

Effects of surfactant on the morphology of α -Bi₂O₃ synthesized by the Sol-gel method: hyperfine interaction study by PAC spectroscopy using ¹¹¹In-¹¹¹Cd nuclear probe nuclei

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Nano and micromaterial research, with a well-defined size and shape, has attracted attention from researchers in the areas of chemistry, physics, engineering and biomedicine, due to the wide range of possible applications such as: health, environment, catalysis and miniaturization of electronic devices. In this sense, the chemical routes of synthesis, such as Sol-Gel, are more prominent because it allows the production of particulate materials and thin films, with controllable size and morphology. In this work, bismuth oxide microparticles were synthesized by the Sol-Gel method using metallic bismuth (99.999% purity) in acid solution. Initially, bismuth was diluted with nitric acid solution and distilled water. After dilution, citric acid (600 mg) and ethylene glycol were added. The volume of ethylene glycol was varied from 1 to 3.75 mL, in order to study the morphological effects of its concentration. The samples were then subjected to the calcination process at 673 K for 12 hours. The samples were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), X-ray energy dispersive spectroscopy (EDS) and Raman spectroscopy. The XRD diffractograms and the Raman spectrum vibration bands showed that the synthesized samples correspond to the bismuth oxide in the alpha phase (α -Bi₂O₃) [1-3]. The EDS results show typical elements of bismuth oxide, without contaminants. The SEM images revealed different morphologies, ranging from the formation of flakes to microspherical particles with good size distribution (diameter 0.7 and 2.0 μ m). All samples have a crystalline structure and vibration modes corresponding to the α -Bi₂O₃ phase, but these have totally different morphologies, which proves the dependence of the morphology with the concentration of ethylene glycol. In order to perform the PAC measurements, ¹¹¹In-¹¹¹Cd probe nuclei were diffused in the samples during synthesis. PAC measurements permitted the determination of electric quadrupole - hyperfine parameters as a function of temperature, from 50 to 673 K.

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