Hetero-type dual metal oxide photoanodes for unbiased solar water splitting with extended light harvesting

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Photoelectrochemical (PEC) water splitting converts abundant solar energy to a storable chemical energy (hydrogen) that burns cleanly without emitting greenhouse gases [1]. Metal oxide semiconductors are promising photoelectrode materials due to their robustness in aqueous solutions, earth abundance and low cost [2, 3]. However, their relatively large band gaps limit the range of solar light utilization and thereby solar-to-hydrogen conversion efficiency (η_{STH}). In this talk, I will present a novel strategy to improve η_{STH} of metal oxides, *i.e.* hetero-type dual photoelectrodes, in which two photoanodes of different band gaps are connected in parallel for extended light harvesting [4]. Thus, a PEC device made of modified $BiVO_4$ and α-Fe_2O_3 as dual photoanodes utilize visible light up to 610 nm for water splitting, and showed stable photocurrents of 7.0 ±0.2 mA/cm^2 at 1.23 V_{RHE} under 1 sun irradiation. This represents the highest value ever reported for metal oxide photoelectrodes under these conditions. When the dual photoanodes were integrated with a silicon solar cell, the tandem cell demonstrates stable and continuous unbiased water splitting with an STH efficiency of 7.7 %. The results represent a significant step forward *en route* to the goal of 10 % η_{STH} required for practical solar hydrogen production using metal oxide semiconductors.

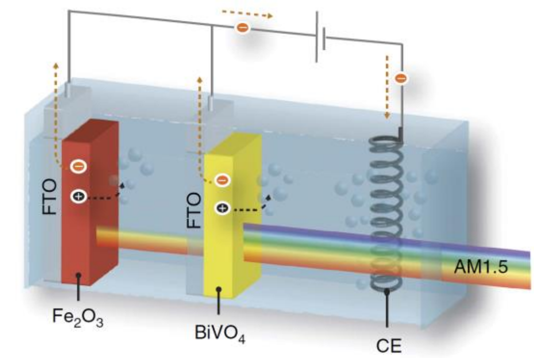

Fig.1 Wavelength-selective solar light absorption by hetero-type dual photoanode.

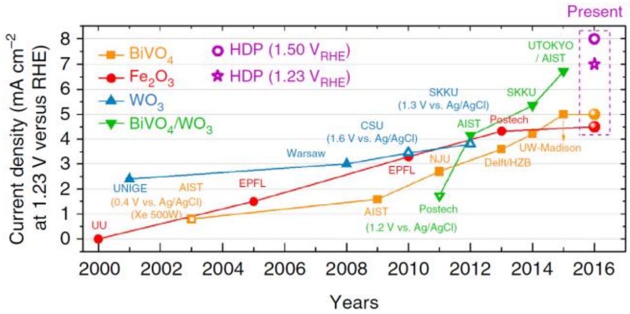

Fig. 2 Reported photocurrents of metal oxide photoanodes.

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