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The Relative Humidity and Electrical Field Effect in the Electrical Properties of Ceramic System SiO_2-Fe_2O_3-MoO_3 Added of Nb_2O_5

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Abstract – The sensing properties of the humidity sensor made of a ceramic system. Ceramic System SiO_2-Fe_2O_3-MoO_3 Added of Nb_2O_5 is investigated. The measurement frequency influences both the linearity of the curves of resistance. Humidity sensing mechanisms of the sensor is discussed. SiO_2-Fe_2O_3-MoO_3 Added of Nb_2O_5 was use in the preparation of ceramic system. The mixed powders were milling by 3 hours and calcined at 1300 °C for 1 h in an alumina crucible. The pellets were sintered at 1300 °C for 1 h. The sensors were successively put into several chambers with 62, 74, 78, 80 and 82 % RH levels obtained by saturation of $CaCl_2.2H_2O$, $Ca(NO_3)_2.4H_2O$, NH_4Cl, $BaCl_2.2H_2O$ and $CaSO_4.5H_2O$ salt solutions methods. The measurement was done after 30 min when the temperatures. Powder X - Ray Diffraction (XRD) pattern of the samples was recorded to confirm the formation of a single phase solid solution and comportment this phase through the Rietveld analysis. The resistance of all the samples in the frequency range 10 Hz – 1 KHz and 1 KHz – 1 MHz respectively. The ceramic was measured at 30, 35, 40, 45 and 50 °C to study its behavior in temperature variation. The dielectric study as a function of frequency was made using a distribution of relaxation times was observed beyond dielectrical permissivity.

Humidity sensors are needed for humidity control, both for residential applications and for industrial processes. Sensing materials under investigation can be grouped into three main categories: organic polymers, electrolytes, and ceramics [1-2]. Comprehensive reviews on humidity sensors can be found in the literature [1–3]. Ceramics have been studied extensively for applications in humidity sensors because of their stability in harsh chemical or physical environments. For that, it comes if studying sensor done the base of cheaper reagents, like SiO2. One in the ways of try to improve their properties it is through the addition of a more efficient system of oxides form a group of ceramics demonstrating a variety of interesting properties and promising applications. The objective of this work was to investigate the humidity sensing characteristics of ceramic system SiO_2-Fe_2O_3-MoO_3 Added of Nb_2O_5 with 0 (A), 0.3 (B) and 0.5% (C) through reaction of the solid state. The samples were analyzed by XRD together with the Rietveld refinement (fig.1), dielectric properties at 300 K, resistivity comportment with relative humidity (figure 2) and frequency and dielectrical permissivity (ε'). In the diffraction of ray-x all of the samples presented two phases different from SiO_2 and one of Fe_2O_3 of smaller percentage. In the samples B and C, besides those three phases, happened formation of FeNbO4 in small percentage. The phases were confirmed through refinement by the method Rietveld. In figure 2, show that with increase of the temperature the ceramic system presented a larger sensibility to the humidity variation.

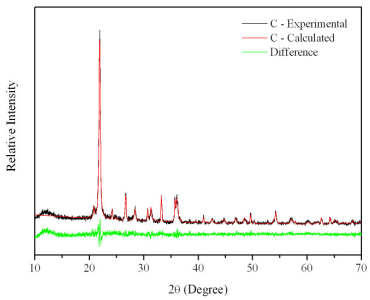

Figure 1: XRD patterns of the sample C with refinement

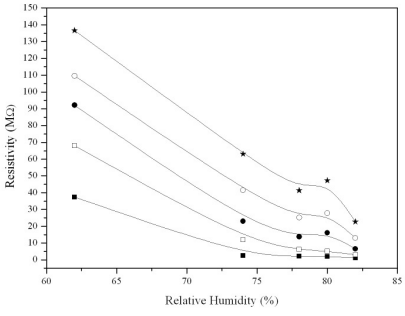

Figure 2: Resistivity comportment with relative humidity. 30 °C (■), 35 °C (□), 40 °C (●), 45 °C (○) and 50 °C (★).

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