Proc. of the Intl. Conf. on Nanotechnology for Better Living, 2016
Editors K. K. Kar, A. Shah and R. Sharma
Vol. 3, No. 1, p. 173
doi:10.3850/978-981-09-7519-7nbl16-rps-173

NBL-2016

The effect of particle size on the magnetic properties of Y_2FeCoO_6

Haripriya G. R.*, Shashi Priya Balmuchu, Pradheesh R.[2], K. Sethupathi and V. Sankaranarayanan

[1]Low Temperature Physics Laboratory, Indian Institute of Technology Madras, Tamil Nadu, India
[2]Center for Electricity and Magnetism, Division of Physical Metrology, Korea Research Institute of Standards and Science (KRISS), Daejeon, South Korea
*Email: haripriyagr@gmail.com

The spin correlated systems gained special attention, as they owe the candidature for spintronic applications in memory handling. The class of materials called as 'perovskites ', are one of them in this regard. The amiability to accommodate suitable addition from the periodic table makes perovskites to exhibit versatile features. The transition metal based double perovskite oxides, which belongs to the modified simple perovskite structure, is one of the strongly spin-coupled systems with 3D interactions.

The system Sr_2FeCoO_6, which is a spin glass with glass transition temperature ~75 K, is reported to show a negative magnetoresistence of 63% with the application of 12 T field at 14 K [1]. To study the effect of electron addition to the system we have substituted Y^{3+} in place of Sr^{2+}. The double perovskite oxide Y_2FeCoO_6 was synthesized by citrate complex sol-gel route [2]. By varying the pH value (~1 and ~8) and annealing temperature of the sol which was obtained from processing the precursors, we obtained particles with average sizes ~700 nm and ~230 nm respectively (Figure 1).

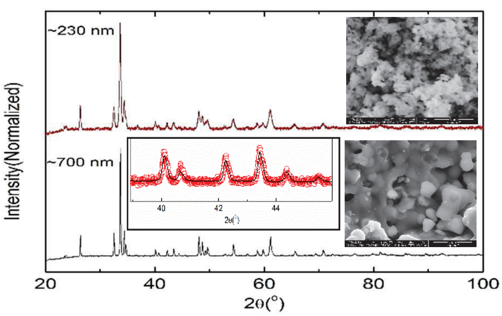

Figure 1: The room temperature powder XRD data and SEM image of the data for Y_2FeCoO_6 samples with particle size 230 nm on top and 700 nm on bottom

The structural characterization using Rietveld refined powder X-Ray diffraction turned out to be orthorhombic *Pnma* for both the samples (Figure 1).From SEM-EDS analysis the composition was ensured.

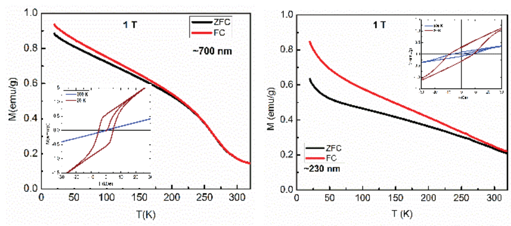

Figure 2: The magnetization data for Y_2FeCoO_6 with particle size 700 nm on left and 230 nm on right

The magnetic measurements carried out reveal the weak ferromagnetic nature of the samples at low temperatures with a paramagnetic nature, at and above 300 K. The bifurcation observed in the constant field magnetization for low applied field values (up to 1T) points towards the existence of mixed interactions in the system (Figure 2). The magnetism arises from the B-site transition metal ions alone as the A-site cation Y^{3+} is having no unpaired electrons. As the parent system is reported to have mixed valence Fe and Co at room temperature, the XPS as well as Mossbauer studies have been carried out. The XPS studies inferred the co-existence of Co^{3+} and Co^{2+} in the ratio 3:17. But the preliminary analysis of Mossbauer measurements suggests the valence state of Fe in the sample is 3^+ at room temperature. The isothermal magnetization at 20 K exhibits significant hysteresis with a large value of coercivity, which is found to be increasing as the particle size was decreased from 700 nm to 230 nm.

References

1. Pradheesh R., et al, Euro. Phys. J. B **85**, (2012) 260.
2. Yingfen Wei, et al, AIP ADVANCES **4**, (2014) 127134.