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Study of the point defects in Al_2O_3:Nd nano-strutured crystals through of analysis of impedance and luminescence results

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Abstract Samples of pure alpha alumina and doped with 5 and 10 mol% of Nd were produced by the method of calcination polymer for applications in ionizing radiation dosimetry, using photoluminescence and thermoluminescence. Results of TEM and EDS showed nano-sctrutured presence of NdAl, $NdAl_2$ and $NdAl_4$ compounds. The effects of these compounds in the impedance and luminescence responses will be explained.

Samples of pure alpha alumina and doped with 5 and 10 mol% of Nd neodymium were produced by the method of calcination polymer for applications in dosimetry of ionizing radiation on photoluminescence and thermoluminescence. The samples were characterized morphologically by TEM and Diffraction of Electrons (EDS). Figure 1 shows an example of image obtained by TEM with nano-structures (~ 100nm), which were identified by EDS as compounds of NdAl and $NdAl_2$ to 5 mol% Nd doping and as $NdAl_2$ and $NdAl_4$ for 10 mol% doping one. Luminescence of the samples were measured and the sample doped with 5 mol% of Nd exhibited the greatest intensity. The phosphorescent decay curves of samples of 5 mol% in terms of increasing doses of gamma radiation, phosphorescent signal was obtained in the UV region and stimulated with blue light. In Figure 1, impedance spectroscopy showed that the Cole-Cole diagrams of the samples are mostly "flat" and decentralized, suggesting the presence of two phenomena, one in high frequencies and another at low frequencies. The phenomenon at low frequencies would be covering a smaller semicircle, at high frequencies. In the impedance spectroscopy of ceramic materials, attached to the phenomenon found in high frequencies in the process of conduction through the grain, and this phenomenon at low frequencies to conduct in the surface of the grain. Thus, comparing the behavior of center of circles (Table I), we observed that the Nd concentration changed the process of conducting samples from the boundary grain to the through, until 5% Nd. Through digraph also calculate the amount of the dipole moment per unit volume of the samples, it's showed in Table I. Increasing the concentration of Nd in the samples increases the concentration of dipoles per unit volume in the samples. This suggests that incorporation of this element in the grains of alumina was occurred. This assumption seems to be confirmed by detection, by EDS, NdAl and $NdAl_2$ compounds in the sample with 0.5 mol% and $NdAl_2$ and $NdAl_4$ compounds in the one doped with 10 mol%.

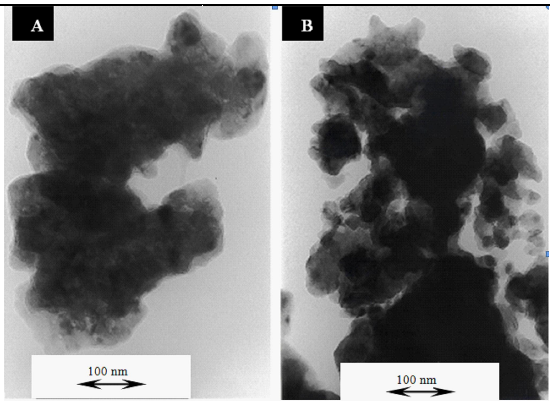

Figure 1: TEM of Al_2O_3:Nd, (A) 5%mol Nd; (B) 10mol% Nd.

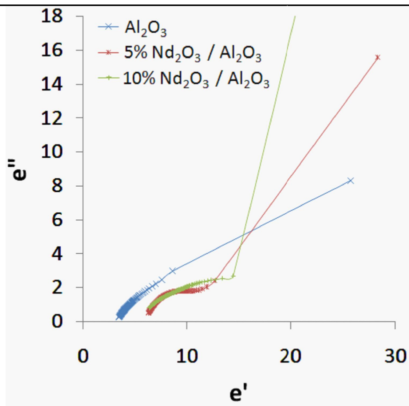

Figure 2: Al_2O_3 with Teflon.

Table I: Dipole moment per unit volume (P), relaxation time (τ) and circle centers at peak frequency for maximum e".

Nd_2O_3	f_o (Hz)	e'	e"	τ (μs)	P (nC/m^3)
0%	12599	7,57	2,48	12,63	25
5%	143847	9,14	1,81	1,11	29
10%	87598	10,39	2,17	1,82	33