

Effective synthesis of iron and vanadium nanocomposites with reduced graphene oxide for the photodecomposition of dyes

Alexandre Barros Gaspar¹

¹ INT. ab.gaspar@uol.com.br

Abstract

Water contamination is one of the major environment-related issues. It is associated not only with health problems, but with severe socioeconomic impacts, and synthetic dyes play a crucial role. Indigo carmine (IC) is an artificial vibrant blue dye, spread worldwide due to its use in denim making, but it is toxic, mutagenic, and very stable in nature. Among different techniques used to remediate dyeing wastewater pollution, heterogeneous photocatalysis of organic dyes emerges as a promising approach due to its advantages, such as catalyst recovery and reuse, use in mild conditions and pollutant chemical transformation. These reactions are considered advanced oxidative processes (AOPs). Nanocomposites of magnetite (Fe_3O_4) anchored on reduced graphene oxide (RGO) with different Fe_3O_4 : RGO mass ratios and V_2O_5 nanostructures with different morphologies as rods (B), massive microspheres (EM) and core-shell microspheres (CS), also anchored on RGO were synthesized, characterized and evaluated in indigo carmine (IC) photo Fenton discoloration. The Fe_3O_4 :RGO nanocomposites presented high dispersion of iron oxide particles, at about 12nm on RGO surface sheets, though Fe_3O_4 high content related to RGO. The samples also showed bandgap energies below that found for bulk Fe_3O_4 , showing an important effect of RGO. The complete IC discoloration was obtained after 30 min of reaction with Fe:RGO 17:1. XPS $\text{Fe}2p_{3/2}$ showed that $\text{Fe}^{3+}/\text{Fe}^{2+}$ ratio was maintained even after three recycles (4 runs), meaning that RGO is responsible for stabilizing Fe_3O_4 particles, thus maintaining its photocatalytic activity. In the V_2O_5 :RGO systems, V_2O_5 -B/RGO showed the best performance probably due to the presence of V^{+4} (structural defects). Among the V_2O_5 nanostructures, V_2O_5 -B was the best and V_2O_5 -CS the worst. After addition in RGO, the performance of the V_2O_5 -B/RGO catalyst increased by 37% and the V_2O_5 -CS/RGO increased by 48%. In this system, the pH of the reaction medium can increase the degree of reaction discoloration.