# Non-aqueous 2D Material Based Hydrogen Isotope

(2019-017)

Design and method for production of an ion selective hydrogen pump

## Market Overview

The separation of hydrogen isotopes from one another is desirable for multiple purposes including nuclear fusion reactors, medical imaging, and cancer therapy. Current separation technologies are aqueous based and utilize isotope exchange or distillation systems. These methods are extremely expensive with large energy consumptions. In addition, the polymer membranes utilized in the hydrogen pumps formed from the separation methods exhibit mechanical issues which lead to damage and performance degradation. A Clemson University researcher has developed a non-aqueous based system, that is safe and durable. The global stable isotope labeled compounds market is projected to reach $312 million by 2024, growing at a CAGR of 3% from 2019 to 2024. This system can achieve high isotope selectivity, while being cost and energy effective.

## Technical Summary

The method for separating hydrogen isotopes from one another comprises of a separation membrane with a sample including a first hydrogen isotope and a second hydrogen isotope. The separation membrane is comprised of a hydrogen isotope selective layer and a hydrogen ion conductive layer. A voltage is applied across the separation membrane from the first side of the membrane to the second side, at an elevated temperature. The voltage provides a driving force to selectively conduct the first hydrogen isotope across the separation membrane from the first side to a second side, thereby forming a product on the second side of the membrane that is enriched in the first hydrogen isotope, a remaining sample on the first side of the separation membrane being enriched in the second hydrogen isotope.

### Application

Hydrogen Production, Hydrogen Isotope Separation

### Development Stage

Proof of Concept

### Advantages

- Method for separation uses less power and a smaller carbon footprint than other current technologies
- This technology is simple to operate and works as a solid-state device
- Hydrogen separation is utilized in government and industry applications

| App Type | Country | Serial No. | Patent No. | CURF Ref. No. | Inventors |
|---|---|---|---|---|---|
| N/A | United States | 16/433,500 | N/A | 2019-017 | Kyle Brinkman |

## About the Inventors

### Dr. Kyle Brinkman

Chair of the Department of Materials Science and Engineering at Clemson University

Dr. Kyle Brinkman received his Ph.D. in 2004 from the Swiss Federal Institute of Technology in Materials Science and Engineering. Brinkman served as a postdoctoral fellow at the Advanced Industrial Science and Technology institute in Japan from 2005-2007. He later worked as a principal engineer in the Science and Technology Directorate of the U.S. Department of Energy's Savannah River National Lab from 2007-2014. Brinkman joined Clemson as an associate professor in 2014 and currently leads of team of 21 faculty, over 220 total undergraduate and graduate students, postdocs and research staff with an annual combined teaching and research budget in excess of $11M.

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