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Photocatalytic degradation of sulfonamide and its human metabolite by immobilized ZnO nanorods/TiO_2 nanoparticles

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ABSTRACT

The heterojunction of zinc oxide (ZnO) and titanium dioxide (TiO_2) over a glass substrate was investigated. The photocatalysts were applied to sulfamethoxazole (SMX) and N-acetyl sulfamethoxazole (AcSMX) photodegradation. ZnO/TiO_2 exhibited a significant photocatalytic activity, visible light absorption and photo-stability. The best photocatalytic activity was achieved by coupling ZnO from zinc nitrate precursor with TiO_2 (N-ZT). Degradation of 49% for SMX and 32% of AcSMX were observed after 240 min of irradiation. The degradation efficiency of SMX still reached 85% and 39% for AcSMX after 12 h under irradiation. For AcSMX metabolite, an interestingly photocatalytic back-transformation to SMX was observed, indicating that this metabolite may serve as an environmental source of the sulfonamide antibiotic. The electrical energy required for SMX and AcSMX photocatalytic degradation was extremely high, although the results showed that application of ZnO/TiO_2 was efficient in reducing the toxicity of the effluent. The main toxic effect was the inhibition of root growth for *Lactuca sativa* seeds, without inhibiting seed germination. Some byproducts generated by SMX degradation were responsible for cytotoxicity against *Artemia salina*. At the same time, no toxicity were found on the treated sample after AcSMX degradation for both *Artemia salina* and *Lactuca sativa* bioindicators.

Keywords: Heterogeneous photocatalysis; Sulfamethoxazole; N-acetyl sulfamethoxazole; Semiconductor heterojunction

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