Efficient treatment of organic pollutants by boron doped TiO2 photocatalysts under visible light radiation

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ABSTRACT

As one of the most widely used photocatalysts, TiO2 suffers from the limited application with respect to harvesting solar energy for the environmental remediation. One way to perform the TiO2 modification is by doping, through which the doped TiO2 would be able to absorb the visible light from the solar illumination as a visible reactive catalyst. The objective of this work is to synthesize boron-doped TiO2 (B@TiO2) photocatalysts using a method called sol–gel. The as-synthesized catalysts were characterized using DR UV–vis spectroscopy, XRD, photoluminescence, XPS, SEM, EDS and TEM. The XRD results show that doping of boron constituent could hinder the grain crystallite growth and selectively favor the anatase phase formation and diboron trioxide phase, B2O3. The characterization works indicated an enhanced absorption edge of B@TiO2 and reduced band gap energy to enable the visible light photocatalytic activity. The lowest intensity of PL result signaled the slowest recombination rate of electron by supposedly newly created energy level by the doped boron, was achieved by 6B@TiO2. The 6B@TiO2 demonstrated the most efficient performance with greater than 93% of MB degradation, owing to the aforementioned modification of the optical and electronic properties during the optimization effort of catalyst synthesis. In this work, a less energy intensive sol–gel procedure was carried out to produce the equally efficient photocatalysts. As a conclusion, the doping mechanism has extended the absorption spectrum of TiO2 and successfully degraded the model dye within the controlled experimental conditions.

KEYWORDS

Photocatalytic; Photoluminescence; Spectroscopy; TEM; XPS; XRD

ACKNOWLEDGMENTS

The authors are grateful to the Universiti Malaysia Pahang (UMP) for financial support through RDU1803154 .