Abstract

Photoactive metal oxide systems capable of reducing non-biodegradable pollutants are highly needed heterogeneous catalysts for environmental purification. Most of the currently available heterogeneous catalysts are obtained from complicated synthetic routes using expensive and perhaps hazardous precursors. The present study reports a novel sol-gel method to synthesize pure TiO_2 and ZrO_2-TiO_2 samples using titanium oxychloride as TiO_2 precursor and zirconyl nitrate hydrate as a ZrO_2 source in the presence of the surfactant. The ratio of Zr-to-Ti was controlled between 0.75 and 3.2 to evaluate the effect of the amount of ZrO_2 in the composites. Consequently, the precipitates were calcined at different temperatures to investigate the effect of removing the template at different sintering temperatures. The physico-chemical properties of the samples were examined by SEM, HRTEM, DT-TGA, XRD, FTIR, XRF, EDX, nitrogen gas physisorption and UV-visible diffusive reflectance spectrometry analyses. These analyses revealed that the crystallization, dispersion, particle size and shape of the samples are critically dependent upon the calcination temperatures and Zr-to-Ti ratios. Abnormal grain growth (AGG) was unexpectedly observed in the samples calcined at higher temperatures ($\leq 800^0$C). Comparisons of the activities of the samples toward decolorization of methylene blue indicated that the photocatalytic efficiencies of the composites with Zr/Ti$\leq$2.2 were superior to that of pure TiO_2.