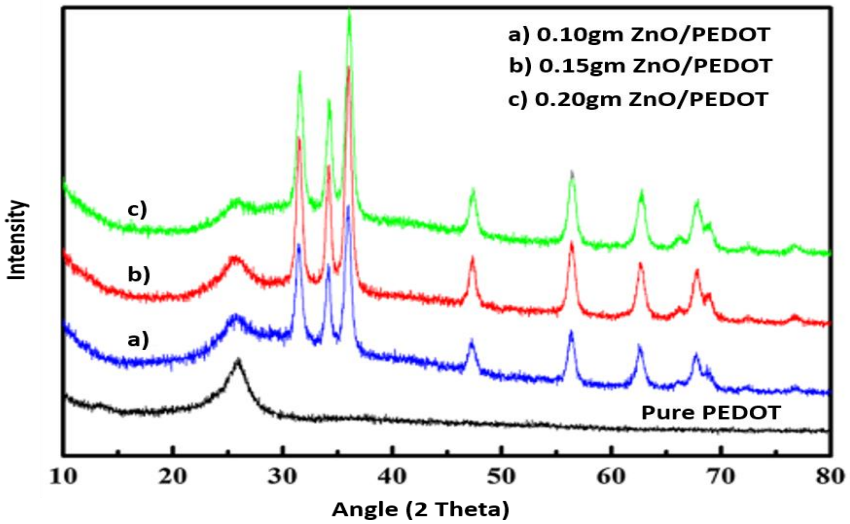

Fig.1: XRD patterns of PEDOT and PEDOT/ZnO nanocomposites

Figure 1 shows that the XRD pattern of PEDOT and PEDOT/ZnO nanocomposites.The pattern shows one characteristics peak at 2θ = 25 ^{0} which is due to the encapsulation of PEDOT in composte. In the case of composites, the diffraction peak at 2θ = 31.5^0,34.2^0,35.9^0,47.3^0,56.3^0,62.2^0,66.7^0,68.9^0,72.5^0 and 76.8^0 are associated to the (100),(002),(101),(110),(103),(200),(112),(201),(004), and (202) planes of the nano ZnO.

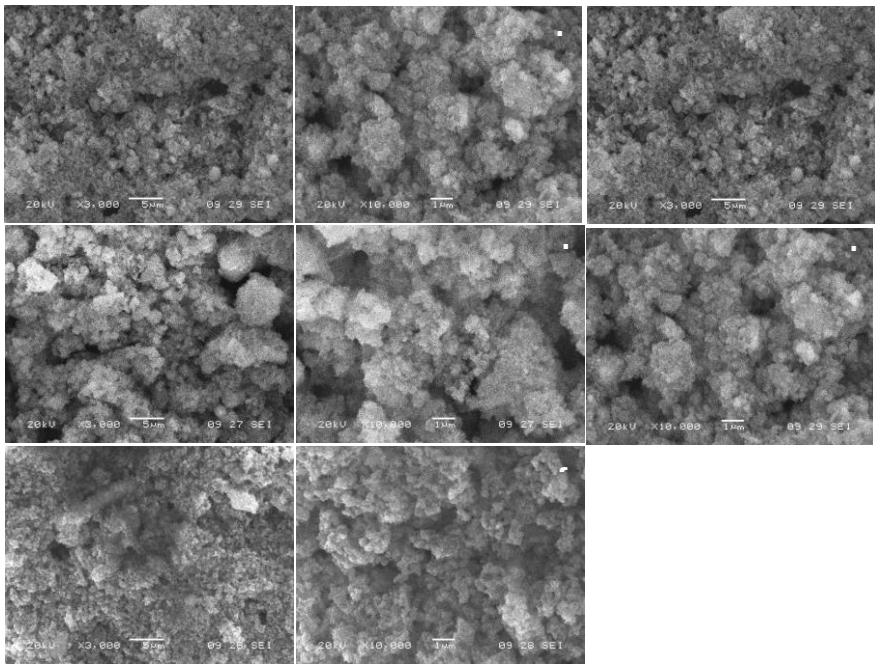

Fig.2: SEM Images of pure ZnO and PEDOT/ZnO nanocomposites

Fig 2 SEM micrographs of the a,b) Pure ZnO c,d) 0.10 g ZnO/PEDOT e,f) 0.15 g ZnO/PEDOT g,h) 020 g ZnO/PEDOT nanocomposites. It can be clearly seen that the shape of the pure ZnO nanoparticles were spherical with particle size in the range of ~ 50-70 nm which are more or less uniformly distributed throughout surface. The shapes of the nanoparticles are mostly spherical in nature while very few relatively large particles are observed which may be due to the effect of agglomeration.

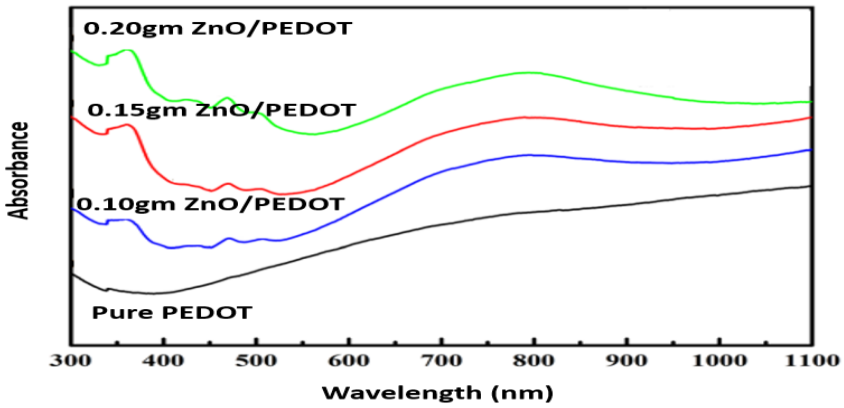

Fig.3: Uv-Vis spectra of PEDOT and PEDOT/ZnO

Figure 3 gives the UV-vis absorption of PEDOT and PEDOT/ZnO.PEDOT shows a broad absorption band in the vis-NIR,starting at approximately 500 nm which corresponds to the polymer having a longer conjugation.The charcteristics bands of the PEDOT/ZnO nanocomposites attributed at approximately 360,425,470,503 and 795 nm, respectively.

CONCLUSIONS:

In this report, we have successfully prepared Poly (3, 4- ethylene dioxy thiophene)/ZnO composites by in-situ polymerization method for the first time. The presence of broad peak of PEDOT at lower angle in the XRD pattern confirmed the formation of the PEDOT/ZnO nanocomposites.SEM micrographs showed an increasing trend of the particle size with the increase in ZnO content, which may be due to the effect of agglomeration . The particle size of the pure ZnO was found to be ~50-70 nm. It was found that the ZnO nanoparticles were uniformly distributed throughout the surface of the PEDOT.

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