Abstract

The present thesis is focused on development of core@shell conducting polymer nanocomposites and blends for their applications in environmental remediation. In this regard, spherical core (polystyrene, PS)@shell (polyaniline and polypyrrole, PANI and PPy) has been synthesized via chemical oxidative polymerization of monomer on the surface of sulfonated PS microsphere. It is followed by the formation of hollow PANI (HPANI) and PPy (HPPy) shells by dissolving PS inner core in THF. Subsequently, HPANI/Ag and HPPy/Ag nanocomposite has been prepared by using AgNO3 and Tollens' reagent as the source of Ag respectively. Finally, HPANI/Ag nanocomposite has successfully been used as a sensor in the detection of pyrogallol, sugar and also as an effective catalyst in the reduction of 4-nitrophenol (4-Np) under ambient conditions. It also showed high electromagnetic interference (EMI) shielding efficiency (SE) of 19.5 dB (11.2 GHz) due to the formation of continuous electronic path for the presence of highly conducting Ag nanoparticles. Our investigations on HPPy indicated its significantly higher EMI SE (34.5-6 dB) compared to PPy (20-5 dB) in the frequency range of 0.5-8 GHz due to the trapping of EM wave by internal reflection. We also observed that EMI shielding is further enhanced to 59–23 in 10 wt% Ag loaded HPPy. This is attributed to the simultaneous contribution of internal reflection as well as reflection from outer surface. In view of developing low cost, light weight, corrosion resistant environmental stable sheets for commercial application in EMI shielding, core@shell concept of PS@PANI has been extended in fabricating its mechanically and thermally stable blends with rubber of different polarity (EPDM, NBR and NR). Our investigations showed high EMI SE of rubber/PS@PANI blends (~30 dB: 1-8 GHz) compared to the same blends prepared from PS, PANI and respective rubber individually (~18 dB: 1-8 GHz).

Keywords: Polyaniline, Polypyrrole, Core-shell, Nanocomposite, EMI shielding.