143aa Evaluation of the Solar Zn/Zno Thermochemical Cycle for Sustainable Hydrogen Generation

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The ultra-high temperature (~1850°C) dissociation of ZnO is the solar step in a two-step thermochemical cycle for renewable H2 production. Experiments were conducted at the High Flux Solar Furnace facility at the National Renewable Energy Laboratory to determine the viability of rapid (10-200 ms) aerosol dissociation of ZnO powders. Efficiency of solar heat utilization, overall conversion, and extent of recombination of O2 with Zn were measured and incorporated into an economic model for industrial production of hydrogen fuels using the Zn/ZnO process.

The overall economics of such a cycle were investigated using ASPENPlus software. Capital costs for a hydrogen plant generating 150,000 kg H2/day were estimated at $780 M, given average solar insolation for Las Vegas, NV. Assuming a heliostat cost ranging between $75/m2-$150/m2, plant gate sale price of H2 was estimated to be between $2.83 and $4.50. Carbon credits and oxygen product sale were seen to decrease this price slightly, but heliostat cost was seen as the major driver in H2 price.