Physico-chemical nanomaterials science

Functionalized silica supporting noble metal nanoparticles for effective oxidative catalysis

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To provide the scientific base of physicochemical nanomaterials preparation, one need to understand the behaviour of catalytic systems including nanoscale organized components. A special attention should be paid to noble metal ions that can be anchored on the surface of porous solids. If these solids based on silica, such carrier plays a role of an inert media in the catalytic recombination reactions. In contrast to pure commercial silica, the silica functionalized with an organic group of various natures is known as that can complex the metal ions with an effective uptake. The organic grafted silica was studied with miscellaneous physicochemical, spectroscopic and thermal analysis methods. If anchoring realizes for the expense of grafted amine residues, the surface interface shows an excellent adsorption capacity for noble metal ions. The thermal treatment, including reduction/oxidation, converts the anchored complexes in the efficient catalysts. In this cause, the formation of nanosized particles of metals, e.g. of the platinum group or gold, is worth studies. Typically, supported platinum metal have predictably high activity against recombination reactions. The catalysts activity in the recombination of hydrogen and oxygen, the model reaction known for the most, was analysed in a line with data of scanning electron microscopy and X-ray photoelectron spectroscopy data. The surface state of nanometer-scaled particles is reported. We follow the traditional mechanistic paradigm at considering the reaction of hydrogen recombination with oxygen. But, we observed several phenomena that are beyond of consideration, in the framework of usual mechanistic views on the surface interface catalysis. The phenomena, probably, have relations with nature of nanoparticles surface and the temperature regime of the reaction under investigation. Remarkably, kinetic experiments cannot be disclosed within the usual exponential growth of reaction rate with the size of np. This observation is interesting if one consider the catalyst work, in the recombination of hydrogen and oxygen, as a dynamically oscillated system. The reasons of inhomogeneity caused by a non-steady state phenomena observed at the kinetic experiments are also suggested.