International Journal in Physical and Applied Sciences
Volume 06 Issue 07, July 2019 ISSN: 2394-5710 Impact Factor: 4.657
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

STRUCTURAL PROPERTIES AND D. C. RESISTIVITY STUDY OF STRONTIUM DOPED LANTHANUM MANGANITE (LSM) THIN FILMS AS CATHODE FOR SOFC

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ABSTRACT

Strontium doped Lanthanum Manganite (LSM) thin films were synthesized by spray pyrolysis technique. These LSM thin films were used as cathode for SOFC which is useful to reduce the operating temperature of SOFC. The LSM thin films were synthesized with o.1, 0.2, 0.3 mol % of strontium content. After sintering the LSM thin films crystalline perovskite phase formed and this films used for morphological analysis by FESEM technique. EDAX analysis was done to confirm the stoichiometry of element. D. C. resistivity measurement was done by two probe technique and it confirms the LSM is semiconducting material.

Keywords: Spray Pyrolysis, d. c. resistivity, Cathode, LSM, SOFC.

1. Introduction:-

The research in the field on low temperature solid oxide fuel cell (SOFC) i.e. $800^{O}C$ is constantly increasing and one of the electrodes (cathode) which has attracted the greatest interest of research is strontium doped lanthanum manganite (LSM). The excellent SOFC cathode material is LSM because it is inapplicable for low temperature [1-3]. LSM series is known to have various crystal structures such as orthombic, tetragonal, rhombohedral and cubic symmetry [4-10]. To improve the performance of cathode many research groups have been studied microstructure of LSM. The microstructure of electrode may be controlled by several factors such as thickness of cathode material [11], particle size and strontium concentration [12] etc.

The primary objective of this research is to prepare cathode thin films with uniform pore structure and study the effect of strontium content on microstructure in deposited thin films. Electrical properties of LSM thin films were also studied.

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2. Experimental:--

The precursors of Lanthanum Nitrate hex hydrate $La(NO_3).6H_2O$, Strontium Nitrate $Sr(NO_3)$ and Manganese Nitrate hex hydrate $Mn(NO_3).6H_2O$ were used for deposition of LSM thin films using spray pyrolysis techniques. By optimizing the various parameters and varying the strontium content the thin films were deposited on alumna substrate. For formation of crystallization of material it was annealed at $800^{O}C$ for 2 hours.

The sintered films were used for morphological study using FESEM technique. EDAX were taken for analyzing stoichiometry of element. D. C. resistivity was measured using two probe method.

3. Results and Discussion:-

3.1 FESEM:

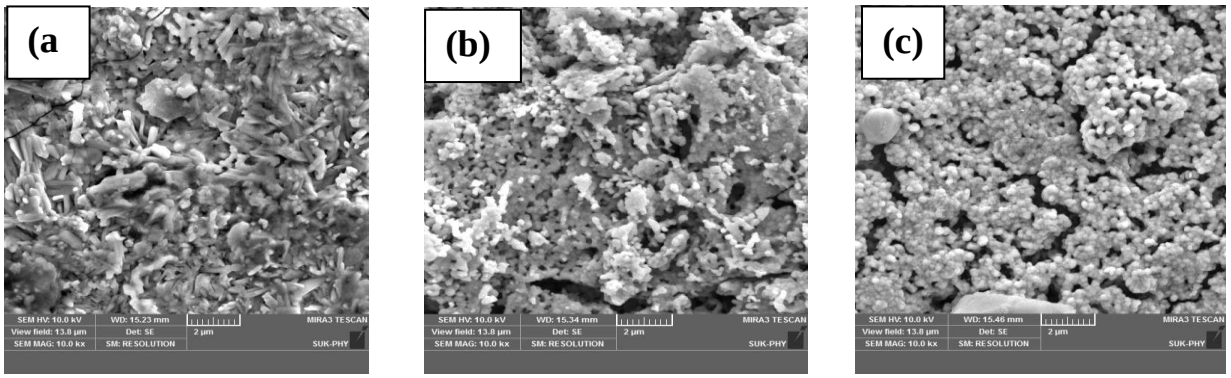


Fig.1. FESEM (a) X=0.1, (b) X=0.2, (c) X=0.3

The surface morphological study of LSM thin films were studied by using FESEM. Fig.1 shows FESEM images of LSM thin films with varied strontium concentration from 0.1-0.3. It is observed that the composite thin films is well adhered to the substrate and has uniformly continuously pores through. It was found that the grains are uniform in size and sufficient porosity is present such that high triple phase boundary is achieved [12, 13]. Such pores structure meet a need in the cathode of SOFC, which possess a high active surface area, while permitting a rapid diffusion of oxygen through the porous cathode films [14]. It is clear that as strontium content increases porosity of the films was enhanced and became clear.

3.2 EDAX Analysis:

The EDAX plots for variation of strontium content are also shown in fig. 2. All EDAX spectra reveal no extra peaks reflected the presence of all constitutes. In all LSM samples, the standard peak position for Lanthanum (La), Strontium (Sr), Manganese (Mn) and Oxygen (O) were

exactly matches. This divulged that the elemental composition of all the LSM samples did not contain any unfamiliar element. Hence the sample investigated for elemental analysis showed almost same as calculated stoichiometry with our original in the sample.

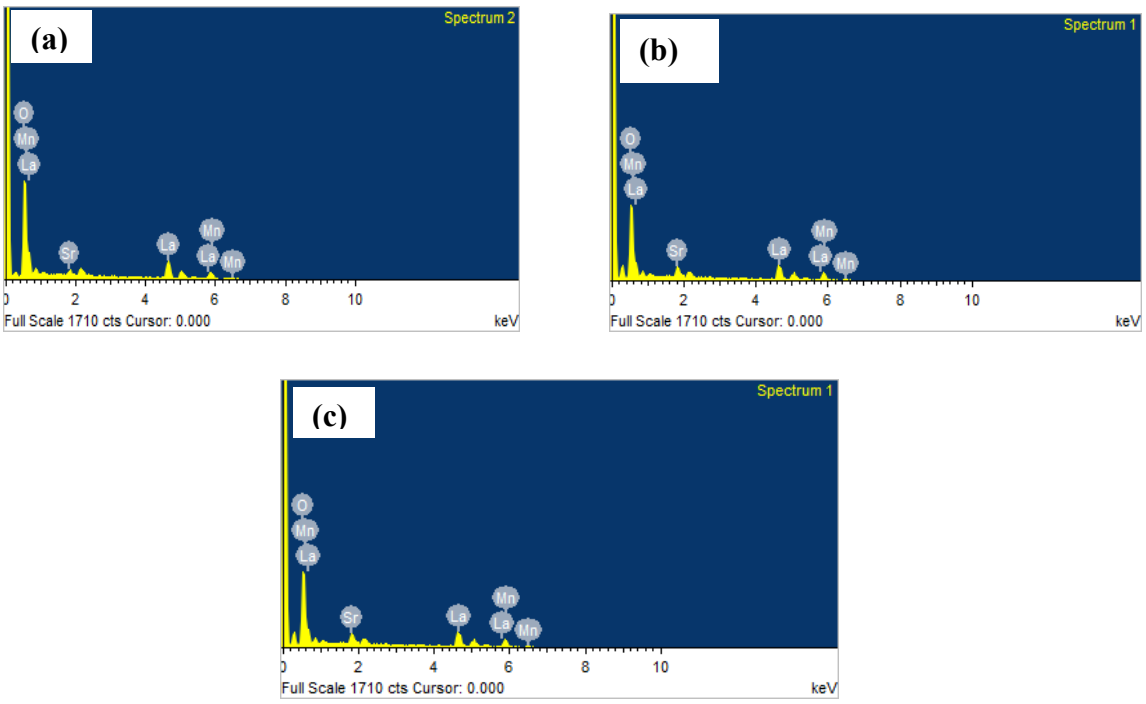
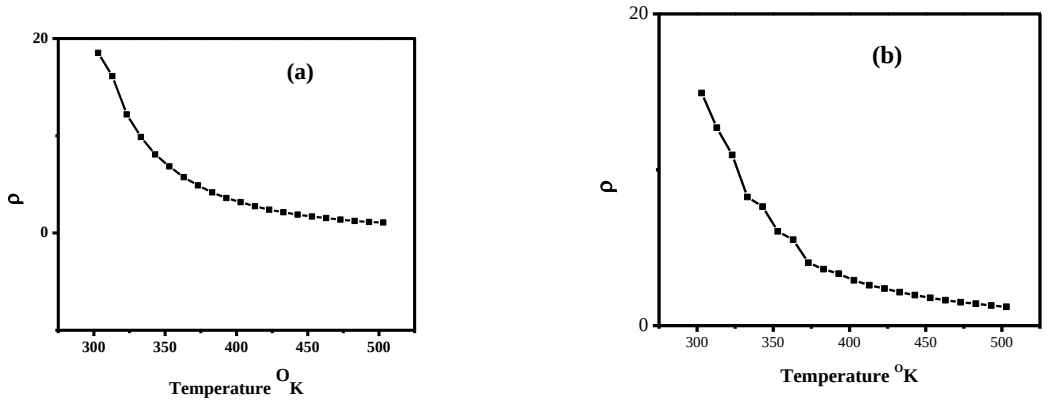
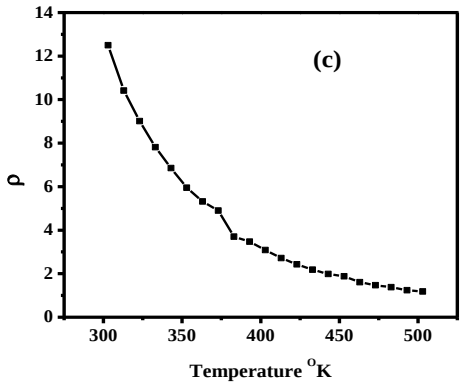


Fig.2. EDAX (a) X=0.1, (b) X=0.2, (c) X=0.3

3.3 Resistivity:-





F Fig.3. Resistivity as a function of temperature (a) X=0.1, (b) X=0.2, (c) X=0.3)0^{O}C for two hours. It was found that as temperature increases resistivity if LSM sample slowly decreases and became constant. As temperature increases resistivity decreases slowly for X = 0.1 sample and as strontium concentration increases resistivity decreases rapidly. Decrease in resistivity with increase temperature clearly shows that LSM sample is negative temperature coefficient of resistance and it is trait as semiconducting behavior. This semiconducting material is useful for SOFC cathode. As temperature increases resistivity decreases due to thermally activated drift mobility charge carriers according to hopping conduction mechanism [15].

4. Conclusion:

The LSM samples exhibit homogenous thin films with porosity and as strontium concentration increases porosity increases. EDAX mapping atomic ratio is 1:1and which is relatively same as that of precursor. D. C. resistivity was decreases due to increase of strontium concentration.

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