Photocatalytic behaviour of visible-light activated g-C_3N_4/TiO_2 heterojunctions

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Abstract

This study reports the synthesis and characterization of g-C_3N_4/TiO_2 heterostructures considering a simple and fast microwave-assisted approach. Carbon nitrate (g-C_3N_4) was mixed with TiO_2 with different amounts (15, 30 and 45 wt. %) to understand the photocatalytic behaviour of such materials. Methyl orange (MO) was tested under solar simulating light. X-ray diffraction (XRD) revealed the anatase TiO_2 phase for all heterostructures produced. Scanning electron microscopy (SEM) showed that by increasing the amount of g-C_3N_4 in the synthesis, large TiO_2 aggregates composed of irregularly shaped particles were disintegrated and resulted in smaller ones, composing a film that covered the g-C_3N_4 nanosheets. Scanning transmission electron microscopy (STEM) analyses confirmed the existence of an effective interface between a g-C_3N_4 nanosheet and a TiO_2 nanocrystal. X-ray photoelectron spectroscopy (XPS) evidenced no chemical alterations to both g-C_3N_4 and TiO_2 at the heterostructure. The materials had their optical properties investigated using UV-VIS and it has been observed a visible-light absorption shift (red-shift in the absorption onset). The 30 wt. % of g-C_3N_4/TiO_2 heterostructure showed the best photocatalytic performance, with a MO dye degradation of 85 % in 4 h, corresponding to an enhanced efficiency of almost 2 and 10 times greater than that of pure TiO_2 and g-C_3N_4 nanosheets, respectively. The superior photocatalytic activity was attributed to the synergy of g-C_3N_4 and TiO_2 materials. Two possible photocatalytic degradation mechanisms of the heterostructure were proposed. This study is expected to effectively contribute to environmental remediation, decomposing a great source of water pollutants, that is the azo dyes.

Keywords*: g-C_3N_4/TiO_2; microwave synthesis; heterostructures; photocatalysis; pollutant degradation.*

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