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The role of cobalt doping on $ZnTiO_3$-$Ti_3C_2T_x$ MXene Schottky heterojunction toward adsorption-enhanced photocatalytic degradation of tetracycline

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Tetracycline (TC), one of the pharmaceuticals and personal care products (PPCPs), is high quality antibiotic used in human to veterinary medical applications. Over the past few years, TC has been considered as an emerging contaminant, as it has been constantly detected in various water system such as surface water, ground water, and sediments, resulting in permanent accumulation in human body, endocrine disruption, and central nervous system defect. To solve the water pollution problem, in this work, a novel Co (*x* wt.%) doped $ZnTiO_3$-MXene (*x* = 0, 3, and 5 wt.%) (ZC*x*TM) Schottky heterojunction was fabricated *via* the wet impregnation and liquid self-assembly method. The as-prepared heterojunction nanocomposites were characterized by using X-ray diffraction, Fourier transform-infrared spectroscopy, N_2 adsorption-desorption isotherm, field emission-scanning electron microscopy, and high-resolution transmission electron microscopy, thermogravimetric, X-ray photoelectron spectroscopy analysis. The result of this study demonstrated that the synthesized ZC*x*TM composite had synergistic performance on the adsorption-enhanced photocatalytic degradation of TC from water. The ZC5TM showed the enhanced adsorption capacity (q_e = 14.9 mg/g) compared to that of sole $ZnTiO_3$ (q_e = 4.9 mg/g) and MXene (q_e = 11.8 mg/g) by complex interactions between the adsorbents and TC. In particular, the ZC5TM represented an outstanding synergistic performance of adsorption and photocatalytic degradation, and its total removal efficiency for TC was 88.4 % within 30 min of adsorption in a dark condition followed by 90 min of visible-light irradiation. Meanwhile, the adsorption performance trends during TC adsorption were explored by comparing various water parameters and components such as initial pollutants, catalysts doses, solution pH, water matrix, temperature, and effects of coexisting ions. In addition, the mechanism of the photocatalytic process was investigated through the radical scavenger tests and electron spin resonance analysis. Consequently, this study can be a proposal for an extended study to prove the effectiveness of the multifunctional heterojunction nanocomposite for the removal of major antibiotics in aqueous media.