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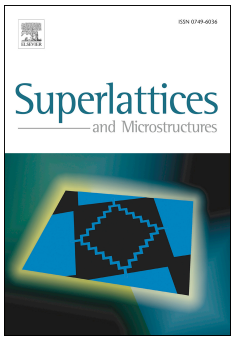

Investigations on microstructure, electrical and magnetic properties of copper spinel ferrite with WO_3 addition for applications in the humidity sensors

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Investigations on microstructure, electrical and magnetic properties of copper spinel ferrite with WO_3 addition for applications in the humidity sensors

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In the present study we report the structural, electrical, magnetic and humidity characteristics of copper ferrite with different percent on tungsten trioxide addition. The aim of this study was to obtain more stable and sensitive active materials for humidity sensors. In order to highlight the influence of tungsten on the structural, electrical and magnetic properties, the ferrite samples were fabricated via sol-gel self-combustion method and sintered for 30 minutes at 1000°C with percent between 0-20% tungsten trioxide additions. The X-ray diffraction investigations showed the copper ferrite phase composition. The scanning electron microscopy revealed the influence of the substitution on characteristics of the crystallites and the profilometry showed the surface topography of samples. The investigation was focused on the variation of permittivity and electrical conductivity, in relation with tungsten trioxide addition, frequency and humidity. We have also, investigated the relevant magnetic characteristics of the copper ferrite material by highlighting the influence of tungsten trioxide addition on to Curie temperature and the permeability frequency characteristics. The data suggests that the copper ferrite with tungsten trioxide addition can be used as active material for humidity sensors.

Keywords: copper ferrite, humidity sensor, electrical permittivity, electrical conductivity, magnetic permeability, Curie temperature

1. Introduction

Ceramic materials, especially ferrites are currently some of the most studied materials because of their promising semiconducting properties like as: stability, porosity, selectivity and life time, make of this as active materials for humidity and gas sensors.

Various applications of magnetic materials raise the interest and describe them in different ways: experimental [1-3], theoretical [4, 5] and numerical [6]. In the last few years, the ferrites have been extensively investigated as electrical and magnetic materials because of their characteristic changes clearly observed by upon the exposure to external action factors (magnetic field, frequency, gases, humidity etc). The ferrite is a special category of magnetic materials, due to its applicative properties like: magnetic resonance imaging, coercivity, magnetization, semi-conductivity or catalytic activity [7-11]. In addition, it is known that the magnetic and electrical properties of ferrite materials are closely related with the specific surface area and grain size. Various remarkable physical and chemical phenomena which can take place on the surface of ferrite materials rely on the surface of conduction of electrons and their structure of pores. The different ways of controlling their electrical conductivity make them interesting also from the non magnetic perspective [12-14].

The level of humidity vapors from environment is an important factor to be considered in real application for humidity sensors. Copper ferrite with spinel structure is one of the most important semiconductors with excellent electrical and magnetic properties and high stability. These characteristics make $CuFe_2O_4$ a suitable material for various applications in sensor, magnetic, etc. One of the most important procedures to modify the properties of the materials is the addition of small amounts of metal ions to the structure of compound. In a very recent investigation by Wang and Kumar [15, 16], the effect

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