

Heat dissipating multi-component inorganic mixture of iron with high-temperature dielectric behaviour

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Synthesis and characterization of two multicomponent mixtures, $0.8 \text{ Fe}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O} \cdot 0.8 \text{ FePO}_4 \cdot 2\text{H}_2\text{O} \cdot 0.5 \text{ NH}_4\text{H}_2\text{PO}_4 \cdot 0.2(\text{NH}_4)_2\text{SO}_4$ (**FPN2A**) and $0.8 \text{ Fe}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O} \cdot 0.8\text{FePO}_4 \cdot 0.5\text{NH}_4\text{H}_2\text{PO}_4 \cdot 0.2(\text{NH}_4)_2\text{SO}_4$ (**FPN2B**) are reported. FPN2A and FPN2B mixtures have average crystallite sizes of 66.1 nm and 79.5 nm, respectively. The respective optical bandgap of FPN2A and FPN2B are 6.02 eV and 5.96 eV with a refractive index of 1.99. Thermal analysis reveals heat-dissipating behaviour of the mixtures with specific heat capacity, C_p (at 307K) of $0.71 \text{ Jg}^{-1}\text{K}^{-1}$ and $0.66 \text{ Jg}^{-1}\text{K}^{-1}$ for FPN2A and FPN2B, respectively. Further, temperature-frequency dependant dielectric properties of the FPN2C (obtained by sintering FPN2B at 423K) have been investigated. The sintered mixture, FPN2C orchestrated variation in permittivity, ϵ' ($\sim 17 - 42$) and dielectric loss, $\tan \delta$ ($\sim 0.04-0.08$) in the frequency range of $1.0 \times 10^3 \text{ Hz}$ to $4.0 \times 10^6 \text{ Hz}$ up to 483K. AC conductivity of FPN2C has been found to be $\sim 8.96 \times 10^{-8} \text{ sm}^{-1}$ up to 483K. TG-DSC analysis reveals the thermal stability of the FPN2C over a wide range of temperature (297K to 1267K) and heat-dissipating behaviour with a C_p of $0.62 \text{ Jg}^{-1}\text{K}^{-1}$.

Keywords: Heat dissipation, Specific heat capacity, Dielectric properties, AC conductivity