

NANOCATALYSTS CONTAINING MAGNETITE AND α -IRON FOR LOW-TEMPERATURE OZONE DECOMPOSITION

T.L. Rakitskaya^{1,2*}, A.S. Truba^{1,2}, A.A. Ennan²

¹Faculty of Chemistry, Odessa I.I. Mechnikov National University, St. Dvoryanskaya 2, 65082, Odessa, Ukraine, trt@onu.edu.ua; ²Physical-Chemical Institute for Environmental and Human Protection, St. Preobrazhenskaya 3, 65086, Odessa, Ukraine

Nanostructured compositions containing magnetite (Fe_3O_4) and α -iron (α -Fe) were obtained by welding of steel using a bare welding wire of Sv08G2S (ER70S-6) type in CO_2 as a shielding gas. The wire had the following composition (wt. %): Fe (97.2), Mn (1.51), Si (0.92), Cu (0.2), and C (0.08). With the help of an electromechanical filter, three fractions of the solid component of welding aerosol were obtained. The first fraction (CD) was picked up from a corona discharge zone, the second fraction (PE) – from a perforated electrode, and the third fraction (GE) – from a grid electrode. The samples of each fraction were characterized by X-ray phase and FT-IR spectroscopy, water vapor adsorption, and pH-metry and also were tested in the reaction of ozone decomposition at the initial ozone concentration, $C_{\text{O}_3}^{\text{in}}$, of 1.0 mg/m^3 . The phase composition was identical for the three fractions: their diffraction patterns showed peaks at the interplanar spacing, d (Å), of 2.964, 2.528, 2.097, 1.712, 1.614, 1.483, and 1.091 characteristic of magnetite and 2.025, 1.432, and 1.169 characteristic of α -iron. However, for CR, PE, and GE fraction sequence, Fe_3O_4 content increased from 61 to 92 wt. % whereas α -Fe content decreased from 31 to 5 wt. %. In this sequence, sizes of Fe_3O_4 crystallites varied as 58, 58, and 45 while sizes of α -Fe varied as 59, 28 and 42.

Figure shows time dependences of a final ozone concentration in the course of ozone decomposition by samples of CD, PE, and GE fractions. All kinetic curves have portions where ozone is not detected (a gas analyser sensitivity was 0.025 mg/m^3). Then final ozone concentrations go up and become equal to maximum permissible concentration, MPC, in different periods of time, τ_{MPC} , depending on the fraction tested. τ_{MPC} characterizes ozone protection intrinsic to the samples and increases in the order $\text{CD} < \text{GE} < \text{PE}$ from 80 to 360 min. A further increase in the final ozone concentration, $C_{\text{O}_3}^{\text{f}}$, is very slow: in 1800 min, $C_{\text{O}_3}^{\text{f}} \approx 0,25 \text{ mg/m}^3$ for all three fractions (not shown in Figure).

It has been found from the experimental data that magnetite phase is responsible for the activity of the two-component, $\text{Fe}_3\text{O}_4 + \alpha$ -Fe, composition.

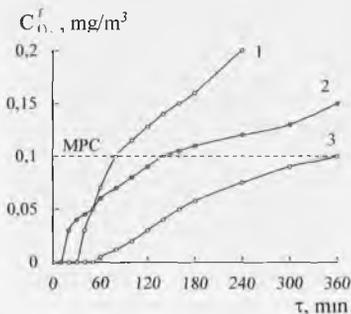


Figure. Time dependences of C for ozone decomposition with samples of different fractions obtained with the help of the electrochemical filter: CD (1), PE (2), and GE (3)