Effect of Sintering Time on the Phase Evolution of Biphasic La_2NiMnO_6

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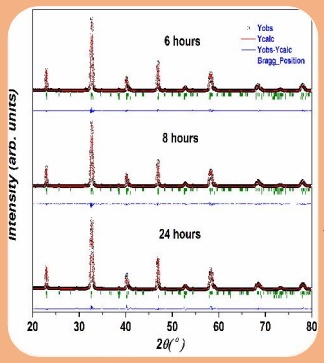
Abstract. Here we have reported the temperature and field dependence of magnetoresistance observed in biphasic La_2NiMnO_6. The samples are prepared with varying sintering time, the idea behind this is to vary the volume fraction of both the phases, as it has been seen that two phase systems show enhanced multiferrocity. Both metal-insulator transition and variable range hopping conduction is observed.



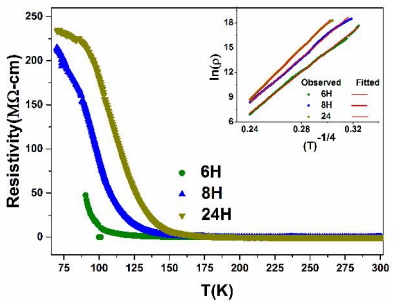
Rietveld refined x – ray diffraction data for La_2NiMnO_6 samples sintered at various temperature are shown in the right figure.

Various parameters obtained from the Rietveld refinement of the x-ray diffraction data are given in Table

TABLE 1. The structural parameters for the series of samples (LSMO) prepared with varying sintering time.

	6 Hours		8 Hours		24 Hours	
Cell Parameters (Å)	($P2_1/n$)	(R-3c)	($P2_1/n$)	(R-3c)	($P2_1/n$)	(R-3c)
Volume Fraction (%)	97	3	98	2	99.7	0.3
a	5.4588(2)	5.5072(3)	5.4585(2)	5.5068(3)	5.545612	5.506322
b	5.5087(2)	5.5072(3)	5.5085(2)	5.5068(3)	5.504528	5.506322
c	7.73548(0)	13.2290(8)	7.7362()	13.2322(9)	7.732720	13.21880
α	90	90	90	90	90	90
β	89.907(5)	90	89.907(5)	90	89.866	90
γ	90	120	90	120	90	120

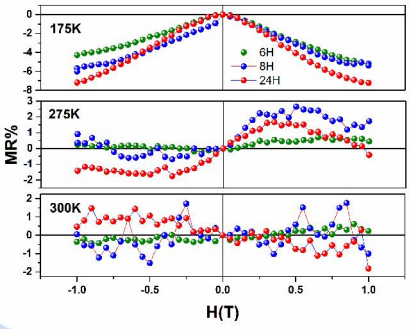
RESULTS AND DISCUSSIONS



* The temperature dependent resistivity in the temperature range of 70K to300K. Inset shows linear fit (solid lines) of lnρ vs $T^{-1/4}$ plot

* The resistivity of all three samples increases as temperature is decreased from room temperature. At certain temperature a rapid increment in resistivity has been found that indicates the occurrence of metal-insulator transition. The transition temperature for the three samples are different and shifts systematically to higher side, as the sintering time is increased. The conduction mechanism is well fitted with the polaronic Mott variable range hopping (VRH) model

$$\rho = \rho_0 \exp\left(\frac{T_m}{T}\right)$$

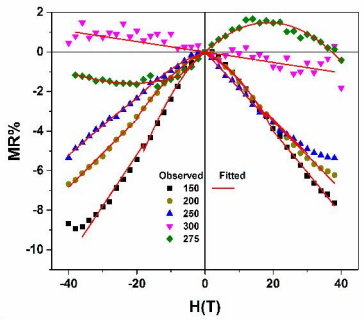


* Isothermal magnetoresistance (MR) has been measured varying magnetic field using bi-polar electromagnet.

* $MR\ \% = \frac{R(H)-R(0)}{R(0)} \times 100$

* The field dependent MR separated into three groups:

1. At 175K when all the prepared samples are in ferromagnetic region (negative MR% observed) .
2. At 275K(~ to T_c) found very different from the conventional behavior
3. 300K where all the samples are in paramagnetic phase (variation of MR% with MF is negligible).



* The field dependent magnetoresistance at 150, 200, 275 and 300K of the 24 hours sintered LNMO.

* Maximum magnetoresistance is found at 150K and decreases gradually with increase in temperature, becomes zero near 300K. The reason behind this may be the magnetic ordering of the sample.

* Experimental MR data is fitted using the following equation:

$$MR\%_{negative} = \left(\frac{aH}{2}\right) - bH^2$$

Conclusion: We have successfully synthesised the biphasic La_2NiMnO_6 with varying sintering time as a result the volume fraction of both the crystallographic phases ($P2_1/n$) and (R-3c) varies. The low temperature dc resistivity and magnetoresistance measurement in which both metal-insulator transition and variable range hopping conduction is observed. And a very peculiar behavior at 275K is found in all the three samples. Further investigation is in progress in order to have in-depth understanding of this phenomenon

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