Physicochemical Properties of Metal Oxide Nanopowders and Core-Shell Structures on Their Basis

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In work considered the complex approach to solving the problem that is to develop a laser reactive technology for produce of nanopowder materials and core-shell structures on their base [1] and the use of patented new luminescent methods for detecting gas particles [2]. Established the physical model of the formation of TiO_2 and ZnO nanoparticles and core-shell structures on their basis by means of laser reactive evaporation of metallic targets, based on nonequilibrium thermodynamic processes of coalescence and oxidation as a target and the target-cyclone distance and obtained depending dispersion and phase compositions and their structural characteristics of the laser pulse parameters evaporating, geometry and characteristics of chemically active environment. Established physicochemical regularities of formation of adsorption surface electronic states initial and doped nanopowders (TiO_2, ZnO) and core-shell structures on their basis during adsorption to gases (O_2, H_2, N_2, CO, CO_2). Created the core-shell nanostructure with a given diameter core and the thickness of the outer shell to monitor the type of spatial localization of carriers in the shell and, therefore, the electric field inside the nanoparticles. It was established that the variation of the electric field inside the core-shell structure because of the uncompensated charge regions leading to changes in the spectral position of the electronic transitions at gas adsorption. In obtained Zn-ZnO nanostructures such as "core-shell" observe them as abnormally high (> 1 order) photoluminescence quantum yield (including in gases) and high selectivity response signal on gas. Doped and laser modified nanopowder materials are sensitive indicators of adsorbed gas phase composition on the surface. By-turn, found that surface doping of materials with impurities of noble metals (Ag, Au, Pt) can increase sensitivity to the corresponding gas component and purposefully implement catalytic processes on the surface of nanopowder.

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3. Ukrainian Patents №8371, IPC (2004) G01N 30/00. The method of gases registration using luminescence of the oxide nanopowder materials / Kotlyarchuk B.K., Popovych D.I., Serednytski A.S. – №20040604875, publ.15.08.2005, Bul. №8.