Microwave-assisted surface attachment of Al ions on in-situ diluted titanium doped hematite photoanode for efficient photoelectrochemical water splitting

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In this work, we introduce a new in-situ diluted (ISD) hydrothermal method for the synthesis of Ti-doped Fe_2O_3 and suggest a novel microwave-assisted surface attachment (MASA) method for fabricating Al/Ti co-doped photoanode. The charge carrier density of photoanode was increased with a Ti^{4+} doping which offers lower bulk resistance. Through, the use of MASA treatment, Al^{3+} ions were homogeneously attached to the surface of the Ti-FeOOH from an aqueous source of aluminum chloride. The photogenerated charge recombination was more weaken after successful diffusion of Al^{3+} and partially formation of the self-induced Al_2O_3 which act as surface passivation. The synergistic interaction of Al co-doping and surface passivation cathodically shifts the onset potential by 120 mV and enhances the photocurrent density to 1.32 mA/cm^2 at 1.23 V vs. RHE. MASA technique not only improves bulk characteristics of the photoanode via Al-modification also enhances the surface charge injection efficiency which promotes excellent water splitting. This study suggests that using the in-situ diluted (ISD) hydrothermal method combined with the MASA technique, produces highly efficient hematite photoanodes.