Optimization of a Hybrid Photoelectrode for Solar Water-Splitting

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A novel multijunction hybrid photoelectrode for solar-powered hydrogen production, which integrates a semiconductor-electrolyte junction with photovoltaic solid state junctions to enable unassisted photoelectrolysis of water, has been developed and demonstrated. An operational prototype device, consisting of a reactively-sputtered tungsten trioxide (WO_3) film and a tandem amorphous silicon:germanium solid-state device, has exhibited stable solar-to-hydrogen conversion in acidic media at 0.6% efficiency. Although the low photoactivity of the sputtered WO_3 film has been identified as the primary performance-limiting factor, the solid-state junctions, based on the bottom two layers of a triple-junction solar cell, were also non-optimal for this application. Plans to enhance efficiency through further oxide film research and development, and through solid-state junction optimizations are described. Promising avenues of investigation, including the band-edge modification of WO_3 films through doping to improve photocurrent levels, the possible use of doped iron oxide (Fe_2O_3) films, and the development of amorphous silicon tandem configurations with enhanced voltage characteristics, are discussed.