

Structural and Magnetic properties of the Nanocrystalline Perovskites $\text{La}_{1-x}\text{Sr}_x\text{FeO}_{3-\delta}$ ($0 \leq x \leq 0.5$)

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Abstract – We have performed X-ray diffraction, Mössbauer spectroscopy, scanning electron microscopy and magnetization measurements on $\text{La}_{1-x}\text{Sr}_x\text{FeO}_{3-\delta}$ perovskites with ($0 \leq x \leq 0.5$). The samples were obtained by sol-gel method, calcined and sintered at air. The crystalline structures were determined by X-ray diffraction and Rietveld refinement. On the samples with orthorhombic symmetry, the unit cell volume decrease with Sr concentration. Mössbauer spectroscopy show that the sintering for samples with $x = 0.3$ and 0.4 increase the magnetic component. The magnetization measurements indicate the existence of weak ferromagnetism for samples with ($0 \leq x \leq 0.3$) and for $x = 0.4$ a high coercive behaviour attributed to Sr hexaferrite.

The perovskite oxide system $\text{La}_{1-x}\text{Sr}_x\text{FeO}_{3-\delta}$ (LSFO) with ($0 \leq x \leq 1$), have attracted considerable attention due to their interesting electronic, magnetic and catalytic properties [1-3]. These properties are strongly dependent of the chemical composition and phase structure. The LaFeO_3 (LFO) exhibits an orthorhombic structure with space group Pbnm, it is isolator and antiferromagnetic with a Neél temperature T_N of approximately 750 K. The SrFeO_3 (SFO) is cubic with space group Pm-3m, it is metallic and helical antiferromagnetic with $T_N=134$ K. Replacement of La^{3+} by Sr^{2+} (LSFO) increase the electronic conduction and decrease T_N . The substitution also increase the formal valence state of Fe ion from 3+ (LFO) to 4+ (SFO). For low Sr concentration, sequence of Fe^{3+} and Fe^{4+} observed at low temperature, has been explained on the basis of the local CO state. For ($0 \leq x \leq 0.3$) Magnetic measurements indicated the existence of a weak ferromagnetism and the spontaneous magnetization decreases with increasing Sr content. In this work we synthesize LSFO samples with ($0 \leq x \leq 0.5$) and different sizes by a sol-gel method. The samples were characterized by mössbauer spectroscopy and magnetic measurements.

Rietveld refinement of x-ray patterns shows orthorhombic structure with space group Pbnm for samples with ($0 \leq x \leq 0.3$) and for $x=0.4$ and $x=0.5$ rhombohedral structure with space group R3c. Mössbauer spectra shows that the sintering for samples with $x = 0.3$ and 0.4 increase the magnetic component. Magnetic hysteresis measurements indicate the existence of weak ferromagnetism for samples ($0 \leq x \leq 0.3$) and for $x=0.4$, a high coercive behavior (Figure 1) attributed to Sr hexaferrite. A mechanism based on ternary phase diagram ($\text{La}_2\text{O}_3\text{-Fe}_2\text{O}_3\text{-SrO}$) for explain the appearing of the Sr hexaferrite secondary phase is proposed.

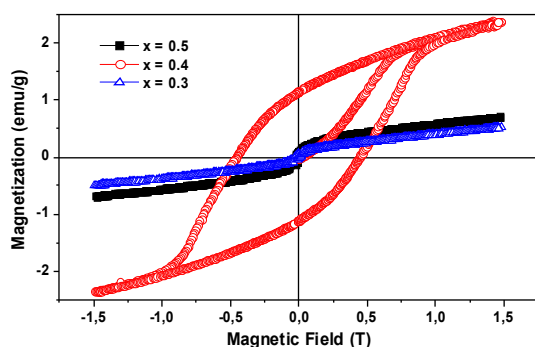


Figure 1: Magnetic hysteresis for Sintered samples.

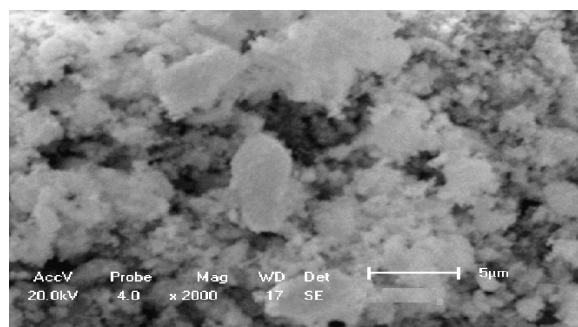


Figure 2: SEM image of the sample with $x=0.5$ calcined at $800\text{ }^\circ\text{C}$.

References

- [1] M. V. Patrakeev, J.A. Bahteeva, E.B. Mitberg, I.A. Leonidov, V.L. Kozhevnikov, K.V. Poeppelmeier, J. Solid State Chem. 172(1) 219 (2003)
- [2] R.J. McQueeney, J.Ma, S. Chang, J.-Q. Yan, M. Hehlen, and F.Trouw, Phys. Rev. Lett. 98, 126402 (2007)
- [3] D. Bayraktar, S. Diethelm, T. Graule, J. Van herle and P. Holtappels, J. Electroceramics 22, 55-60 (2009)
- [4] J. Li, X. Kou, Y Qin and H.He, Physica Status Solidi (A) Applied Research 191 (1), pp. 255-259 (2002)