



Inventors

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Niobium Membrane for Low-Cost Production of Oxygen

AzTE Case # M15-122P

Background

Gasification is a very flexible process to convert carbon-containing materials into electric power, Fischer Tropsch fuels, hydrogen, ammonia, and other chemicals, while simultaneously capturing carbon dioxide for sequestration or enhanced oil recovery. Oxygen production is a major component of the gasification process. Although oxygen is readily available in the air, purification of oxygen is prohibitively expensive, especially for large scale operations. Current purification techniques require cooling air to cryogenic temperatures to start the simple distillation process. This creates a massive up-front cost for producers. Low cost separation of oxygen from air would be an enabling technology for many different applications, ranging from synthetic gas production to local delivery of oxygen for medical applications. Typically, companies will mass-produce oxygen in an attempt to lower the per-ton cost of purified oxygen. However, this is still extremely expensive, and many applications require smaller scale oxygen production.

Invention Description

Researchers at Arizona State University have invented a method of producing oxygen on a small scale at a low cost. Niobium, a transitional metal used in many industrial processes, can be used as an extremely effective oxygen-hydrogen separation membrane. The metal is able to separate hydrogen and oxygen molecules from one another in water and air. Since hydrogen and oxygen are available on both sides of the membrane, the net energy cost of the system is very close to zero, making operation costs low. With air and steam on different sides of the membrane, the Niobium is able to purify oxygen cheaply on any scale.

Intellectual Property

Status:

Pending

Potential Applications

- Small scale Fischer-Tropsch processes
- Oxygen production and separation
- Coal gasification
- Gas separation
- Synthetic gas production
- Localized oxygen delivery for medical therapies

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Benefits and Advantages

- **Low Cost** – Net energy cost of the reaction is very close to zero, so operation costs are low.
- **Modularity** – Can be used on a variety of scales, and individualized to meet specific industry needs.
- **Small Scale Applications** – Allows oxygen to be affordably purified on a small scale.
- **Energy efficient** – All water is reconstituted, making the net enthalpy (energy) cost for the process zero.