Microwave Absorbing Properties of Polycrystalline $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$

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

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

Abstract
Sample $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ 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 $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$, sol gel method, microwave absorbing

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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 in 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 $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ allows it to be used as the EM-wave absorber.

Methods
Polycrystalline $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ powder was synthesized using sol gel methods with nitrat precursors $\text{La(NO}_3)_3$, $\text{Sr(NO}_3)_2$, $\text{Mn(NO}_3)_2\cdot4\text{H}_2\text{O}$, $\text{Ni(NO}_3)_2\cdot6\text{H}_2\text{O}$ 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.

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 crucible 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$_3$](image)

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$_3$](image)

![Figure 3: FTIR spectra of La$_{0.67}$Sr$_{0.33}$MnO$_3$](image)

![Figure 4: Frequency dependence of the microwave reflection loss sample La$_{0.67}$Sr$_{0.33}$MnO$_3$](image)
The microwave absorbing properties of sample 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**


