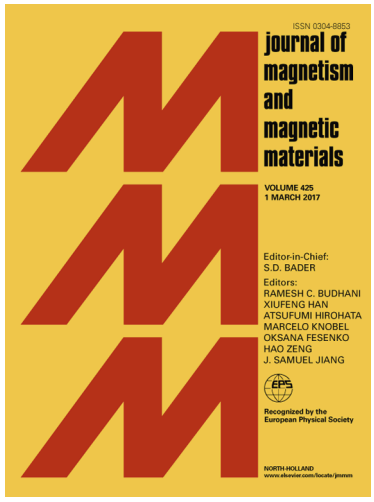

ESR studies of transition from ferromagnetism to superparamagnetism in Nano-ferromagnet $La_{0.8}Sr_{0.2}MnO_3$

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ESR studies of transition from ferromagnetism to superparamagnetism in Nano-ferromagnet $La_{0.8}Sr_{0.2}MnO_3$

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Abstract

Electron Spin resonance spectroscopy (ESR) was used to determine the magnetic properties of nanocrystalline samples of $La_{0.8}Sr_{0.2}MnO_3$ having an average crystallite size ranging from 9 to 57 nm. The control of the size is performed by adopting the autocombustion method with two-step synthesis process. The main objective of this study is to determine the effect of crystallite size on the magnetic behavior of materials. As well as the domains of the sizes correspond to the superparamagnetic state and to single-domain and multi-domain ferromagnetic states. However, we have noticed that Electron Magnetic Resonance (EMR) and Low Field Microwave Absorption (LFMA) spectra are highly crystallites size dependent. Significant changes in the line shape, LFMA signal, resonance field, and linewidth (ΔH_{pp}) can be used as indices of magnetic state transitions. Moreover, the discontinuity observed in ΔH_{pp} and g-factor is attributed to the changes of magnetic states. Magnetic measurements showed a good agreement with ESR results. Therefore, samples having crystallite size less than 24.5 nm are in a superparamagnetic state and those between 24.5-32 nm are single-domain ferromagnetic. The multi-domains ferromagnetic are manifested for sizes greater than 32 nm. Above 24.5 nm in accordance with the core-shell structure, the increase in g-factor with crystallites size is attributed to the increase in core size magnetic. In the superparamagnetic zone, the practically constant value of the g-factor assumes that the volume of the core magnetic is not affected by increasing crystallites size. This contradictory observation with the core-shell model was explained by the phenomenon of phase separation often reported for manganites perovskite. Thus, the low size crystallites consist of several small ferromagnetic volumes distributed in a paramagnetic matrix, that we called crystallite multi-core superparamagnetic.

Keywords: Manganite Perovskite, ESR, Phase transition, Superparamagnetic, Phase separation

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