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Synthesis of magnetically recoverable Fe^0/graphene-TiO_2 nanowirescomposite for both reduction and photocatalytic oxidation of metronidazole

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Abstract: Novel ternary nanocomposite based on nano zero-valent iron (nZVI) and graphene-TiO_2 nanowires (Fe@GNW) was successfully synthesized for both reduction and photocatalytic oxidation of metronidazole (MNZ). Fe@GNW exhibits synergetic effects and significant properties, such as facilitating the photogenerated charges separation, enhancing the surface activity of nZVI, improving the adsorbent ability of catalyst, possessing the magnetic property for facile recycling. Due to the formation of micro-graphene-nZVI batteries and heterogeneous photo-Fenton system, Fe@GNW showed a superior activity in removal of MNZ (99.3%) compared with TiO_2 nanowires (43.0%) and graphene-TiO_2 nanowires (67.6%). Moreover, Fe@GNW retained excellent stability without apparent loss in catalytic activity after five cycles. MNZ removal by Fe@GNW experienced a two-stage process of reduction-adsorption and photocatalytic oxidation, which could be well-described by a revised pseudo-first order kinetics. The decomposition pathways of MNZ were proposed based on the analysis of intermediates. The quenching tests demonstrated that h^+ and $\cdot OH$ are responsible for MNZ decomposition. New insights into the mechanism of the