

Enhancing photocatalytic activity of titanium dioxide through incorporation of MIL-53(Fe) toward degradation of organic dye

ABSTRACT

Photocatalytic activity of titanium(IV) oxide (TiO_2) can be enhanced through modification of its surface-active sites. Here, iron(III) carboxylate [MIL-53[Fe]]-incorporated TiO_2 (as MIL-53(Fe)/ TiO_2) was prepared using a hydrothermal method. This material was then calcined at 500°C to obtain a MIL-53(Fe)-derived $\gamma\text{-Fe}_2\text{O}_3/\text{TiO}_2$ photocatalyst. A photocatalytic study of MIL-53(Fe)/ TiO_2 and MIL-53(Fe)-derived $\gamma\text{-Fe}_2\text{O}_3/\text{TiO}_2$ toward cationic methylene blue (MB) and anionic methyl orange (MO) showed that MIL-53(Fe)/ TiO_2 (0.25 wt%) and MIL-53(Fe)-derived $\gamma\text{-Fe}_2\text{O}_3/\text{TiO}_2$ (0.75 wt%) resulted the best degree of dye degradation. The MIL-53(Fe)-derived $\gamma\text{-Fe}_2\text{O}_3/\text{TiO}_2$ (0.75 wt%) composite for instance is capable of degrading almost 100% of 20-ppm MB and MO, respectively, within 6 hr. Photocatalytic degradation of MB and MO was well fitted to the Langmuir-Hinshelwood *pseudo*-first order kinetics model, which indicates physisorption as the key partway that facilitates dye decomposition on the surface of a photocatalyst under UV-A irradiation. This study provides new insights into the exploration of MILs/ TiO_2 materials for the environmental remediation and pollution control.