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ORIGINAL PAPER

Quantum-Sized Chitosan Modified ZnO for the Photocatalytic Oxidation of Oxytetracycline Under Fluorescent Light Irradiation

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Abstract

This study explores the ability of chitosan to control the size of ZnO quantum dots (CHT/ZnO QDs) and defects formation via the microwave-assisted method, as well as their photocatalytic oxidation activity towards oxytetracycline (OTC). The intramolecular and intermolecular hydrogen bonds within the chitosan -OH and -NH_2 were altered by ZnO and microwave radiation. As a result, the particle size decreased from 9.35 ± 0.21 nm to 7.86 ± 0.28 nm. Additionally, the presence of chitosan led to higher oxygen vacancies ($V_s o$) and Zn_i interstitials. The small size enhanced the absorption of photons, while defects suppressed the recombination rate of photogenerated electron/hole (e^-/h^+) pairs. The synthesized CHT/ZnO QDs exhibit outstanding photocatalytic performance by removing 97.4% of OTC within 40 min through pseudo-first-order kinetics with the rate constant (k) of 0.0568 min^{-1} and driven by the h^+ and $O_2^{\cdot-}$. This result was achieved by comprehensively investigating the impact of pH condition, initial concentration of OTC, and photocatalyst dosage. We believe that this work provides a potential photocatalyst design for antibiotics removal.

Keywords ZnO QDs · Chitosan · Oxytetracycline · Microwave · Fluorescent light · Photocatalysis