CARBON DIOXIDE GAS SENSING PROPERTY OF NICKEL SUBSTITUTED ZINC FERRITE

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ABSTRACT

The polycrystalline NiZn ferrite have been synthesized by co-precipitation method and characterized by X-ray powder diffraction and FTIR spectroscopy. The FTIR spectra is obtained in the range from 400 cm^{-1} to 4000 cm^{-1}. Absorption bands observed at higher frequencies suggest the existence of significant modes of vibrations. The existence of absorption bands at frequency about 1627 cm^{-1}, 2923 cm^{-1}, and 3437 cm^{-1} are attributed to vibrational modes of triatomic water molecule. The absorption bands, observed at 414 cm^{-1} and 590 cm^{-1}, confirm the formation of the spinel structure. Employing these materials, the sensing elements, were developed on cylindrical glass as substrate. Carbon dioxide (CO_2) gas sensitive electrical properties of the compositions were investigated. The results are attributed to the chemisorption of oxygen species at specific operating temperature. Existence of nano crystallites favors surface phenomenon of adsorption. The materials show n-type conductivity at ambience and depict increase in the resistance due to presence of oxidizing gas. The electrical resistance of sensing elements (RCO_2) was measured for variable concentration of CO_2 gas from 0% to 15%. The RCO_2 increases with increase in CO_2. The sensitivities of the compositions under investigation are also estimated and the result of investigation is discussed here.

Keywords: Spinel Ferrites, X-ray Diffraction, FTIR, Operating Temperature, Electrical Resistance, Gas Sensor.

INTRODUCTION

The ferrite materials of nanostructure exhibit nano particles and very small grains with uniform grain distribution. This leads to increase in the effective surface area, which is an inherent requirement adsorption mechanism (Azad, Akbar, Mhaisalkar, Birkefeld, & Goto, 1992). The gas sensing properties are mostly based on the surface phenomenon such as chemisorption and physisorption. The surface of ferrite materials, at typical operating temperature, reveals chemisorption of the oxygen species needed for physisorption of oxidizing or reducing gases (Abdel-Latif, 2012). The surface of ferrite materials, at typical operating temperature, reveals chemisorption of the oxygen species needed for physisorption of oxidizing or reducing gases. The gas sensing properties of nanostructured thin films of copper ferrites have been investigated by Chapelle et al. (2011). They observed maximum sensitivity at temperature about 280 °C for H_2. They found increase in the resistance due to presence of the H_2 gas (Yamazoe, 2005). They reported that the magnesium ferrites exhibit good sensitivity to the H_2S and ethanol. It was also reported that the zinc ferrites show significant response to the H_2S gas (Xinshu, Yanli, & Jiaqiang, 2002). Reddy, Manorama, and Rao (1999) have synthesized nickel ferrite by using co-precipitation method and investigated the response of the nickel ferrite for various gases. They reported that nickel ferrite is most sensitive to chlorine gas with best selectivity as well. They also demonstrated that the timing parameters such as response time and recovery time are also significant. The gas sensing properties of Lanthanum ferrites were investigated by Kong and Shen (1996) and they reported an increase of resistance of the sensor due to existence of the reducing gas. The response of the sensor is mostly