Advanced Graphene oxide/Polypyrrole-Based Materials for Electromagnetic Shielding Devices

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Electromagnetic interference (EMI) continues to pose a major challenge across various industries and applications due to the widespread use of electronic devices, the growing reliance on wireless communication systems, and the increasing interconnectedness of modern technologies. To address these concerns, this study evaluates the potential of graphene oxide/ conductive polymer nanocomposites as an innovative class of materials for efficient EMI shielding. To produce materials with improved EMI shielding capabilities, conductive polymers, and graphene composites combine their special properties in which the composite's EMI shielding efficacy exceeds that of its individual component. In this study, a new generation of nanocomposite was synthesized by in situ polymerization of pyrrole in the presence of TiO_2 colloidal NPs, neat GO and GO/Ag NWs nanocomposite. Synthesis was performed by chemical oxidative polymerization of pyrrole with ammonium peroxy-sulfate in an acidic (HCl) condition. Structural properties of obtained nanocomposites were analysed by FTIR and Raman spectroscopy and XRD measurements. FTIR and Raman analysis showed the presence of a conductive (salt) form of polypyrrole. In addition, Raman spectroscopy and XRD measurements confirmed the presence of the anatase crystal structure of TiO2 NPs, as well as the presence of Ag NWs. XRD measurements further demonstrated the existence of both crystalline and amorphous regions within the synthesized nanocomposites. Surface morphology of all samples was studied by FESEM microscopy and it was noticed the presence of different types of nanostructures depending on the initial mole ratio of individual components. The electromagnetic shielding efficiency of all synthesized nanocomposites was measured in the frequency range of 8-12 GHz. It was observed the disparity in electrical conductivity due to the presence of interfacial polarization between crystalline and amorphous regions which played a significant role in the dissipation of electromagnetic waves.

References

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