Synthesis of BiFeO3-Powders and Films by Sol-Gel Process

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The present work aims to design and study novel functional materials with multiferroic properties required in electric applications, such as magnetic and magnetoresistive sensors, actuators, microwave electronic devices, phase shifters, mechanical actuators etc. Complex oxides $BiFeO_3$ for analysis of its ferromagnetic properties were synthesized by sol-gel method as powders and films. The size, shape and degree of crystallinity of the nanoparticles formed by sol-gel method can be controlled by varying of the temperature and the ratio of the concentrations of the initial reactants and the stabilizer. To stop the growth of particles in all cases, it is usually quite to cool quickly the reaction mixture. To isolate the nanoparticles, the precipitating solvent is added, which mixes with the reaction system, but poorly dissolves the "protective shells" of the nanoparticles and, therefore, destabilizes the suspension. As a result, the nanoparticles precipitate as powder, which can be separated by centrifugation. The sol-gel method makes it possible to obtain practically monodisperse nanoparticles of various metals oxides.
The initials for the first way of sol-gel synthesis were salts of metals; ethylene glycol; zitric acid; ethylenediamine. At the beginning, salts of metals was dissolved separately in ethylene glycol without the addition of water. Then, citric acid was added to form metals citrate. After that, the pH of the solution was adjusted to value of 7-8 by neutralizing excess citric acid with ethylenediamine. After homogenization of the resulting mixing solution, ethylene glycol was added thereto. The solution was stirred for 30 minutes and then dried on the vacuum evaporator to form the powder. The reactions take place between the citrates of different metals and ethylene glycol leads in the condensation stage to the formation of a three-dimensional polymer network with uniform distribution of metal ions into the film with homogeneous composition. The mass ratio of citric acid to ethylene glycol was 3:2. Then the samples of $BiFeO_3$ sol-gel materials were annealed at the temperature of 550 ° C for 10 hours (powders) and at the temperature of 800 °C for 20 minutes (films).

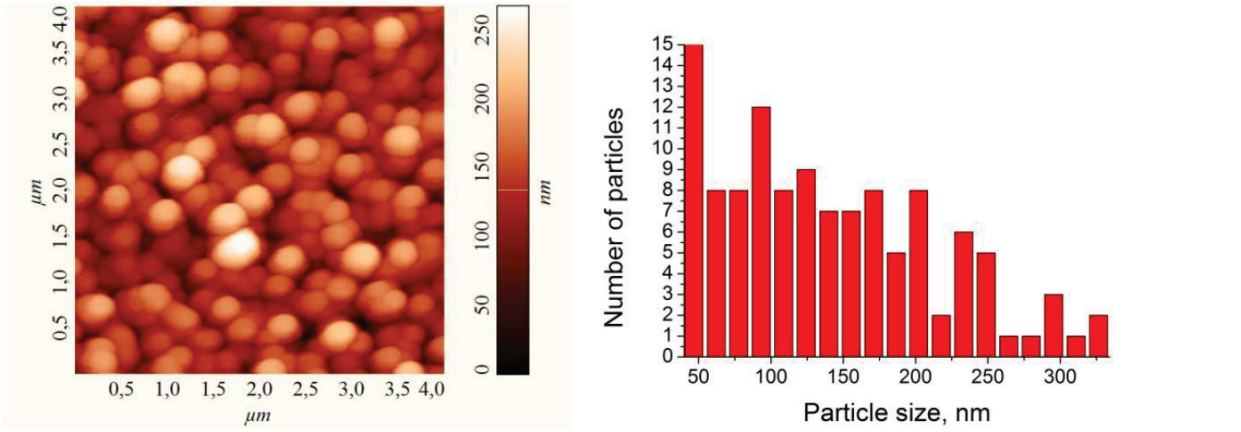

Fig. 1. AFM – image (a) and particle size distributions (b) BiFeO3 sol-gel films

Keywords: sol-gel, film, powder, ferromagnethics.

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