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Effect of Preparation Methods on the Activity of Titanium Dioxide-Carbon Nitride Composites for Photocatalytic Degradation of Salicylic Acid

Leny Yuliati[1-3], Azlan Mohd Salleh[4], Mohd Hayrie Mohd Hatta[4], Hendrik O. Lintang[1-3]
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Titanium dioxide has been recognized as an active photocatalyst especially forwater treatment technology.[1] Unfortunately, the anatase titanium dioxide can only be activated by ultraviolet (UV) light while the rutile form can only extend its absorption near visible light irradiation due to its large band gap energy, which are 3.20 and 3.03 eV, respectively.[2] Since solar spectrum consists of more visible part than UV light, designing visible light active photocatalyst is crucial. Carbon nitride has been one of the potential visible light active photocatalysts that can be prepared by a cheap precursor such as urea.[3]In this study, titanium dioxide-carbon nitride composites were prepared by three methods, which were one pot oxidation, impregnation, and physical mixing.Investigating the effect of these preparation methods is an important approach to develop highly active photocatalysts.
Each series of the photocatalysts were prepared with different ratios of titanium to carbon, *i.e.*, 1, 5, 10, 20, and 50 mol%. All samples were characterized by X-ray diffraction (XRD) and diffuse reflectance ultraviolet-visible (DRUV-Vis) spectroscopies. The characterization results confirmed the successful preparation of titanium dioxide, carbon nitride, and the titanium dioxide-carbon nitride composites. Photocatalytic activity tests were carried out for degradation of salicylic acid at room temperature under UV and visible light irradiations. It was confirmed that all the prepared titanium dioxide-carbon nitride composites showed better photocatalytic activities than the bare titanium dioxide and bare carbon nitride. Under UV light irradiation, 90.6% of salicylic acid degradation was achieved on the best composite prepared by one pot oxidation with 5 mol% of titanium to carbon (Ti/C) ratio.On the other hand, the highest degradation under visible light irradiation was 94.30%, observed on the composite that was prepared also by one pot oxidation method with the Ti/C ratio of 10%. Therefore, among the investigated methods, the best method to prepare the titanium dioxide-carbon nitride composites with high photocatalytic activity was one pot oxidation method. Owing to the higher conduction band of titanium dioxide than the carbon nitride, the excited electrons would be transferred from the conduction band of titanium dioxideto the conduction band of carbon nitride. This would reduce the electron recombination rate in the titanium dioxide,which would result in the synergic effect to enhance the activity of the composites. Under UV light irradiation, in addition to the generated holes on titanium dioxide, generated holes oncarbon nitridewould also react with salicylic acid to finally produce water and carbon dioxide.On the other hand, under visible light irradiation, the generated holes on the carbon nitride would be the main active species that would oxidize the salicylic acid.

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