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Topic: Synthesis and characterization of polymer composites for Electronic applications

Abstract

Polymer composites/nanocomposites were developed for application in electronics as EMI shielding and sensor materials. The different concentration of activated carbon in synthetic acrylic resin (AC: AR), Ag nanoparticles and nc-ZnO in PVP, and ferrite nanoparticles in multiwalled carbon nanotubes (Fe_3O_4:MWCNTs) nanocomposites were prepared by chemical route and characterized for physical properties by powder X-ray diffraction, FTIR, Raman, UV-VIS, SEM, EDX, TGA , EPR, VSM and two-probe dc conductivity techniques.

AC:AR composites with optimized conducting and shielding properties have porous morphology and very low surface resistivity which enhances EM radiation absorption. The shielding effectiveness increases with AC filler loading. The dielectric measurements revealed that pure AR has low relative permittivity value (~5) which increases to (~79) for 30 wt % AC containing composite. This gives EMI shielding effectiveness value of - 36 dB that corresponds to blockage of > 99.9 % of the incident electromagnetic radiation, and suggests that AC/AR composites are promising materials for making efficient EMI shields. The enhancement in the microwave shielding and absorption properties of the Acrylic resin has been achieved by the incorporation of filler (AC) in the acrylic matrix. This work is published in Journal of Polymers.

Ag: PVP nanocomposites were prepared by solution casting method with different Ag nanoparticles concentration and characterized for their structural, morphological, optical and electrical properties. The crystallinity of nanocomposites increases with increasing Ag concentration. The absorption peak observed ~ 430 nm for 20 wt% Ag sample, shifted to lower wavelength with increase in Ag wt% due to the creation of new electronic levels in forbidden gap, formation of conjugated bonds and carbon clusters. The direct and indirect energy band gap decreases from (2.30 $\pm$ 0.002) eV to (1.80 $\pm$ 0.002) eV and (2.25 $\pm$ 0.002) eV to (1.78 $\pm$ 0.01) eV respectively with increasing Ag concentration from 20 to 80 wt % by the formation of charge transfer complexes in host lattice. This work is published in Ind. J. Pure and applied Physics.

nc-ZnO:PVP composites were synthesized by sol-gel spin coating method and characterized by XRD, SEM, FTIR, AFM and ESR analytical techniques. XRD patterns exhibits improved crystallinity with crystallite size in 45 nm-55 nm range. IR

transmission spectra show characteristic peaks of PVP and nc-ZnO. SEM image revealed uniform cross-linked structure. ESR spectrum of nc-ZnO:0.05M PVP composite samples has resonance signal with peak-to-peak linewidth, g-value and spin concentration ~ 35 G, 2.0362 and 5.2374×10^{18} spins/g respectively.The sensing property of these nanocomposites were explored for different concentrations of ethanol vapour from 25 to 45 °C. Ethanol vapours are adsorbed on the surface of nc-ZnO:PVP composites.

CNT based nano-ferrite composites were synthesized by varying CNT's wt%. The physical properties of nanocomposites were analysed by X-ray diffraction, FTIR and EPR techniques. IR and UV-VIS spectroscopy studies confirmed the bonding of Fe_3O_4 with carbonyl groups of CNTs formed during purification. EPR spectra shows broad ferromagnetic resonance signal with superimposed narrow signal. These composites are tested for the removal of dyes from contaminated water by using effective adsorption, chemisorption and magnetic properties of these nanocomposites.