ISSN: 2502-2318 (Online)
ISSN: 2443-2911 (Print)
Homepage: http://omega.uhamka.ac.id/
Accredited by RISTEKDIKTI, Decree No: 14/E/KPT/2019

Omega: Jurnal Fisika dan Pendidikan Fisika **5** (1), 20 - 22 (2019)
(*Journal of Physics and Physics Education*)

Microwave Absorbing Properties of Polycrystalline $La_{0.67}Sr_{0.33}MnO_3$

Wahyu Dian Laksanawati*, Feli Cianda Adrin Burhendi, Acep Kusdiwelirawan

Physics Education Study Programme, Universitas Muhammadiyah Prof. DR. HAMKA
Jl. Tanah Merdeka, Pasar Rebo, Jakarta 13830, Indonesia

(Received 12 Februari 2019; published 6 July 2019)

Abstract
Sample $La_{0.67}Sr_{0.33}MnO_3$ has been successfully synthesized by sol gel method shown by the results of XRD formed a single phase with rhombohedral crystal structure. The results of SEM showed particles are agglomerated yet functional groups Mn−O−Mn has been formed based on the results of FTIR. The ability of the sample to absorb the microwaves still lower that the value of reflection loss obtained at −26.05 dB.

Keywords: polycrystalline $La_{0.67}Sr_{0.33}MnO_3$, sol gel method, microwave absorbing

DOI: 10.31758/OmegaJPhysPhysEduc.v5i1.20

*Corresponding author. E-mail address: winamovic@yahoo.com

Introduction

The microwaves in the range of $1 - 20$ GHz is currently being increasingly used in public for example on the radar, wireless telecommunication systems, local area networks (LANs), and various other telecommunications equipment [1]. On the one hand, these developments make it easier to live a modern society, but on the other hand can cause various social problems such as increased electromagnetic interference (EMI) and disruption of security systems on the aircraft [2], hence the importance of material that can absorb microwaves with a frequency range $8 - 12$ GHz with criteria have high resistivity and low magnetic properties [2, 3]. In this case, the metal magnetic such as material $La_{0.67}Sr_{0.33}MnO_3$ allows it to be used as the EM-wave absorber.

Methods

Polycrystalline $La_{0.67}Sr_{0.33}MnO_3$ powder was synthesized using sol gel methods with nitrat precursors $La(NO_3)_3$, $Sr(NO_3)_2$, $Mn(NO_3)_2 \cdot 4\,H_2O$, $Ni(NO_3)_2 \cdot 6\,H_2O$ and citric acid used as fuel in chemical process. First, precursor materials dissolved in aquabidest, then we mix all of the solution with a magnetic stirring bar at a constant speed of 350 rpm.

Then, raised the temperature to 80 degrees Celsius and kept the temperature remains constant until the process ends. When the solution temperature had reached 80 degrees Celsius, add citric acid which has been dissolved into aquabidest then measure its pH. Reaction of sol gel in the literature to occur when the pH close to 7, we therefore add ammonia solution to raise the pH to approximately 7 after PH approached 7, the solution thickens, the temperature and the speed of magnetic bar is kept constant until the composition of the water is reduced [4].

When the composition of the water is reduced and magnetic spin bar can no longer, then we enter the glass beaker in the oven with a temperature

of 100 degrees Celsius, which aims to eliminate water composition. After that, we remove the samples that had dried from the glass beaker and then we heat into the furnace at a temperature of 550 degrees Celsius to remove nitrate and citrate. In this process expands the sample obtained and dark gray color sample pulverized with a mortar, then put in crusible and reheated to a temperature of 850 degrees Celsius to remove remaining impurities. Samples generated in the form of black powder, then the sample is characterized crystal structure with X-Ray Diffraction, see the sample morphology using SEM, and views of functional groups Mn−O−Mn with FTIR, and to determine the nature of the absorbance of the microwave using Vector Network Analyzer.

Results

Polycrystalline sample with chemical formulation $La_{0.67}Sr_{0.33}MnO_3$ has report the crystallite structure is single phase with characterization by X-ray diffraction were shown in Figure 1. Refinement has result that crystallite size of $La_{0.67}Sr_{0.33}MnO_3$ is 33.55 nm with crystallite system rombohedral.

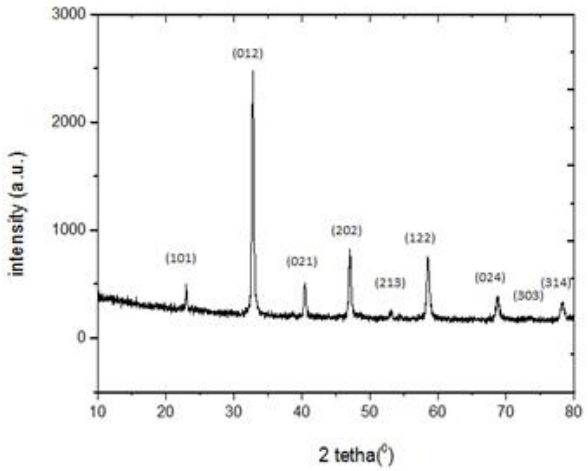

Figure 1: XRD pattern of $La_{0.67}Sr_{0.33}MnO_3$

Then we observe the morphology of the sample with two-dimensional images of the SEM as shown in Figure 2. SEM results show that the particles are mutually agglomerated powder sample so it is difficult to determine the particles intact. In this SEM results obtained particle size of the sample is still in the micro scale.

Then we'll see if the Mn−O−Mn is formed on the sample as shown in Figure 3. Sampel $La_{0.67}Sr_{0.33}MnO_3$ has been characterization with Fourier Transform Infrared with range of wave number from 450 to 4000 cm^{-1}. The FTIR pattern show to us that the Mn−O−Mn bounded has absorp infrared at wave number 676,32 cm^{-1} were shown in Figure 2 and the dominant peak at wave number 3750 cm^{-1} caused the hidroxy compound in sampel $La_{0.67}Sr_{0.33}MnO_3$ and then we also see the nature of the absorbance of the sample in Figure 4.

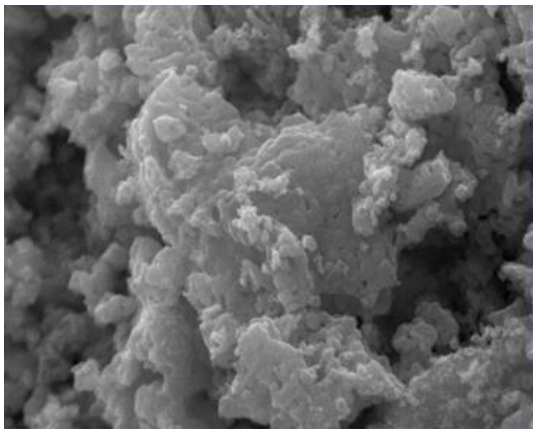

Figure 2: SEM image of $La_{0.67}Sr_{0.33}MnO_3$

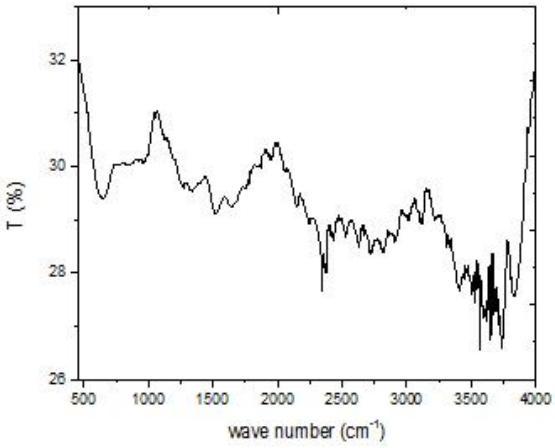

Figure 3: FTIR spectra of $La_{0.67}Sr_{0.33}MnO_3$

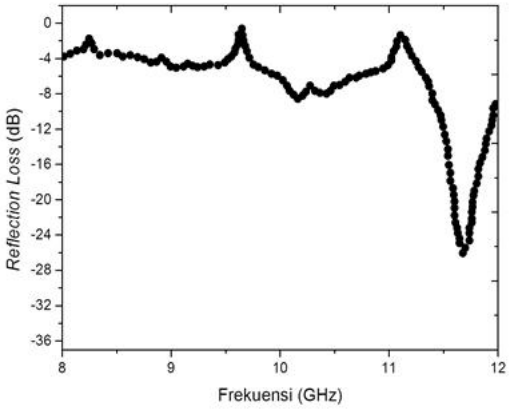

Figure 4: Frequency dependence of the microwave reflection loss sample $La_{0.67}Sr_{0.33}MnO_3$

The microwave absorbing properties of sampel $La_{0.67}Sr_{0.33}MnO_3$ characterized by Vector Network Analyzer with range frequency $8-12$ GHz, pattern of absorption show that the maximum reflection loss of sample is -26.05 dB at frequency 11.67 GHz.

Conclusion

Sample $La_{0.67}Sr_{0.33}MnO_3$ has been successfully synthesized by sol gel method shown by the results of XRD formed a single phase with rhombohedral crystal structure. The results of SEM showed particles are agglomerated yet functional groups $Mn-O-Mn$ has been formed based on the results of FTIR. The ability of the sample to absorb the microwaves still lower that the value of reflection loss obtained at -26.05 dB.

References

[1] K. Zhou, H. Xia, K. Huang, L. Deng, D. Wang, Y. Zhou, and S. Gao, The microwave absorption properties of $La_{0.8}Sr_{0.2}Mn_{1-y}Fe_yO_3$ nanocrystalline powders in the frequency range $2-18$ GHz, Phys. B Elsevier **404**, 175-179 (2009).

[2] D. I. Kim, Developments of new EM wave absorbers, Int. Symp. Electr. Electron. Eng. **1**, 23-29 (2005).

[3] Y. L. Cheng, J. M. Dai, D. J. Wu, and Y. P. Sun, Electromagnetic and microwave absorption properties of carbonyl iron $La_{0.6}Sr_{0.4}MnO_3$ composites, J. Magn. Magn. Mater. **322**, 97-101 (2010).

[4] S. Ravi and A. Karthikeyan, Nanoparticles synthesized with modified sol-gel route, Phys. Procedia **54**, 45-54 (2014).