Ta_3N_5 photoanodes prepared by thin film transfer for solar water splitting

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A thin film transfer method was applied to fabricate Ta_3N_5 photoanodes for photoelectrochemical (PEC) water oxidation. Poly-crystalline Ta_3N_5 thin films (570−1620 nm) on Si substrates were prepared by radio frequency magnetron sputtering of Ta, oxidation in air and nitridation in an NH_3 flow. After a second sputtering of Ta and Ti conductive layers, the Ta_3N_5 thin films were separated and transferred onto metallic substrates by facile mechanical exfoliation. The Ta_3N_5/Ta/Ti photoanodes modified with cobalt phosphate as an oxygen-evolution catalyst generated a photocurrent of ca. 2 mA/cm^2 at 1.23 V vs. RHE. Void space formed among small Ta_3N_5 crystal grains (< 50 nm) during the nitridation was considered to limit the transport of minority charge carriers (holes) and majority charge carriers (electrons) in Ta_3N_5 thin films. The thin film transfer method also facilitated the modifications of the interface between Ta_3N_5 films and conductive substrates. A NbN_x interfacial layer was found to improve the crystalline quality of Ta_3N_5 thin film and increase the photocurrent to 4 mA/cm^2 at 1.23 V vs. RHE.