Nanocomposites and nanomaterials

Adsorption of Au^{3+} ions from water solutions by SiO_2/DMSA nanocomposites

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As known, nanoscale pyrogenic silica (NPS) is widely used as an adsorbent for various applications. Properties of highly dispersive pyrogenic silica have been studied. Concentration of functional OH^- groups for the studied SiO_2 was ~ 7-9.5 μmol/m^2 at S_{spec} ~ 280 m^2/g. Researches into morphology showed both non-porosity of primary particles and their tendency for clustering and agglomerations. DMSA attaches to silica via carboxyl group link with surface hydroxyl group according to the reaction:

$$SiO_2///–2OH + HOOC–(CHSH)_2–COOH \rightarrow SiO_2///–(OOC)_2–(CHSH)_2$$

The presence of DMSA and formation of coating on silica surface was proved by Fourier infrared spectroscopy investigations (Perkin Elmer 1720) in 400-4000 cm^{-1} range and X-ray photoelectron spectroscopy method (EC-2402 with PHOIBOS-100-SPECS energy analyzer). The adsorption capacities (A_{max}) of original and modified silica surfaces were determined with Au^{3+} ions concentration measuring using atomic absorption analysis (C-115 M spectrophotometer, λ = 242.8 nm) in flame acetylene-air mixture. Au^{3+} water solutions within 5-200 mg/L concentrations diapason were used for the studies.

The adsorption activities of nano-sized non-modified SiO_2 and SiO_2/DMSA composite were investigated. Thus, for SiO_2 under 298 K, pH-3.0 A_{max} = 10.6 mg/g and R value (the level of extraction) is 76.2 %, whereas for SiO_2/DMSA nanocomposite in the same conditions A_{max}= 21.8 mg/g and R = 85.7 %. The maximum Au^{3+} extraction from water solutions takes place in the first 30-40 min and corresponds to the obtained kinetic data. The increase in Au^{3+} ions equilibrium concentration leads to adsorbents surface monolayer adsorption saturation. This isotherm form can be described with Langmuir equation.

The obtained results open a prospect in SiO_2 and SiO_2/DMSA composite use as magnetosensitive adsorbents for Au^{3+} cations extraction from water solutions.