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Synthesis of a Core-Shell structured PANI/$Li_{0.5}Fe_{2.5-x}Gd_xO_4$ nanomaterial for EMI Shielding application

Mohd. Hanief Najar[1]*, M. Abdullah Dar[2], Kowsar Majid[3]

[1] Department of Chemistry, Govt. College of Engineering and Technology
Safapora Ganderbal-191201, J&K (India)
[2,3]Department of Chemistry, NIT Srinagar-190006, J&K (India)

ABSTRACT

A core-shell structured PANI/ $Li_{0.5}Fe_{2.5-x}Gd_xO_4$ ($0.0 \leq x \leq 0.2$) nanocomposite material has been prepared by in situ emulsion polymerization method as is evidenced by X-ray diffraction and Scanning electron microscopy. Transmission electron microscopy confirms the formation of core (ferrite)-shell (PANI matrix) structured nanocomposite material. These materials have been investigated for electromagnetic interference (EMI) shielding in the X-band (8–12 GHz) frequency range. Higher shielding effectiveness (SE_T) of around 42 dB has been obtained in this study than many other systems reported recently. The main contributing factor has been ascribed to the absorption (SE_A = 34–36 dB) instead of reflection (SE_R = 4.0–6.3 dB), owing to the enhancement in the electromagnetic attributes. Effect of increasing Gd^{3+} ion content in PANI/ $Li_{0.5}Fe_{2.5-x}Gd_xO_4$ nanocomposite has been analyzed for the electromagnetic attenuation. It depicts a decreasing trend of SE with Gd^{3+} doping except for x = 0.2 sample. This has been attributed to the increasing particle size of ferrites, resulting into the decrease in dielectric (ε' = 59–56 at 9.5 GHz) attributes owing to increased grain to grain contact. Higher value of SE for x = 0.2 sample can be due to the secondary phase formation in ferrite, which increases the number of grain boundaries and thereby increases ε'. However, increasing magnetization with Gd^{3+} doping is less likely a factor affecting shielding as compared to dielectric attributes. Such a material with high SE demonstrates the potential of these materials for making future microwave shields.

Key words: Polyaniline, Ferrites, Magnetic and Dielectric properties, EMI Shielding