One-step Electrochemical Synthesis of Polyaniline/Metallic Oxide Nanoparticle (γ -Fe₂O₃) Thin Film

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Polyaniline and metallic oxide (γ -Fe₂O₃) composite thin film was simultaneously synthesized using an electrochemical technique in a solution containing aniline, oxalic acid, and iron(III) sulfate in an alkaline medium. The results of the reaction process, which was monitored using infrared spectra at a specific wavelength of 638 cm⁻¹ along with an X-ray diffractogram of the respective angles 30.6°, 35.4°, and 60.7° 2 θ degree, indicated the presence of (γ -Fe₂O₃) and polyaniline in a single step. UV-Vis spectra suggested that the metal oxide interacted synergistically with the quinoid and benzoid groups, with absorption of approximately 560 nm and 280 nm present in the polymeric matrix. Thermogravimetric analysis (TGA) of the composite lost 10% of the weight at approximately 188°C. Together with TEM images, the results showed that iron oxide particles are nanometer-sized (126 $\pm$ 30 nm). Furthermore, SEM images show that multiple cycles of synthesis modify the mechanical properties of films prepared simultaneously with (γ -Fe₂O₃). The voltammetric behavior of the composite showed a reversible process. Furthermore, a preliminary test showed that our material has the potential to be applied in gas sensors.

Keywords: Composites; Nanostructures; Structural materials; Electrochemical properties; Electrochemical measurements.

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