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Research Article

Magnetic and Electrical Properties of System Cualxfe$_{2-X}$o$_4$ Ferrite

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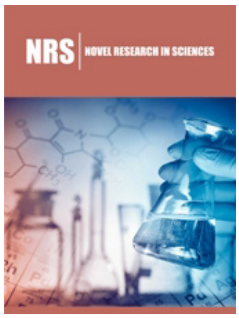

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Abstract

Recently, the ceramics materials have been a field of intense study, due to their advantages and properties. The magnetic properties of spinel ferrites are drastically influenced by the type of cations as well as their distribution in either of the A- and B-sublattice of the material under investigation. The electrical conduction and resistivity are fundamental properties of semiconductors and critical parameters in the development of new materials and devices in the electronics industry. CuAlxFe$_2$-xO$_4$ (where x= 0, 0.5, 1.0, 1.5 and 1.99) have been pre-synthesized for 24 hs at 800°C and then synthesized at 1100°C for 8h using the usual ceramic method solid state reaction technique using aluminum, copper and iron oxides. Room temperature saturation magnetization was measured as a function of element copper. Parameters magnetic are measured by hysteresis loop (Magnetization M versus Field B). The samples magnetic properties were characterized by using a vibrating sample magnetometer (VSM). The DC electrical conductivity was obtained from the curve of voltage versus current curried through the specimen. The electrical conductivity, σ(T), was measured by a contact method in accordance with the four-point scheme. The system under investigation, copper ferrite aluminate has been studied by means of X-ray powder diffraction (XRD) patterns analysis at room temperature. The system CuAlxFe$_2$–xO$_4$, belong to a large class of compounds having the general formula AB2O$_4$ and crystallize in the cubic spinel structure, where A and B are divalent and trivalent ions respectively.

Keywords: Copper aluminate ferrite; Magnetic hysteresis; Electrical conductivity

Introduction

The most important ferrimagnetic materials are certain double oxides of iron and another metal, called ferrites. These materials are extensively used in many applications such telecommunication, audio and video, power transformers and many other applications involving electrical signals normally not exceeding a few megacycles for seconds, magnetic fluids, microwave absorbers and medical diagnostics [1]. Diamagnetic substitution in single and mixed ferrites have received a lot of attention over the past years. The preference of non magnetic ions in spinels is found to alter their magnetic and electrical properties, and studies have revealed useful information on the nature of the exchange interaction, direction of magnetization, cation distribution, spin canting etc. [2].

Experiments

The system CuAlxFe$_2$-xO$_4$ (where x = 0, 0.5, 1.0, 1.5 and 1.99) were pre-synthesized by 24 hours at 800 °C and then summarized at 1100 °C for 8h by conventional ceramic method, by solid-state reaction with the oxides of aluminium, copper and iron. The vibrating sample magnetometer was employed to investigate the variation of magnetization with magnetic field. DC electrical conductivity were obtained, using a Keithley source measure unit model 2400, from current voltage characteristics temperature dependence of the electrical resistivity. The temperature dependence of electrical resistivity of the studied ferrites of different compositions has been investigated from room temperature up to 450 ºC and indicates insulator/semiconductor behaviour with decreasing resistance with increasing temperature. The x-ray diffraction patterns of all samples were recorded using X-ray diffractometer (PANalytical) with Cu Kα radiation (α= 1.54060 nm).

Result and Discussion

Figure 1 & 2

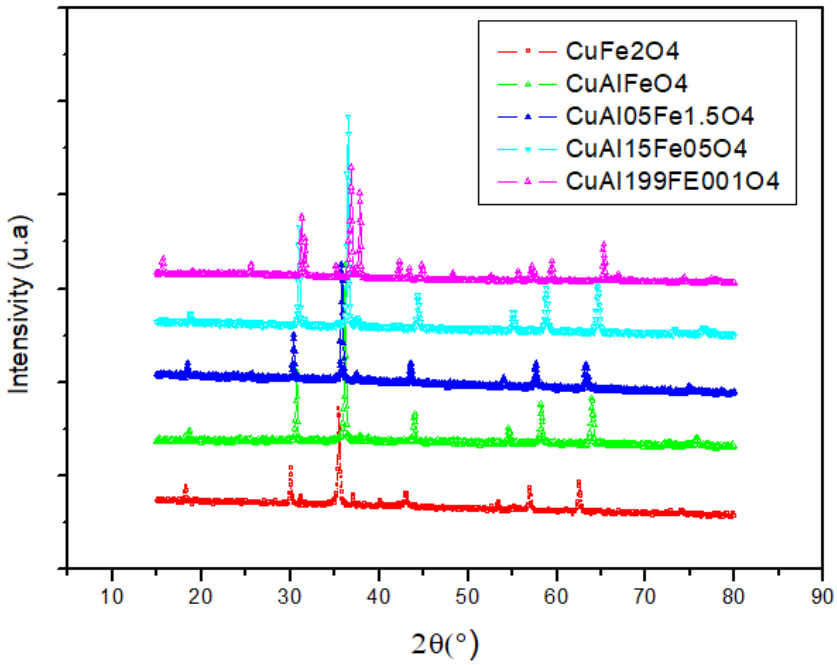

Figure 1: X-ray diffraction patterns of $CuAlxFe_{2-x}O_4$.

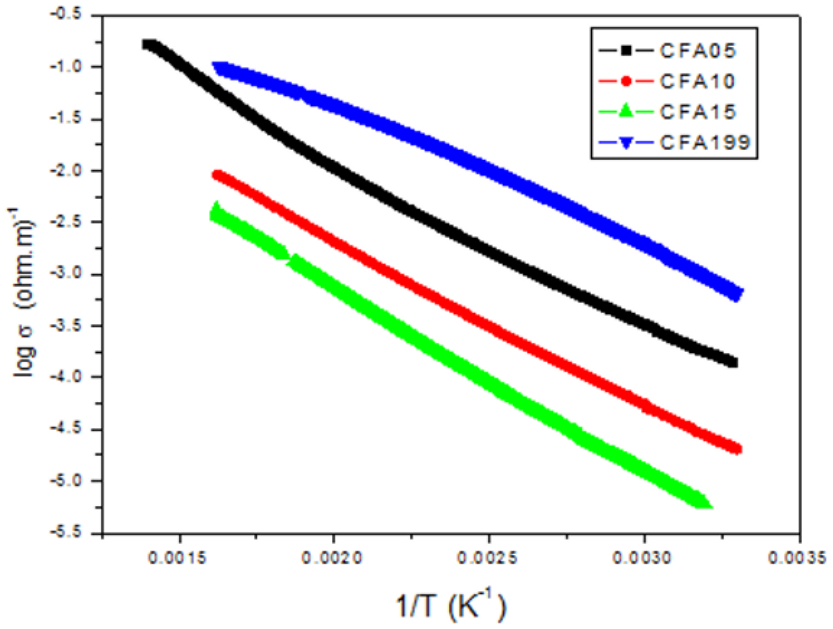

Figure 2: Temperature dependence of electrical conductivity of $CuAlxFe_{2-x}O_4$.

Conclusion

XRD patterns of all the compositions presented on Figure 1 revealed are crystallizing in a FCC structure (space group Fd3m). The resistivity of the sample decreases with increasing temperature. Linearity shown on Ahrrenius plot on Figure 2 indicates that the transport occurs with constant activation energy. The electrical resistivity increases with the content of aluminum, due to its conductive property. The results showed that the maximum saturation magnetization was obtained in CFO while compared to the other samples in the series. The increase in aluminum content results in a significant decrease in saturation magnetization and remanence while the coercivity increases.

Acknowledgement

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