Nanostructured surfaces

Zirconium and aluminum oxyhydroxides formation during sol-gel process

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Application of nanostructured materials recently attracts a great attention due to their unique properties. The usage of Zr(IV) and Al(III) oxyhydroxides as precursors for nanomaterials synthesis is well known due to their high thermal and mechanical stability and enhanced sorption properties [1]. Using of sol-gel method allows to control particles size during sol and gel formation, and, as a result, to obtain nanostructured materials (ceramics, sorbents, coatings, etc.) with given properties based on highly homogeneous mixture of metals oxyhydroxides.

Preparation and investigation of nanoparticles formation and surface properties of Zr(IV) and Al(III) oxyhydroxides were conducted according to methodologies presented in [2, 3]. It was determined, that the growth rate of Zr(IV) and Al(III) oxyhydroxides primary particles during sols formation depends on the composition of the initial metal chloride solution, but their size does not exceed 15 nm. The diameter of particles when gel is formed is equal to 32-47 nm, that depends on the initial mixture composition and can be determined by the equation $d=0{,}08 \cdot Al+1{,}44 \cdot K+30{,}85$ (where Al - molar content of ions Al(III) in the initial solution mixture of salts of Zr(IV) and Al(III),%; K - mole fraction of carbamide in the initial mixture). SEM images of metal oxyhydroxides granulated by “oil-drop” method testify the formation of highly porous structures (up to 540 m^2/g) caused by aggregation of 50-60 nm particles in 1-10 μm clusters.

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