# Mid – infrared transmission of polycrystalline (LaSr)(MnNi)$O_3$

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**Abstract**. Polycrystalline (LaSr)(MnNi)$O_3$ was shintesized using sol gel methods with nitrat precursors $La(NO_3)_3$, $Sr(NO_3)_2$, $Mn(NO_3)_2.4H_2O$, and $Ni(NO_3)_2.6H_2O$ and the different heating process. Sample (LaSr)(MnNi)$O_3$ with chemical formulation $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ with x = 0,05 and 0,10. We report the crystallite structure of $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ with x= 0,00 and 0,10 are single phase with characterization by X-ray diffraction. Refinement has result that crystallite size of $La_{0,67}Sr_{0,33}Mn_{0,95}Ni_{0,05}O_3$ is 24,67 and $La_{0,67}Sr_{0,33}Mn_{0,9}Ni_{0,1}O_3$ is 21,84 with crystallite system rombohedral, it show us that increasing at Ni composition influence of decreased crystallite size. Sampel (LaSr)(MnNi)$O_3$ has been characterization with Fourier Transform Infrared with range of wave number from 450 to 4000 $cm^{-1}$ were chategories at mid infrared wave. The FTIR pattern show to us that the Mn-O-Mn bounded has absorp infrared at wave number 605 $cm^{-1}$ and the dominant peak at wave number 3750 $cm^{-1}$ caused the hidroxy compound in sampel $La_{0,67}Sr_{0,33}Mn_{0,95}Ni_{0,05}O_3$.

## 1. Introduction

The last few years, doped alkaline earth metals such as Sr on the site La in material LaMnO3 make changes in properties of the insulator paramagnetic to the metal magnetic and doped metals transition such as Ni, Fe and Co in the material LaSrMn3 that was previously a metal magnetic turned into is antiferromagnetic with the effect of colossal magneto-resistance (CMR), it indicates a high application potential in the field of electronic magnetic material. In addition, the electromagnetic characteristics of the oxide material make it a good absorber of microwaves. [1] The electromagnetic wave absorbent material has a criterion that high resistivity and magnetic low. This relates to the mechanism Double Exchange (DE) centered on the bond Mn-O-Mn, a third transition metal Mn doped to the site would damage the magnetic properties of materials and the mechanism Double Exchange so that the resistivity of the material will increase [2]. In this study, we want to know whether the functional groups Mn-O-Mn which acts as a central Double Exchange actually formed on the material, therefore the testing Fourier Transform Infrared (FTIR) Spectroscopy with a range of wave number between 450 cm-1 to 4000 cm-1 in the category Mid Infrared.

## 2. Experimental details

Samples $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ with variations in the value of x = 0.05 and 0.10 is made by sol gel method. Precursor materials used include La(NO3) $_3$, Sr $(NO_3)_2$, $Mn(NO_3)_2.4H_2O$, and Ni $(NO_3)_2.6H_2O$ with scales on each material according to stoichiometric. All the precursor material aquabidest nitrate dissolved, then the solution is mixed and stirred using a magnetic rod with a constant speed 300rpm and the temperature was maintained at $80^0$ C. To thicken the solution and make the solution pH around 7 then added a solution of ammonia. When the solution has been stirred for 3 hours,

viscous solution will turn into a paste that is increasingly losing the element of water. Once the water content is reduced and the magnetic rod can not rotate anymore, then the samples are in the glass beaker $120^0$ put in the oven for 2 hours to remove the water content in the samples. The sample is dried and then calcined at a temperature of $550^0$ for 8 hours to remove the element of nitrate and citrate, the sample will be issued black fluffy. Samples black-gray and then crushed using a mortar until it forms a perfect powder, after which the samples through a sintering stage at a temperature of $850^0$ for 5 hours, the samples were out of this stage has not changed much from the previous phase. Powder sample is then characterized by XRD and FTIR.

## 3. Results and discussion

Samples have been synthesized by sol gel method then characterized by XRD and FTIR to learn about percentage transmission toward mid infrared wave number.

### *3.1. Structure characterization*

Refinement of the XRD characterization results showed that the samples are samples of x = 0,05 and x = 0,10 already has a single phase with rhombohedral crystal structure, there is no phase changes that occur in both samples that can be seen in Figure 1.

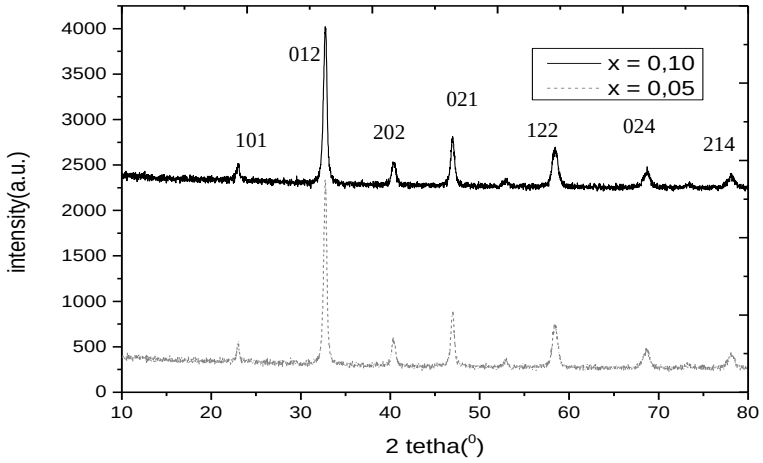


**Figure 1.** XRD Pattern of $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ with x = 0,05 and 0,10

Refinement result of samples $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ show that these samples are single phase with crystallite structure rombohedral in space group R-3c, The increase in doping Ni on samples $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ resulting lattice parameter decreases and the crystal size also decreased, namely on the sample x = 0,05 at 24,67 and x = 0,10 at 21,84.

### *3.2. Fourier Transform Infrared (FTIR) measurement*

Samples $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ that single phase then characterized by FTIR. This characterization has purpose to know group of Mn-O-Mn bond formed in samples. Mn-O-Mn bond very influence in mechanism double exhange. IR spectra in samples $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ showed at figure 2 below.

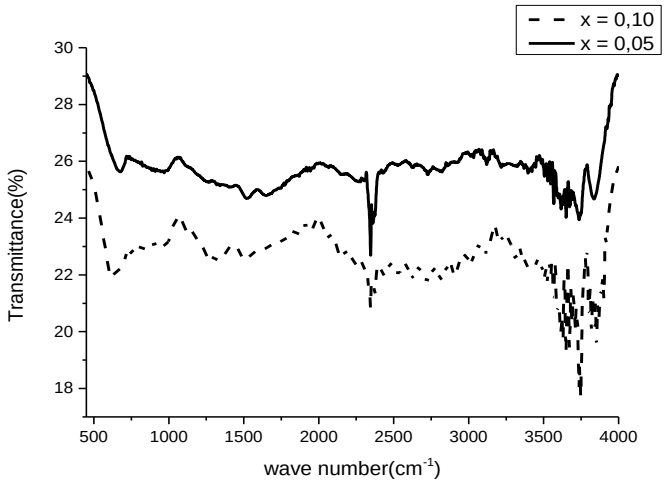


**Figure 1.** FTIR Spectra of $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ with x = 0,05 and 0,10

Characterization by FTIR returned to see if the functional group Mn-O-Mn has been completely formed. FTIR results reported that the sample $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ have formed the functional groups in the substance. Bond Mn-O-Mn vibrates at a frequency or wave 605 $m^{-1}$ shown in Figure 2. In this discussion area into 3 wave numbers v1, v1 and v3. In v1 is between 550-650 $cm^{-1}$ are formed bounded Mn-O-Mn, at wave number v2 2385-2650 $cm^{-1}$ vibration caused by hydrogen bonds, and the v3 namely in the area wave number 3650-3595 $cm^{-1}$, in this case the vibrating namely because the hydroxy group [3]. Contradiction in sample x = 0,05 and sample x = 0,10 is in the transmittance percentage, in sample x = 0,05 about 25,68% and sample x = 0,10 is about 21,99%, its mean that if doped Ni increased, so percent transmittance decreased.

## 4. Conclusions

Samples $La_{0,67}Sr_{0,33}Mn_{1-x}Ni_xO_3$ has been made with sol gel method with the results of refinement in the form of single-phase samples with rhombohedral crystal structure and crystal size decreases with increasing value of x . FTIR results in both samples showed that the functional groups have been formed Mn - O - Mn ( metal oxygen Bound ) at the wave number of 605$cm^{-1}$.

## 5. Acknowledgement
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## 6. References
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