Nanocomposites and nanomaterials

The electrical conductivity and photocatalytic activity of nanodispersed γ-Fe_2O_3

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Ultrafine γ-Fe_2O_3 is multifunctional functional material with numerous applications mostly biomedical and engineering. In addition γ-Fe_2O_3 has photocatalytic properties which depend on the particles sizes and morphology. The mesoporous γ-Fe_2O_3 was obtained by mixing of $Fe(NO_3)_3 \cdot 9H_2O$ and $C_6H_8O_7 \cdot H_2O$ aqueous solutions with the next hydrothermal treatment of iron citrate sol. Dried precipitate (sample G1) was annealed at 150 (G2), 250 (G3) and 350°C (G4). G1, G2 and G3 samples were monophase ultrafine γ-Fe_2O_3, G4 – the γ / α-Fe_2O_3 mixture. The increase of coherent scattering regions sizes for γ-Fe_2O_3 in 7-11 nm range with the growth of annealing temperature was observed. The specific surface areas of G1, G2, G3 and G4 sample were 20, 45, 97 and 35 m^2/g, respectively. The frequency dependences of complex conductivity for all samples were typical for disordered semiconductors and explained by small polaron hopping mechanism between iron sites with the valence interchange. The materials have direct optical band gap close to 2.9 eV higher comparatively to bulk maghemite (2.3 eV) due to the quantum confinement effects. The photocatalytic activity of the obtained material was determined by decomposition of methylene blue (MB) under UV light (200 W/m^2). The correlation between rates constants of reaction and sample's electric conductivity was observed (Fig.1). The increasing of conductivity causes the growth of electron mobility in the superficial layers of the photocatalyst and leads to increasing of quantum efficiency and photoactivity.

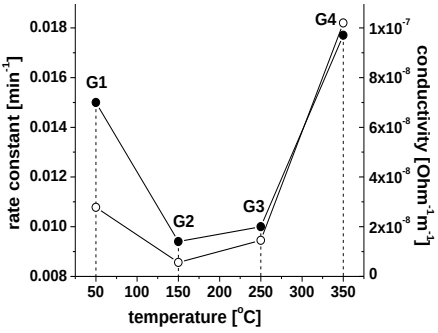

Fig.1 Rate constants of photocatalytic degradation MB and DC conductivity of mesoporous γ-Fe_2O_3 samples