Titania nanoparticles by acidic peptization of xerogel formed by hydrolysis of titanium(IV) isopropoxide under atmospheric humidity conditions

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Abstract

Thermally stable nanoparticles (NPs) of anatase phase titania, TiO2, were prepared by calcinations of acidic peptization products of titania xerogel, TiO2 center dot xH(2)O, that formed via an eco-friendly method. The method was based on hydrolysis of titanium isopropoxide over a long time period under atmospheric conditions (temperature 25 +/- 5 degrees C and humidity 50 +/- 10%.). Acidic peptization accompanied with ultrasonic vibrations was affected, simultaneously, by three different acids, namely acetic, nitric or sulfuric acid. The uncalcined and calcined materials that obtained after peptization with each add were characterized by thermogravimetric analysis (TGA), differential scanning calorimetiy (DSC), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), and N-2 adsorption/desorption techniques. Influence of the different acids on the structure (crystal phase) and texture (primary particle size and porosity) of the calcined TiO2 powders, has been explored. Results indicated that sulfuric acid or acetic adds facilitated formation and stability of pure anatase phase for up to 500 degrees C. On the other hand, nitric acid peptization led to major anatase to rutile transformation at such calcination temperature. Moreover, high surface area as high as 133 m(2) g(-1) was obtained for the material peptized by sulfuric add and calcined for 3 h at 400 degrees C. Comparative effects of the different adds on the xerogel peptization were discussed in terms of acid strength, chelating effect and thermal stability of the adsorbed acidic anions upon calcination. The present study simplifies obtaining of anatase NPs from titania xerogel, avoids direct exposure to NPs and can be utilized, in small or large scale treatment of membranes and catalyst supports. (C) 2013 Elsevier B.V. All rights reserved.

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