Effect of in-situ Ti doping and SiO_x hole transport channel on Ti-$ZnFe_2O_4$/SiO_x/CoPi nanocoral array photoanode for efficient photoelectrochemical water splitting

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Photoelectrochemical (PEC) water splitting efficiency is limited by the high overpotential, severe recombination of photogenerated charges in bulk, and surface of the photoanodes. In this study, we propose the SiO_x-modified Ti-$ZnFe_2O_4$ (Ti-ZFO/SiO_x) nanocorals array, an advanced photoelectrode material that conjugates the in-situ Ti-doped $ZnFe_2O_4$ nanocorals and the second-order SiO_x hole transport channel layer via combining the hydrothermal and microwave methods. The in-situ Ti doping in $ZnFe_2O_4$ (Ti-ZFO) and the microwave-assisted SiO_x hole transport channel yield improved hole transfer to the coupled oxidation co-catalyst (Co-Pi) in Ti-ZFO/SiO_x/CoPi photoanode. Compared to Ti-ZFO, 1.6 times enhancement in photocurrent density (0.570 mA/cm^2) was achieved for the Ti-ZFO/SiO_x/CoPi photoanode at 1.23 V_{RHE}. Owing to the synergistic effect of the Ti doping and SiO_x hole transport channel in the optimized Ti-$ZnFe_2O_4$/SiO_x/CoPi nanocorals electrode, 70 and 34 μmol H_2 and O_2, respectively, were evolved during 10 h PEC water splitting. Therefore, our work is the foundational pilot for constructing the hole transport channel between photoanode and electrolyte via the microwave method.