CU method projected to meet DOE cost targets for solar thermal hydrogen fuel production

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A report commissioned by the U.S. Department of Energy has concluded that a novel University of Colorado Boulder method of producing hydrogen fuel from sunlight is the only approach among eight competing technologies that is projected to meet future cost targets set by the federal agency.

The process, which is being developed by Professor Alan Weimer's research team of CU-Boulder's chemical and biological engineering department, involves an array of mirrors to concentrate the sun's rays and create temperatures as high as 2,640 degrees Fahrenheit. The process consists of two steps -- each involving reactions of a thin film of metal ferrite coating with a reactive substrate contained in a solar receiver -- to split water into its gaseous components, hydrogen and oxygen.

Currently, the lowest cost method for producing hydrogen is the steam-methane reforming of natural gas, primarily methane. In this process, significant amounts of carbon dioxide -- a powerful greenhouse gas -- are released into the atmosphere.

The DOE commissioned 76-page report was produced by TIAX, a technology processing and commercialization company headquartered in Lexington, Mass. The report authors evaluated process conditions, major capital equipment, materials and utilities usage rates, estimated

equipment sizes, financial and operating assumptions.

CU's approach does not result in greenhouse gas emissions and is more cost effective than competing technologies because the water-splitting reactions occur at lower temperatures and are faster, said Weimer. In addition, less energy and fewer active materials are required, resulting in lower costs.

Weimer said the solar receiver's thin film coating on a porous active support allows heat and steam -- necessary to reactions -- to flow more easily through the device and for reactions to occur more efficiently.

"We've been able to reduce the temperature required to split water by about 250 degrees Celsius [482 degrees F] and we have eliminated what appears to be a major roadblock in terms of an unstable intermediate by using thin films and a reactive substrate," said Weimer. "It's pretty significant and it seems like there's a good shot for this to become mainstream in the southwest U.S. and other high insolation regions around the world."

Weimer refers to his water-splitting method as a "triple play." It not only uses renewable resources and produces sustainable hydrogen, but it also can purify brackish into potable water -- a byproduct that he says could address water shortage issues in the future.

Weimer is presenting his research today at the DOE Hydrogen and Fuel Cells Program and Vehicle Technologies Program Annual Merit Review and Peer Evaluation Meeting in Washington, D.C. Weimer said he hopes to garner continued research support through government and private resources.

The DOE is investigating novel approaches for solar thermochemical

water splitting to produce hydrogen with the eventual goal of commercializing production. Cost targets in this analysis set hydrogen production in 2015 at 6 dollars per kilogram -- equal to 2.2 pounds -- and hydrogen delivery in 2025 at 2 to 3 dollars per kilogram. CU-Boulder's thin-film metal ferrite process is projected to meet both benchmarks.

Other technologies appearing in the analysis included reactions with hybrid-sulfur, copper chloride, sulfur-ammonia, zinc oxide, manganese oxide and cadmium oxide.

Provided by University of Colorado at Boulder