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Enhanced Microwave Absorbing Properties of Fe-NG-Polymer Nanocomposites in 2-18 Ghz Frequency Range

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Abstract. *In the recent times, rapid increase in the level of electromagnetic (EM) pollution has created the problem of electromagnetic interference (EMI) at microwave (MW) frequencies. The use of nano-magnetic composites in MW absorption has attracted tremendous attention owing to their novel physical and chemical properties. In the present work, we have prepared Fe-NG-polymer nanocomposites through melt blending technique for the excellent MW absorption properties. The crystalline size of exfoliated nanographite (NG) and iron (Fe) nanoparticles were estimated from XRD patterns using Scherrer's formula. Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) have shown the homogeneous dispersion of NG and Fe nanoparticles in the polymer matrix. Differential scanning calorimetry (DSC) measurement has shown the enhancement in glass transition temperature (T_g) after incorporation of NG and Fe nanoparticles in the nanocomposites. The thermal degradation temperature (T_d) of nanocomposites has been found to increase with increase in loading of NG and Fe nanoparticles. Raman spectra clearly indicate the existence of NG in all the prepared nanocomposites. The room temperature electrical conductivity (σ) measurement has been used to estimate the percolation threshold (ϕ_c) in nanocomposites. The complex permittivity (ε^*) and permeability (μ^*) measurements have been carried out on vector network analyser (VNA) in 2-18 GHz frequency range. The reflection loss (R_L) has been calculated through transmission line using Naito-Suetake model. The minimum reflection loss (R_{Lmin}) of ~ –27 dB (99.9% MW absorption) was observed in Fe (20.0 wt%)–NG (3.0 wt%)–polymer nanocomposite sample. The reflection loss data indicates that the prepared nanocomposites can be used for light weight and low cost commercial MW absorbing applications.*

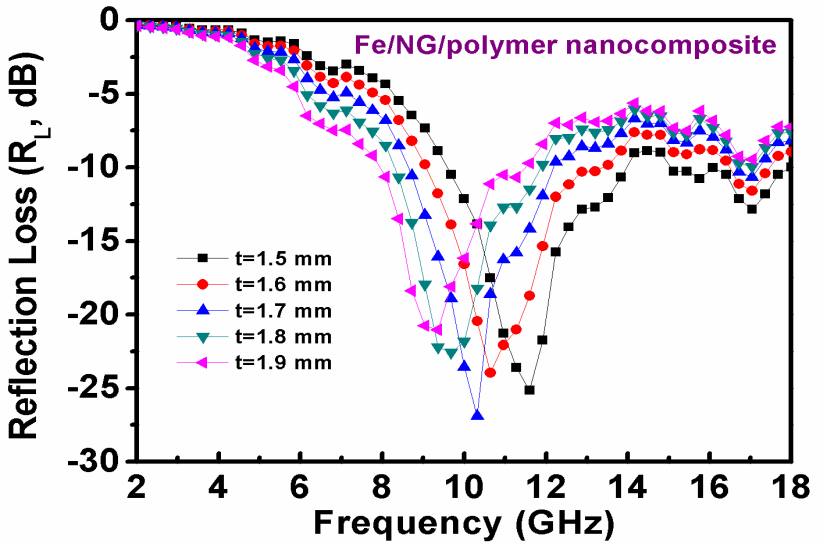

Figure: The variation of reflection loss (R_L) with MW frequency.