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Enhancement of porosity of sodium silicate and titanium oxychloride based TiO2–SiO2 systems synthesized by sol–gel process and their photocatalytic activity

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Abstract

The textural properties of TiO2–SiO2 composites (TSCs) were successively enhanced using three approaches; (1) washing the hydrogels with different solvents, (2) using surfactant and (3) forming the TiO2 sol in ethanol medium. The sol–gel process was exquisitely used to form the composites using cost effective precursors. Initially, the precipitated hydrogels were washed with water or alcohol to evaluate the influence of washing on the dried hydrogels. Consequently, two composites were formed differently in the presence of stearic acid (SA) as a surfactant and the other by forming TiO2 sol in ethanol medium prior to reaction with silica source. The TSC powders were examined by XRD, N2 physisorption studies, FTIR, TGA, SEM, XRF and HRTEM. The BET surface area of the sample obtained after washing the hydrogels with ethanol (TSCE) was the largest (594 m2/g) while porosities of the composites obtained using stearic acid as a surfactant (TSCSA, 0.96 cm3/g) and ethanol as a medium to form the TiO2 sol (TSCES, 1.85 cm3/g) were relatively superior to those obtained under influence of changing washing solvent. Photocatalytic decolorization of methylene blue by the composites calcined at 800 °C revealed that the TSCES-800 possessed the highest activity of all the composites due to its superior properties.

Keywords

Photocatalysis; Porosity; Sodium silicate; $TiOCl_2$