Dynamics of electron density, and dielectric properties of $CoFe_2O_4$ nanoparticles influenced by substitution of La^{3+} at Fe^{3+}

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Cobalt ferrite ($CoFe_2O_4$) has been subjected to the existence or nonexistence of ferroelectric properties. The nominal composition of $CoLa_xFe_{2-x}O_4$ (where, x = 0, 0.05, 0.10, 0.15, 0.20, 0.25, and 0.30) has been synthesized by the sol-gel method. The synthesized grain sizes varied from 60 nm to 80 nm. The electron density plots obtained using Rietveld refinement of the x-ray diffraction data showed the displacement of the Co and Fe ions which is highly influenced by the substitution of La^{3+} at Fe^{3+}. It is also observed that the AC conductivity increases with the increase of La^{3+} amount in the parent sample ($CoFe_2O_4$) which is dominated by frequency. The contribution of grain and grain boundaries on dielectric relaxation has been investigated at room temperature (25°C). The electric permittivity (ε) is also enhanced due to substitution La^{3+} at Fe^{3+}. Finally, the composition $CoLa_{0.10}Fe_{1.9}O_4$ sintered at 700°C shows the highest electric permittivity (ε') with low dielectric loss ($tan\delta$) and finds suitable application for the strain gauge, made by evaporating a small amount of metal onto the surface of a thin sheet of this material.

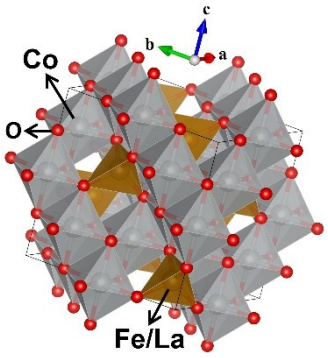

Fig. 1. Unit cell structure of $CoLa_{0.10}Fe_{1.9}O_4$ sample sintered at 700°C.

Keywords: Microstructure, Electron-density, Conductivity, Dielectric relaxation, Permittivity.

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