

Case ID:M20-130P

Published: 10/23/2020

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

### Inventors

Ivan Ermanoski

### Contact

Shen Yan  
shen.yan@skysonginnovations.com

#### Background

Thermochemical reactors can provide an effective means for splitting water and carbon dioxide. These reactors are able to produce energized chemicals such as H<sub>2</sub> 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 CO<sub>2</sub> splitting, thermochemical reactors represent the most advanced technology and have found application in CO<sub>2</sub> 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 CO<sub>2</sub>. 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 °C which removes oxygen from the metal oxide. The second step introduces either water or CO<sub>2</sub> to the chamber which reoxidizes the metal oxide, removing oxygen from the feedstock to yield H<sub>2</sub> or CO.

#### Potential Applications

- Production of hydrogen (H<sub>2</sub>) and carbon monoxide (CO)
- Carbon dioxide (CO<sub>2</sub>) 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](#)