Optimization of Photoelectrochemical Cells for Solar Water Splitting

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Solar water oxidation from photoelectrochemical approach can proceed through several reaction pathways. The two attractive pathways are the four-electron pathway to evolve O2 and the two-electron pathway to evolve H2O2. For either pathway, an efficient photoanode is needed to absorb sunlight and transport/transfer charge carriers to the photoanode and electrolyte interface. Tungsten trioxide/bismuth vanadate (WO3/BiVO4) heterojunction has emerged as a top metal oxide based photoanode, but its performance is still shy of its theoretical potential, indicating room for further improvement. This work focuses on enhancing the heterojunction core, WO3, and through which to further improve the overall performance of the heterojunction. Specifically, WO3 nanohelices are used as the base structure and WO3 nanoneedles are further epitaxially grown on top, forming a carrot-shaped core. The resulting WO3 nanoneedles/nanohelices photoanode shows greatly enhanced light harvesting property and charge carrier dynamics, which is utilized as a host for further deposition of doped BiVO4.