

Investigation on multiferroic behavior of brownmillerite composite by thermal and magnetic field perturbation

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Our investigation on the auto combustion sol-gel synthesized $(1-x)KBiFe_2O_5 - (x)NiFe_2O_4$ composite, where $0 \leq x \leq 1$, has been performed through the temperature, magnetic field, and frequency-dependent scientific methods. Rietveld refinement analysis with a proper χ^2 value confirms the purity, phase formation, and lattice parameters. The surface morphology shows a drastic change in grain size from in $x=0.1$ ($1.48 \pm 0.05 \mu\text{m}$) to $x=0.2$ ($0.77 \pm 0.03 \mu\text{m}$). The progressive addition of NFO randomizes the grain size and produces slight variations. In the $x=0.2$ composite, the 113% improved dielectric permittivity is (17.46×10^4) saw in composite. The 4 times enhanced M_R ($5.04 \pm 0.09 \text{ emu/g}$); however, the trivial variation in the H_C (15%) of $182 \pm 3 \text{ Oe}$ in $x=0.4$. The magnetic anisotropy of NFO is reflected in the LAS fitting, yielding a value of $5.52 \times 10^4 \text{ erg/cm}^3$ for the $x=0.4$ composite. Diffuse reflectance spectroscopy (DRS) and the Kubelka-Munk (KM) method figure out the direct band gap ($n=2$) of 1.74 eV for $x=0.4$ composite, suitable for photovoltaic applications. A maximum of 2.01% magnetodielectric (MD) coupling at 10 kHz is seen for the $x=0.1$ composite. Investigation suggests that a composite with high dielectric and moderate magnetization properties is suitable for low-magnetic-field-controlled data storage, sensor, and spintronic device applications.

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