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Temperature dependent Raman Spectroscopic Study of the Fe doped $La_{0.67}Sr_{0.33}MnO_3$ Prepared Using Ball Milling Method

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Polycrystalline samples of $La_{0.67}Sr_{0.33}Mn_{0.65}Fe_{0.35}O_3$ (LSMFO) were synthesized using the standard ball mill method with different calcination temperatures ranging from 800°C to 1100°C for 7 h. The phase purity of these samples was confirmed using X-ray diffraction (XRD) patterns. All samples were found to have rhombohedral crystal structure with $R\bar{3}c$ space group. The lattice parameters, cell volume, bond angle and bond length have been obtained using the Rietveld refinement by FullProf software. The average crystallite size calculated using the Debye-Scherrer formula was found between 27 and 60 nm. Surface morphology of the prepared samples has been examined using a scanning electron microscope (SEM). SEM images show the formation of well-arranged grain sizes distributed from 240 to 400 nm, much larger than one estimated using the Scherrer formula. All tiny particles are highly agglomerated with the increasing temperature and porosity decreases with increasing temperature. An analysis of the frequency and peak broadening of Raman modes as a function of temperature clearly shows the significant temperature effect on the A_{1g} and E_g modes of LSMFO. The shifts and broadening of the A_{1g} and E_g modes are discussed in light of the oxygen sublattice distortion. Our study shows the reduction in distortion with increasing calcination temperature, which suggests a decrease in the JT effect.

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