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Synthesis Growth and Characterization of $La_{1.8}M_{0.20}Cu_{1-x}Mn_xO_{4,}$ (M=Sr,Ca) Oxides

MANISH VERMA[1], B.DAS[1],N.P. LLALA[2], D.M. PHASE[2] and V.K. AHIRE[2]

[1]Department of Chemistry, University of Lucknow - 226 007 (India).
[2]UGC-DAE CSR,University Campus,Khandwa Road,Indore - 452 017 (India).
*Corresponding author E-mail:photonics2008@rediffmail.com

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ABSTRACT

Polycrystalline samples of $La_{1.8}M_{0.20}Cu_{1-x}Mn_xO_4$ (0d”xd”0.20) were synthesized by solid state reaction method. The phase purity was confirmed by powder X-ray diffraction. The scanning electron microscopy was done on the $La_{1.8}M_{0.20}Cu_{1-x}Mn_xO_4$ samples. The $La_{1.8}Sr_{0.20}Cu_{1-x}Mn_xO_4$ sample was found to be superconducting while $La_{1.8}Ca_{0.20}Cu_{1-x}Mn_xO_4$ sample was found to be magnetoresistive.

Key words: Solid state reaction method, X-ray diffraction, Scanning Electron Microscopy, Microstructure, SEM, Magnetoresistance, LSCO, LCCO.

INTRODUCTION

There is now extensive research work on lamellar copper oxide materials to explain the mechanism of various phenomenons in oxides [1-6]. To study the phenomenon like superconductivity, magnetoresistance and other physical properties the doping of various elements at Cu site was done by various research groups [5-7]. In this paper we attempt to explain the accurate condition.

MATERIALS AND METHODS

The polycrystalline samples were prepared by means of a conventional solid state reaction method using high-purity powders of La_2O_3, $SrCO_3$/$CaCO_3$, CuO, and MnO_2. The powders were mixed, pressed into pellets, were then reacted at 1100°C for 7 days with three intermediate grinding. The chemical formula for the final compounds is $La_{1.8}M_{0.20}Cu_{1-x}Mn_xO_4$ with x=0, 0.10, 0.15, 0.20 and M=Sr/Ca. Phase identification was done with the help of X-ray Diffraction (XRD) pattern recorded on powder Rikagu Diffractometer using $Cuk_{á}$ radiation. Rikagu Diffractometer has scanning rate of 2 degree per minute. Microstructure was analyzed by Scanning Electron Microscopy (SEM) JEOL JSM 5600. Also EDAX was done on these samples to map the elements present in samples (not shown). Resistance as a function of temperature for all the samples of LSCO was measured using a standard four-probe method. Magnetoresistance (MR) was measured as a function of Temperature.

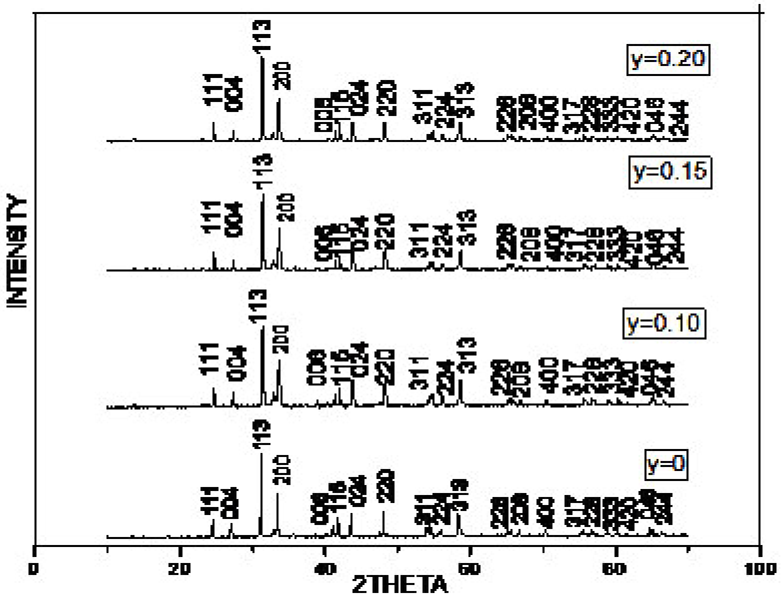

Fig 1. X-ray diffraction of LCCO i.e.
$La_{1.8}Ca_{0.20}Cu_{1-x}Mn_xO_4$ with x=0,0.10, 0.15,0.20

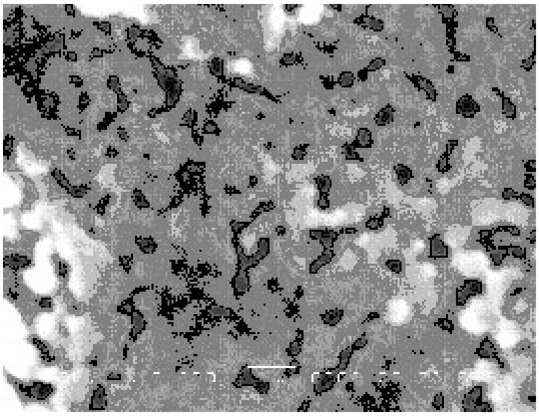

Fig 2a. LSCO, y=0

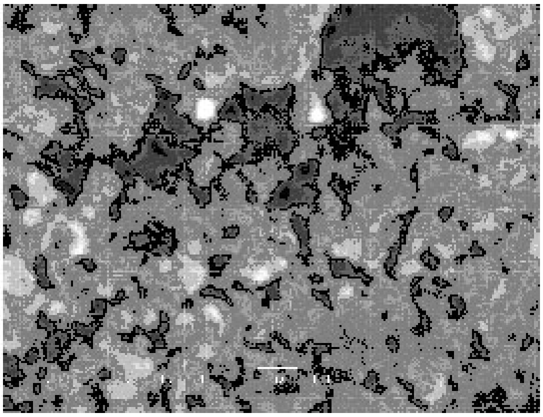

Fig 2b. LSCO with y=0.15.

RESULTS AND DISCUSSION

Each sample of $La_{1.8}Sr_{0.20}Cu_{1-x}Mn_xO_4$ and $La_{1.8}Ca_{0.20}Cu_{1-x}Mn_xO_4$ was carefully characterized by powder X-ray diffraction and confirmed to be single phase which can be indexed as having K_2NiF_4-type tetragonal symmetry (not shown) and Orthorhombic symmetry respectively (see Fig 1). No impurity peaks are present in the X-ray Diffraction patterns. Mn definitely substitutes for Cu site as confirmed by the fact that the samples with Mn doping remain single phase.

The SEM pictures of the LSCO samples with irregular grain size <1 µm are shown in Fig. 2a, Fig.2b. We observe the grains are randomly distributed and there is low intergrain porosity. The SEM of LCCO (not shown).

The Fig 3 shows that the MR of $La_{1.8}Ca_{0.2}Cu_{0.85}Mn_{0.15}O_4$ decreases with increasing temperature due to less scattering from Mn at constant magnetic field of 0,1,3,5 tesla. Thus LCCO is magnetoresistive oxide.

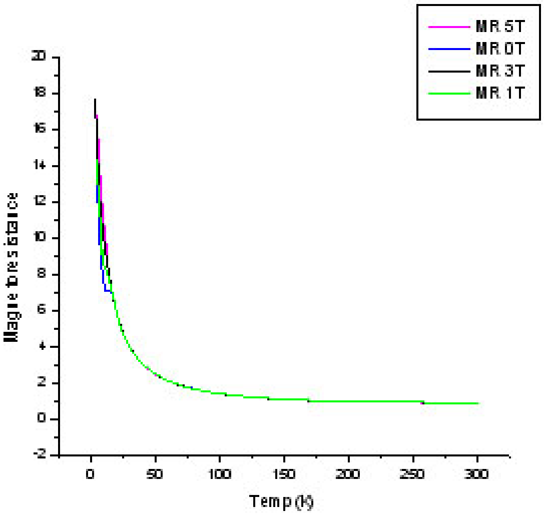

Fig. 3. The magnetoresistance (MR) of $La_{1.8}Ca_{0.2}Cu_{0.85}Mn_{0.15}O_4$.

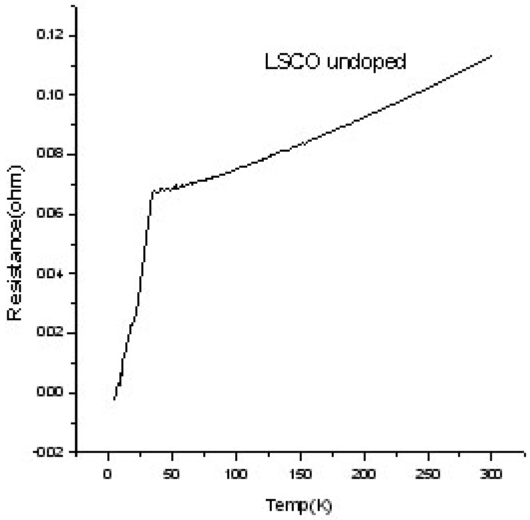

Fig 4. R-T plot for undoped LSCO.

Fig 4 shows the temperature dependence of resistance of the $La_{1.8}Sr_{0.20}CuO_4$.For undoped LSCO the transition temperatures was measured to be 36.766k.

CONCLUSION

In summary**,** the polycrystalline samples of $La_{1.8}Sr_{0.20}Cu_{1-x}Mn_xO_4$ (LSCO) and $La_{1.8}Ca_{0.20}Cu_{1-x}Mn_xO_4$ (LCCO) were synthesized using solid state reaction method. The powder XRD shows that $La_{1.8}Sr_{0.20}Cu_{1-x}Mn_xO_4$ was tetragonal K_2NiF_4 type phase which is well suited for polycrystalline sample while $La_{1.8}Ca_{0.20}Cu_{1-x}Mn_xO_4$ was orthorhombic symmetry. The $La_{1.8}Ca_{0.2}Cu_{0.85}Mn_{0.15}O_4$ sample was found to be magnetoresistive while the $La_{1.8}Sr_{0.20}CuO_4$ sample was found to be superconducting. These different effects need further study.

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REFERENCES

1. E. Cohen, G. Deutscher, *Physica* ,**C 454**, 1 (2007).
2. T. Park, Z. Nussinov, K.R.A. Hazzard, V.A. Sidorov, A.V. Balatsky, J.L. Sarrao, S.-W. Cheong, M.F. Hundley, Jang-Sik Lee, Q.X. Jia, J.D.Thompson, *Phys. Rev. Lett.* **94** ,17002 (2005).
3. T. Kawamata, M. Yamazaki, N. Takahashi, T. Adachi, T. Noji, Y. Koike, K. Kudo, N. Kobayashi, *Physica* **C 426** ,469 (2005) .
4. T. Churei, H. Hiraka, Y. Endoh,M.Matsuda, K. Yamada, *Physica* **C 194,** 392–396(2003).
5. T. Kawamata, T. Adachi, T. Noji, Y. Koike, *Phys. Rev.* **B 62** ,R11981(2000) .
6. G. Xiao, Marta Z. Cieplak, J.Q. Xiao, C.L. Chien, *Phys. Rev.* **B 42** ,8752(1990).
7. arxiv.org/pdf/cond-mat/0108151.