Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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Electrically Powered Thermochemical Reactor for Two-Step Splitting of Water or Carbon Dioxide

Background

Thermochemical reactors can provide an effective means for splitting water and carbon dioxide. These reactors are able to produce energized chemicals such as H2 and CO, which can be subsequently used in other chemical reactions (e.g., as reductants or as fuels). In water splitting, the main competing technologies are steam-methane reforming and electrolysis. Although electrolysis can be achieved through renewable sources, it is comparatively expensive. In CO2 splitting, thermochemical reactors represent the most advanced technology and have found application in CO2 reutilization. In some cases, thermochemical reactors must harness direct solar flux to provide the required heat for splitting, subjecting operation to the availability of sunlight, weather conditions, and time of day.

Invention Description

Research at Arizona State University has resulted in the development of an electrically powered two-step thermochemical reactor for splitting water and CO2. Unlike conventional thermochemical reactors, it is able to perform electrical heating in an economical way owing to its modular design, inexpensive materials, and use of a specialized fast-cycling heater. The reactor consists of a plurality of unit cells, each composed of a metal oxide, housed in a chamber. In the first of two thermochemical steps, the metal oxide is heated to more than 1450 ºC which removes oxygen from the metal oxide. The second step introduces either water or CO2 to the chamber which reoxidizes the metal oxide, removing oxygen from the feedstock to yield H2 or CO.

Potential Applications

- Production of hydrogen (H2) and carbon monoxide (CO)
- Carbon dioxide (CO2) reutilization
- Renewable energy generation

Benefits and Advantages

- Inexpensive and compact modular design
- Electrically powered process does not require solar flux
- Increased efficiency and temperatures over existing reactor designs
- Compatible with a wide range of reactive metal oxides

Faculty Profile of Professor Ivan Ermanoski