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Chalcopyrite and Tantalum Oxide Nitride Thin Films for Visible Light-driven Overall Water Splitting

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Photoelectrochemistry is a promising route for the production of solar fuels, since it acts at room temperature and can be performed on any scale. An application of p-type chalcopyrite-based ternary thin films such as $Cu(In,Ga)Se_2$ ($E_g \approx 1.35$ eV) or $Cu(In,Ga)S_2$ ($E_g \approx 1.5$ eV) is of high relevance for the visible-light driven hydrogen evolution reaction (HER). These highly efficient chalcopyrite thin films are utilized as so called thin film heterojunction solar cell devices in the large-scale production of the photovoltaic industry. Such ternary thin films are applied in the photoelectrochemical cell (PEC) under solar light illumination. The chalcopyrite-related thin film composites show a high hydrogen evolution reaction (HER) even at low external bias potentials very close to the hydrogen reduction potential. Furthermore, solar hydrogen evolution is detected qualitatively and, quantitatively, by on-line mass spectrometry coupled to a new designed PEC set-up. Additionally, porous TaON thin films with tunable band gap energies are used as photoanode material for oxygen evolution reaction (OER) in PEC water splitting. Photoelectrochemical OER is found by TaON thin films. The microstructural morphology and chemical surface composition are studied in order to obtain informations on the stability of our new photoelectrode composites.

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