Abstract

ZnO-TiO_2 nanostructured composites have been synthesized via the facile sol-gel route in varying molar-based sol ratios of Zn:Ti (v/v). The composites were characterized for the structural properties by X-ray diffraction (XRD), morphology by scanning electron microscopy (SEM) and Transmission electron microscopy (TEM), optical properties by diffuse reflectance spectroscopy (DRS) and photoluminescent (PL) whereas the functional groups were determined by the Fourier transform infrared FTIR technique. Nitrogen (N_2) adsorption-desorption isotherms were used for textural analyses. The results indicated a strong dependence of the microstructural, morphological, optical and luminescent properties on Zn:Ti molar ratios which bear a direct influence on the photocatalytic performance of the composites. The XRD revealed strong crystallization at 600 °C with crystallites of about 29 nm–45 nm, SEM for the pure ZnO revealed well dispersed short ZnO nano-rods while the TiO_2 had smaller particles with high tendencies of forming large spherical agglomerations. The ratio Zn:Ti of 1:1 of the ZnO:TiO_2 composite emerged with best particle blend of ZnO and TiO_2 nanoparticles. The optical properties of the composites revealed bandgap energies (E_g) that varied with the molar ratios attaining a minimum value of 2.91 eV. It was observed that the reported composite E_g was lower compared to the bandgap energies individual semiconductor oxides and was well-matched with the highest PL emission. Nitrogen adsorption-desorption studies revealed that the composite had higher porosity as compared to either pure TiO_2 or ZnO. Further, photodegradation tests conducted on the removal of methyl blue dye by the composite achieved higher degradation rates which were attributed to the improved performance as a result of the coupling of the two semiconductor materials.