Nanoobjects microscopy

Microscopy of oxide nanoparticle ensembles

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Recent studies show that in dispersed solid state systems in contrast to colloidal systems the self-organization processes have their own specificity and largely determine the special properties of powder systems. Study of evolution behavior of ensembles of nanoparticles based on zirconia using conventional and high-resolution transmission electron microscopy shows that they have phenomena of self-organization in the synthesis process, consolidation under pressure and during sintering of nanopowders. Zirconia nanopowders without hard agglomerates with different particle size and content of yttrium oxide were obtained by our own technology based on the co-precipitation method using the physical impacts during synthesis. It was found that in these systems the collective crystallization of particles in aggregates, oriented joining of nanoparticles and their lacing due to diffusion of oxygen are implemented. Orientation motive that occurs at all stages of the evolution of the particles causes a high degree of perfection of the grain boundaries.

Effect of self-organization of zirconia nanoparticles under pressure of 7500 MPa at room temperature conditions was found and studied. This effect consists in appearance of transparency of samples and their monolitization to a density close to the theoretical, which is not realized in the case of pressing of micron powders. The mechanism which explains the formation of transparency and unusually high density of nanopowder ensemble under high pressure without heating to a high temperature sintering was proposed.

Results of understanding of large number of self-organization effects of nanoparticles allowed the authors to demonstrate the advantages of using nanopowders based on zirconia in specific practical applications.

1. *Konstantinova T., Danilenko I., Glazunova V., Volkova G., Gorban O.* Mesoscopic phenomena in oxide nanoparticles systems: processes of growth // J Nanopart Res.-2011.-**13**.-P. 4015–4023.