

Comparative Method Behavior Interaction Potential Surface To A Structure (Al₂O₃(Zno/Sno₂)+Ti_{0,1}O₂) In Low Isotropic Model With Multiple Harmonic Oscillators Single Bond

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Abstract: In this paper, we present the results of the simulated behavior and experimental measurement of the chemical potential or potential interaction for a raw ceramic phase structure (Al₂O₃(ZnO/SnO₂)+Ti_{0,1}O₂) used the theoretical model of multiples single harmonic oscillators. The above results were obtained considering the application of such materials by contact field sensors. In turn, was taken as the approximate basis for the interaction potential as a nonlinear function of: temperature, relative electric permittivity, relative humidity, type of charge carriers(n) and(p) of the material and surface voltage. On the other hand, was calculated and simulated the electrical behavior responsible for the chemical potential energy propagation in the structure of the compound under study.

Keywords: Apparent density, chemical potential, electric permittivity, relative humidity, voltage

1. INTRODUCTION

Simulated results of experimental measurement behavior and interaction potential or chemical potential $V(x, T)$ to a raw ceramic material phases (Al₂O₃(ZnO/SnO₂)+Ti_{0,1}O₂), used presents the following work, the manufacture of thermal radiation sensors for industrial processes. The experimental results were obtained considering the application of a mathematical model of black body radiation and nonlinear function dependent on the temperature, relative dielectric permittivity, relative humidity RH and measured voltage. On the other hand, is calculated, and the electrical behavior of the chemical potential responsible for the propagation of energy in the structure of compound (Al₂O₃(ZnO/SnO₂)+Ti_{0,1}O₂) was simulated depending on the distribution of the charge carriers such (n) and (p) of the material.

2. THEORETICAL MODEL

The method proposed in this paper, equation (1), and model describes the flow of electric charge carriers (n / p) in the interstices of the metal oxides, elements that are the foundation of ceramics, as a multi-coupled oscillators, this brings direct consequence, that the current density depends on the structural factor.

$$\nabla^2 V(x, T) = -\frac{1}{\mu} Cth \left(\frac{x_j - x}{L_n} - wt \right) \left[w - \frac{\mu E}{L_n} \right] - \frac{D_n}{L_n^2 \mu_n} + \frac{D_p}{L_p^2 \mu_p} \quad (1)$$

Since the distributions of carriers (electrons n and holes p) function $n(x, T) = 2 \left(\frac{2\pi m k T}{h^2} \right)^{3/2} \exp \left(-\frac{\epsilon_c - \epsilon_f}{k T} \right)$ (2)

$$\text{And, } p(x, T) = 2 \left(\frac{2\pi m k T}{h^2} \right)^{3/2} \exp \left(-\frac{\epsilon_f - \epsilon_v}{k T} \right) \quad (3)$$

Where: $\epsilon_c, \epsilon_v, \epsilon_f$ - energy in the conduction bands, valence bands and Fermi energy level; kT - thermal energy The current density generated in the default structure of charge carrier density can be evaluated as:

$$J(x, T) = (-n(x, T)V_x + p(x, T)V_x)f(\mu) \quad (4)$$

Where the function $f(\mu)$ – is defined as the structural factor of the sample under study; speeds V_x distinguish movement of charge carriers in the X coordinate

3. EXPERIMENTAL PROCEDURE:

To develop the core objective of the research project relating to this subject, we proceeded to prepare different samples of crude compound reference ceramic material with different humidity RH [4], different level of pressing and different thickness in order to evaluate the behavior of the current density within the samples while keeping the temperature thereof constant. The process of comparison of experimental data and simulation of the surface electric field and chemical potential of the samples under study was carried out taking into account the boundary conditions imposed on the analytical Cauchy development of equation (1). The conditions imposed on equation (1) lead to establish the form of diffusion of charge carriers in the interstitial regions of the compound, the effect of temperature and shape of the electrostatic potential. The simulated reaction of equation (4) is presented in Figure 1 below, while the simulated behavior of the chemical potential and the electrostatic field generated by the samples, are shown in Figures 2 and 3 respectively.

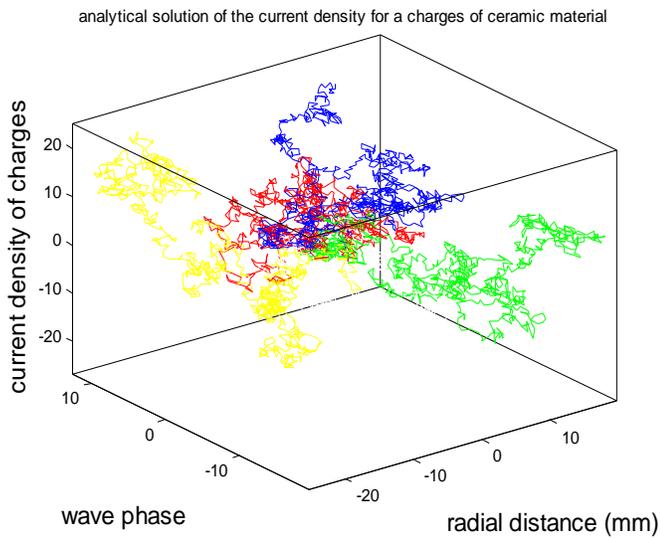


Figure 1: Analytical solution of the current density for charges of ceramic raw materials

Surface experimental current behavior in this type of samples is showed in figure 4

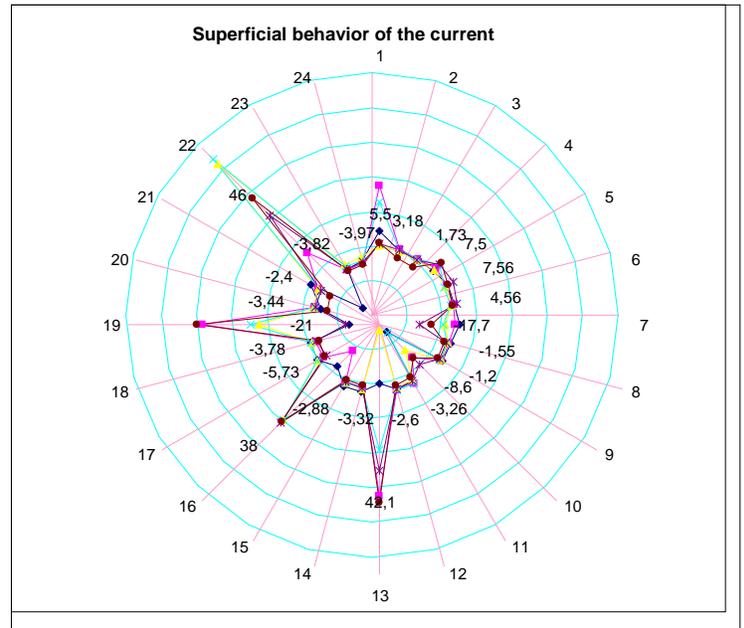


Figure 4: superficial behavior of the current measure in (nA) for the different used samples

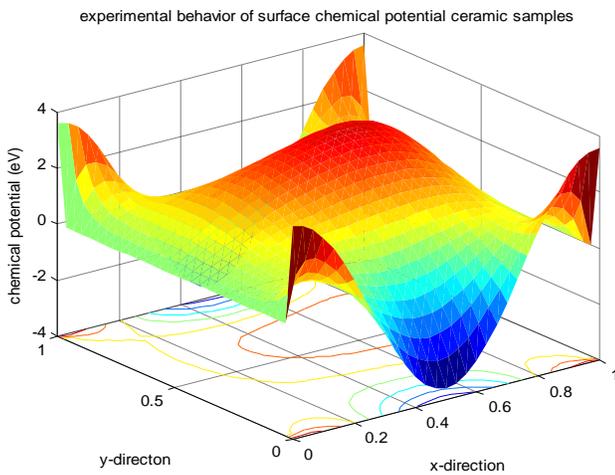


Figure 2: Experimental behavior of surface chemical potential of raw ceramic materials

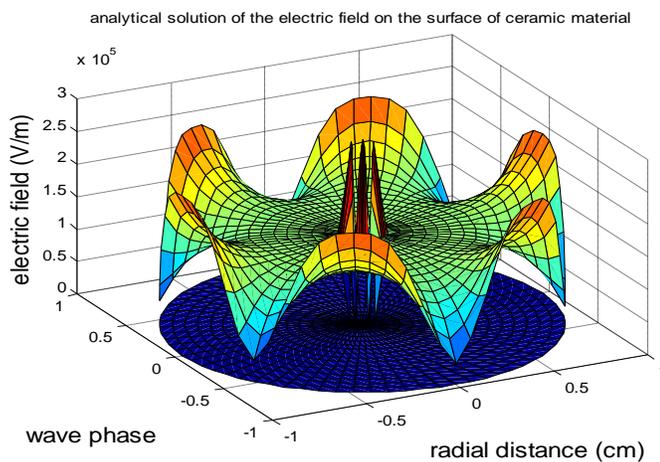


Figure 3: Analytical solution of the electric field don the surface of raw ceramic materials

4. CONCLUSIONS

- Comparing the experimental data of the surface current of the ceramic samples (Figure 4), with the simulated electric field pattern in the surface (Figure 3), one can see the influence of the chemical potential anisotropic structure (current peaks), this result is the low uniformity of compounds (metal oxides) in the samples, because the mechanical mixing process in the production facility does not offer a high quality product in thermal homogeneity. This brings additional consequence to final product, and the variation of the apparent density of the samples per unit volume.
- This anisotropic behavior of the chemical potential for the production of humidity sensors is a further advantage of the structure, as to include copper sulfate, because this chemical potential, causes the sulfate migrate to the surface of the samples and hydrate contact with the atmosphere and thus can determine the relative humidity of a gaseous atmosphere.

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