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Structural evolution on size reduction (~d <30nm) in half doped manganite system

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1 Introduction

In the field of material research the synthesis of one dimensional (1D) single crystalline nanomaterials have received much attention because of their interesting physical properties which are different from its bulk form. We have synthesized template free fabrication of single crystalline nanowires of hole doped manganite of $La_{0.5}Sr_{0.5}MnO_3$ (LSMO0.5), $La_{0.7}Sr_{0.3}MnO_3$ (LSMO0.3), $La_{0.5}Ca_{0.5}MnO_3$ (LCMO0.5) and$La_{0.7}Ca_{0.3}MnO_3$ (LCMO0.3) using the hydrothermal technique and to investigate their structural properties. Our motivation was to see whether size reduction retains the crystallographic structure. Hence we propose to study the crystallographic structure of LSMO, LCMO (x=0.5) nanowires (<50nm) by using synchrotron x-ray beam line in the powder diffraction mode in the temperature range 4.2K-300K.

2 Experiment

High purity $La(NO_3)_3.6H_2O$, $Sr(NO_3)_2$, $Ca(NO_3)_2.4H_2O$, $KMnO_4$, $MnCl_2.4H_2O$ and KOH were used for the preparation [1-3]. Stoichiometry proportions of the chemicals were dissolved in de-ionized water to form a uniform solution, and then the pH of the solution was adjusted to 14 by adding KOH with stirring using a magnetic stirrer. The final reaction solution was poured into a 50 ml Teflon vessel till 80% of its volume was filled and then it was placed in a stainless steel cylinder. To prepare the nanowires the crystallization reaction was performed at 250^0 C - 270^0 C for 40 - 50 hours in an oven. After that, the autoclave was cooled to room temperature naturally and depressurized and the obtained product of the reaction was washed with de-ionized water and dried overnight in air at 120 °C. Fig. 1 shows the Scanning Electron Microscopy (SEM) image of the ensemble of LSMO0.5 nanowires. x-ray powder diffraction measurement was done on all four samples in the temperature range 20-300K using BL-18B beam line, wavelength λ= 0.794Å.

3 Results and Discussion

Fig. 2 shows the powder X ray diffraction (XRD) of LSMO0.5 nanowires at 300 K using synchrotron source. It is the tetragonal structure of the space group *I4/mcm*. This raw data is refined by Reitveld method. The lattice parameters are a = b = 0.5439 nm and c = 0.7719 nm. We have taken low temperature XRD up to 10 K. Tetragonaliticity reduces and orthorhombocity increases with decreasing temperature. We are trying to fit and analyse all the data of the samples.

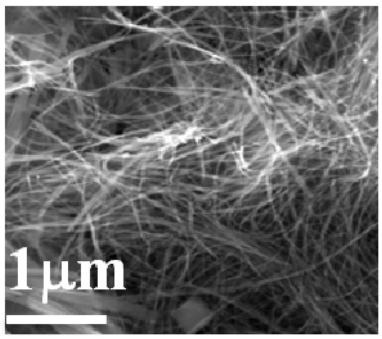

Fig. 1: SEM image of the ensemble of LSMO0.5 nanowires.

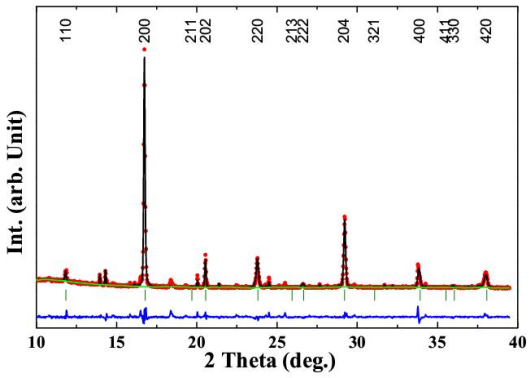

Fig. 2: XRD of LSMO0.5 nanowires at 300 K.

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References

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