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Photoelectrochemical Hydrogen Production (overview)

Development of high-efficiency photoelectrochemical systems to produce hydrogen directly from water, using only sunlight as the energy source, is a major goal of the DOE Hydrogen Program. Since 1995, a number of photoelectrode configurations designed for high efficiency and low cost have been explored in the Hawaii Natural Energy Institute's (HNEI's) Thin Films Laboratory [1]. In 1997, a small-scale reactor based on monolithically-stacked triple-junction amorphous silicon/germanium alloy (a-Si:Ge) thin film solar cells was used to demonstrate solar-to-hydrogen efficiencies up to 7.8%. These solar cells were modified with cobalt-molybdenum and iron-doped nickel oxide thin film catalyst coatings developed at HNEI. In separate tests, these thin-film low-cost catalysts were operated in KOH electrolyte for over 5,000 hours with no evidence of significant degradation.

More recent efforts focused on a UH-patented unique 'hybrid' photoelectrode structure (see the full text of U.S. Patent 6,887,728 [2]), developed at HNEI, which combines a tandem a-Si:Ge solar cell monolithically series connected to a thick, photoactive over-coating of nano-structured metal oxide. In early testing, these devices showed great promise for the development of long-life, high-efficiency hydrogen production systems. Working with key industry and academic partners, HNEI hopes to successfully demonstrate solar-to-hydrogen efficiencies in excess of 10% and exceptional stability in a working version of the hybrid photoelectrode by 2015. For more information, see Photoelectrochemical Hydrogen Production (details) [3].

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