Design of intelligent response antifouling composite materials

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Abstract: Developing environmentally friendly, broad-spectrum, and long-lasting antibacterial materials remains challenging. Our ternary BiOI@Bi_2S_3/MXene composites, which exhibit both photothermal therapy (PTT) and photodynamic therapy (PDT) antibacterial properties, were synthesized through *in-situ* vulcanization of hollow flower-shaped BiOI on the surface of two-dimensional Ti_3C_2 MXene. The unique hollow flower-shaped BiOI structure with a high exposure of the (001) crystal plane amplifies light reflection and scattering, offering more active sites to improve light utilization. Under 808 nm irradiation, these composites achieved a photothermal conversion efficiency of 57.8%, boosting the PTT antibacterial effect. The heterojunction between Bi_2S_3 and BiOI creates a built-in electric field at the interface, promoting hole and electron transfer. Significantly, the close-contact heterogeneous interface enhances charge transfer and suppresses electron-hole recombination, thereby boosting PDT bacteriostatic performance. EPR experiments confirmed that $\cdot O^{2-}$ and •OH radicals play major roles in photocatalytic bacteriostatic reactions. The combined antibacterial action of PTT and PDT led to efficiencies of 99.7% and 99.8% against *P. aeruginosa* and *S. aureus,* respectively, under 808 nm laser irradiation. This innovative strategy and thoughtful design open new avenues for heterojunction materials in PTT and PDT sterilization.

Keywords: Photothermal; Photodynamic; Heterostructure; Interfacial Regulation; Antibacterial

Reference

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