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Complex permittivity, permeability, magnetic and microwave absorbing properties of Ni^{2+} substituted mechanically milled U-type hexaferrites

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Abstract

The polycrystalline samples of Ni^{2+} substituted U-type hexaferrite; $(Ba_{0.7}Bi_{0.2})_4(Co_{1-x}Ni_x)_2Fe_{36}O_{60}$ ($0.25 \leq x \leq 1.00$, in steps of 0.25) were prepared through solid state reaction method. XRD patterns, fitted with Le Bail method, revealed the formation of U-type hexaferrite phase in as-prepared samples. Scanning electron micrograph (SEM) indicates the presence of plate-like hexagonal particles with average sizes of ~1 to 4 μm. In order to reduce the grain sizes down to nanoscale, two stage high energy mechanical jet milling was performed on x=0.75 composition sample. The jet milled hexaferrite exhibits relatively smaller grain sizes (~20-50 nm), lower saturation magnetisation (M_s~38.6 emu/g) and higher coercivity (H_c~590.2 Oe) in comparison to unmilled sample of same composition (x=0.75). The jet milled sample, with nanoscale hexaferrite particles, exhibits excellent reflection loss (R_L) of −43.8 dB (99.99% MW absorption) at 11.3 GHz frequency. In addition, the jet milled sample displays a broad frequency bandwidth (~8.6 GHz) for $R_L \leq -10$ dB (90% MW absorption), extending over ~9.1 to 17.7 GHz frequency range.

Keywords: U-type hexaferrite; Complex permeability; Complex permittivity; Saturation magnetisation; Reflection loss; Mechanical jet milling

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