Physico-chemical nanomaterials science

The effect of preparation temperature on the efficiency of composite metal oxides catalysts containing noble metals

O.Yu. Boldyrieva[1], V.A. Kozhanov[1], A.V. Yatsymyrskiy[1], D.A. Stratiychuk[2], V.V. Lisnyak[1]

[1]Chemical Department, National Taras Shevchenko University of Kyiv, Volodymyrska 62a, 01060 Kyiv, Ukraine. E-mail:kozhanov1994512@gmail.com

Today's catalytic processes beginning at the gas-solid interface, e.g. oxidation/reduction, are stimulated by the presence of nanomaterials. Technologists frequently operate with nanocomposites composed of nm scaled particles supported on the nanoscale oxide. In numerous works, the supports preferably size is recommended to be less than about 50 nm. Such scaling gives more preferably dimensions of active mass, of less than about 10 nm. Predictably, the nanoeffect in the noble metal catalysis should be observed for the particles less than about 5–7 nm. Despite mentioned requirements, the use of nanoscale supports may causes the deterioration of catalysts and blocking filters with effused mass. Consequently, more resistive catalytic material should be elaborated, so here we report on oxide materials with supported active mass of nm scaled platinum metals.

The catalysts prepared contain from 0.1 mass% up to 0.5 mass% of Pt or Pd. Respective tests are conducted in a flow reactor at atmospheric pressure under GC control of inlet/outlet gas composition. The effect of the preparation temperature on catalysts efficiency in the oxidation reactions is disclosed. The catalysts that are characterized by acceptable resistance to overheating were obtained. The catalysts were tested in the lean reductant-air mixture that mimicked by means of the reductant gas (H_2, CO or CH_4) mixtures with excess of oxygen. The high active state of the prepared composites conserves for at the least 40 cycles of heating-cooling and longtime storage, up to 1 year. The nanoscaled platinum metals and surface morphology are visualized with TEM and SEM imaging, correspondingly. The particles dimension distribution shows non discrete character. Despite that the catalysts prepared by the same technique shows close conversions against temperature trends indication on the synergetic work of the oxide support and the platinum metals. This behavior corresponds to the surface layer rearrangements at the stage of the preparation and shows the effect of surface-interface, between platinum metal nm particles and reduced oxide surface at the catalysts operation.