Nanocomposites and nanomaterials

Studying mechanisms and kinetics of growth of *ZnO* and *SnS* nanocrystals grown in liquid media

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Synthesis of semiconducting nanocrystals and nanoclusters with predefined shape and composition and narrowly distributed sizes is one of the most important issues in nanomaterials development. Such class of nanomaterials is in demand in some fields of modern electronics and optoelectronics.

Nanoclusters of inorganic semiconductors are synthesized mostly using various chemical methods, particularly colloid chemistry, that makes chemistry a key science for nanotechnologies development. Besides, some other methods can also be used to synthesize nanoclusters. For example, a method of electronic beam epitaxy in the Stranski-Krastanov mode can be involved for synthesis of the 'quantum dots' in some semiconductors. However, these methods are less effective and more expensive than the chemical applications.

A generalized Lifshits-Slezov-Wagner distribution [1] for nanoclusters or nanocrystals growth according to two parallel mechanisms (Wagner and diffusion) has been used to explain a series of experimental histograms, which cannot be correctly related to the Wagner or the Lifshits-Slezov distribution separately. A process of the nanoclusters growth at the Ostwald ripening stage of the phase transformation in the solid systems can be correctly described using the generalized distribution of Lifshits-Slezov-Wagner.

The Ostwald ripening stage is also present in a process of formation of a new semiconducting nanoclusters phase (phase transformation of the first type) during chemical synthesis of nanoclusters in the liquid medium. That is why the Lifshits-Slezov-Wagner theory can be used for analysis of the mechanism and kinetics of the *ZnO* and *SnS* nanoclusters [2,3] formation from supersaturated solutions. The theory should be modified taking into account possible joined influences of both (Wagner and diffusion) mechanisms on the process of the growth of the nanoclusters.

As a result, the *SnS* nanoclusters experimental histograms were found in good correlation with the generalized distribution of Lifshits-Slezov-Wagner at various values of x. The rate of the nanocluster's growth is controlled mostly by formation of new chemical bonds or a surface chemical reaction, which runs on the nanocluster's surface.

The growth of the *ZnO* nanoclusters can be controlled by any of the Wagner's or diffusion mechanisms.

The growth rate constants were estimated by means of comparison between experimental and theoretically calculated temporal changes in the average radii or average diameters of nanoclusters. These constants can be used to optimize technological conditions for synthesis of nanoclusters from supersaturated solutions.

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3. *Antoine de Kergommeaux, Jérôme Faure-Vincent, Adam Pron, Rémi de Bettignies, Bernard Malaman, and Peter Reiss* Surface Oxidation of Tin Chalcogenide Nanocrystals Revealed by 119Sn–Mössbauer Spectroscopy // J. Am. Chem. Soc. –2012, – Vol. **134**, №28, – P. 11659-11666.