Enhanced photoactivity of cerium tungstate–modified graphitic carbon nitride heterojunction photocatalyst for the photodegradation of moxifloxacin

Published: 31 May 2020

Volume 31, pages 11434–11447, (2020) Cite this article

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Abstract

Design and optimization of visible-light-driven photocatalysts for degradation of organic pollutants is an important step towards environmental decontamination. In this study, wolframite cerium tungstate ($Ce_2(WO_4)_3$, (CW)) hybridized with g-C_3N_4 (CN) nanosheets was synthesized via a simple hydrothermal route followed by an ultrasound-assisted synthesis method. The prepared $Ce_2(WO_4)_3$@ g-C_3N_4 (CW@CN) heterojunction was investigated for photocatalytic degradation of the antibiotic moxifloxacin (MXF) under visible light irradiation. Structural, morphological, and optical properties as well as chemical composition of the as-synthesized heterojunction were investigated by transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), UV–Vis diffuse reflectance spectroscopy (UV–Vis DRS) and photoluminescence (PL). MXF photocatalytic degradation by the binary nanostructure ($Ce_2(WO_4)_3$@ g-C_3N_4) (94.1%) was the highest compared to g-C_3N_4 (53.6%) and $Ce_2(WO_4)_3$ (46.4%). Such enhanced activity could be ascribed to efficient suppression of the charge carriers' recombination, leading to adequate formation of the reactive species responsible for MXF degradation. Furthermore, the $Ce_2(WO_4)_3$@ g-C_3N_4 heterojunction showed remarkable stability over five consecutive cycles, with only 11.5% reduction after the 5th cycle. This work established the potential applicability of $Ce_2(WO_4)_3$@ g-C_3N_4 nanostructures towards photocatalytic removal of MXF.