

Nanoparticle Supercrystals – a Path to New Phenomena and Devices in the Nanoworld

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Abstract. In today's "classical" nanoscience, we deal with 0D, 1D and 2D nanomaterials, where the type of dimensionality indicates the number of dimensions of the structure, which are outside the agreed interval 1 – 100 nm. 3D supercrystals (SCs) with a regular structure analogous to classical crystals form a bridge between the nanoworld and the macroworld. They are usually composed of spherical or less symmetric nanoparticles. 3D SCs but also their 1D and 2D counterparts enable new applications and the number of papers in this area has been growing significantly over the past two decades. The paper provides a brief overview of the methods of preparation of SCs and their properties – in particular the defects of structure, magnetic and optical properties, as well as stability. Special attention will be paid to methods of strengthening supercrystals. These aspects are relevant for applications of SCs in catalysis, plasmonics, sensorics, etc. A significant point of view is the regularity of supercrystal structure and its repeatability over cm distances which allow us to examine the mechanisms of their electrical conductivity and magnetic phenomena, and, in the future, to integrate them into electronic circuits as miniaturized devices created by nanoelectronic technologies. The review of the above mentioned topics will be illustrated by results from our laboratory.