Ben-Gurion University of the Negev
Blaustein Institutes for Desert Research
The Swiss Institute for Dryland Environmental and Energy Research
Department of Man in the Desert

BTMID WEEKLY SEMINAR

Onboard Hydrogen Production to Eliminate Storage and Distribution Challenges

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Abstract:
Hydrogen is a promising option that can replace other fossil fuels. The most important and most urgent application of hydrogen is its use for transportation. However, several barriers have to be overcome before hydrogen vehicles can be put into large-scale practical utilization. One of the most severe challenges is the lack of a safe and efficient onboard storage technology.

Hydrogen-fueled cars rely on stocks of gas produced in centralized plants and distributed in either liquefied or compressed form via refueling stations. Liquefaction takes about 40 percent of the energy content of the stored hydrogen, while the energy density of the gas, even when compressed, is so low that it is unlikely to ever be able to fuel a normal car.

One possible option to overcome some of these hurdles is to produce the hydrogen on-site as it is needed. One method of on-site hydrogen production is to react a light metal with water in the presence of an alkali solution. The reaction of metals and alkali solutions can take place at low temperatures and has high hydrogen storage capacity based on both volume and mass, compared with other candidate technologies.

In this research, a process is described in which metal is used as a means to store and transport solar energy from a production site to motor vehicles, where it is used to generate hydrogen and heat. It eliminates the distribution, storage, and pumping of hydrogen at the refueling station, and reduces the amount of hydrogen stored on the vehicle to a minimum. The solar fuel cycle involves two steps: reduction of zinc and aluminum oxides to aluminum or zinc in an endothermic reaction at the solar plant, and hydrolysis of metal in alkali solution to produce hydrogen and zinc/aluminum oxides. This project proposes to investigate the second step. The oxides of zinc or aluminum will be recovered from the hydrogen production site and recycled in step one.

Our research results showed a very promising and efficient conversion of metals to oxides and hydrogen. We were able to produce hydrogen in very fast and controllable way, the chemical conversion efficiency of the system reached to 98%.

Tareq Abu Hamed *holds a PhD in Chemical Engineering from Ankara University in Turkey. He did his first post doctorate research at the Weizmann Institute of Science in Israel, where he worked at Environmental Sciences and Energy Research Department. His second post doctorate was at the University of Minnesota, at the Solar Energy Laboratory of the Mechanical Engineering Department. He has published profusely in a wide variety of journals, and received several awards (Dan David Prize). Tareq served as the Acting Chief Scientist, Vice Chief Scientist and The Director of Engineering Research at The Ministry of Science, Technology and Space, and is currently the Academic Director and the head of the Renewable Energy Center at the Arava Institute and a researcher at the Dead Sea and Arava Science Center.*

Date & Location:

Tuesday, March 13, 2018, 13:15
Department of Man in the Desert Seminar Room