Strong interfacial polarization in transition metal (Fe/Co/Ni) doped LaCrO_3 for high dielectric permittivity materials

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In this study, we delineate the fabrication and characterization of colossal permittivity materials of water-soluble lanthanum chromate (LaCrO_3) by doping of transition metal ions at Cr site (Fe/Co/Ni, @10%). We have synthesized the transition metal (TM) doped LaCrO_3 nanoparticles using gel combustion technique. Effects of transition metals doping in LaCrO_3 on structural, thermal and dielectric properties have been studied. These prepared nanoparticles characterized through XRD, TEM and FTIR have shown single phase nature with orthorhombic structure. The FTIR Spectra of prepared nanoparticles have been shown in Figure 1. Further thermal analysis has been done through TGA and DSC. The XRD analysis shows that the presence of transition metals increases the crystallite size and TEM images confirms the formation of nanoparticles with uniform distribution of nearly equal particle size. The average particle size of the pure LaCrO_3 is less than the average particle size Fe doped LaCrO_3 obtained from image J histogram.

Figure 1: FTIR Spectra of prepared nanoparticles

The nanoparticles exhibit significant enhancement in dielectric constant with low dielectric loss value as a function of doping TM is varying. Due to the charge transfer between transition metals and LaCrO_3 , the nanoparticles show distinct dielectric properties. Figure 2 shows the variation of real Dielectric Constant with frequency of all the samples. Thus, the high values of dielectric permittivity of transition metal doped LaCrO_3 nanomaterials are potential flexible high-performance dielectric materials for electronic devices such as solid oxide fuel cells (SOFCs) or embedded capacitors.

Figure 2: Variation of real Dielectric Constant with frequency of all samples

References

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