SAIP2017



Contribution ID: 16

Type: Oral Presentation

Mechanical milling effect on the structural and magnetic properties of sintered La_{0.67}Sr_{0.33}MnO₃

Tuesday, 4 July 2017 11:10 (20 minutes)

Structural and magnetic properties of sintered and milled La_{0.67}Sr_{0.33}MnO₃ was investigated in the temperature range of 300-2 K. The refined X-ray diffraction (XRD) data show that all samples are single phase and crystallize in rhombohedral symmetry with <i>R-3C</i> space group. The as-prepared samples (SK) where milled for 1, 3, 6 and 12 hours (SKM1, SKM3, SKM6 and SKM12). The crystallite size decreased from 46-11 nm as a function of milling except for SKM12 which increased slightly to 12 nm due to thermal effect of prolonged milling. The cell volume increased from 349-352 Å³ except for SKM12 which dropped to 349 Å³ due to peak shift to a higher $2 < i > \theta < /i > as a re$ sult of strain. High-resolution transmission electron microscopy HRTEM and high-resolution scanning electron microscopy HRSEM of the samples show a variation in the morphology. The saturation magnetisation netisation. <i>M_S</i> for all samples increases as temperature decreases. At the maximum and minimum measuring temperature of 300 K and 2 K respectively, the <i>M_S</i> for SK, SKM1, SKM3, SKM6 SKM12, are 52, 45, 22, 13, 7 emu/g and 80, 79, 64, 53, 40 emu/g respectively. The drop in <i>M_S</i> has been explored based on a core-shell model. The coercivity at 2 K showed a significant increase from 0.17 kOe for SK to 0.87 kOe for SKM12. The hysteresis loops of all samples at 2 K exhibit a trend from superparamagnetism to ferromagnetism, while at 300 K, a trend of superparamagnetism to paramagnetism is observed.

Summary

Mechanical milling, superparamagnetism, paramagnetism, ferromagnetism

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 (Hons, MSc,
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PhD

Main supervisor (name and email)
and his / her institution

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Session Classification: Physics of Condensed Matter and Materials 1

Track Classification: Track A - Division for Physics of Condensed Matter and Materials