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Effect of neutron beam on electrical properties of yttrium oxide nanoparticles

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In the present work, the influence of a neutron beam on the electrical properties of yttrium oxide is studied. The experiments were carried out in the temperature range of 300-700 K and were irradiated with fast neutrons of different intensity (4.0×1012 n/cm², 1.3×1013 n/cm² and 4.0×1014 n/cm²). It has been established that the electrical properties of Y2O3 nanocrystals in a wide temperature range show an increase in the electrical conductivity according to a linear law after irradiation of various intensities. The increase in conductivity depending on the intensity of the radiation of fast neutrons is associated with the predominance of yttrium vacancies in the conductivity.
The electrical conductivity of unirradiated samples of Y2O3 nanocrystals varies linearly in the temperature range 290–340 K. However, an increase in the intensity of the fast neutron flux leads to an increase in the electrical conductivity in a given temperature range. To determine the mechanism of experimental experiments, the condition of repeated measurement of the electrical conductivity of unirradiated samples of Y2O3 nanocrystals was repeated. As is known, during repeated measurements, a decrease in the value of the electrical conductivity of the samples is observed and it becomes equal to the repeated values when moving to higher temperatures. Also, studies carried out by the method of "Differential Scanning Calorimetry" show that on the surface of samples of Y2O3 nanocrystals in the temperature range of 300-540 K, a complex process occurs, such as dehydration of weakly absorbed water molecules. The kinetics of the dehydration process as a mechanism makes it possible to reduce the numerical value of the electrical conductivity, establish regularities in a wide temperature range, and form an opinion on the general change in the electrical conductivity depending on the intensity of the fast reaction. neutron flux. Water molecules adsorbed on the active surface of nanostructured compounds form an ion-dipole interaction with bulk cations, and the overall result of this interaction leads to the formation of new hydroxyl functional groups. The mechanism of desorption of water molecules on the crystal surface has characteristic values of anions and cations Y and O in the electrical conductivity of the sample. As the intensity of the fast neutron flux increases, the observed changes in the electrical properties can be explained by the activation of vacancies, point defects, and excited states.

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