National Aeronautics and Space Administration

Power Generation and Storage

Cryo-Fluid Capacitor (CFC)

A Device for Solid-State Storage and On-Demand Distribution of Cryogenic Fluid Commodities

NASA's Kennedy Space Center (KSC) has created the Cryo-Fluid Capacitor (CFC) that capitalizes on the energy storage capacity of liquefied gasses and relative simplicity of high pressure gas bottles, while limiting the downfalls associated with both methods. By exploiting a unique attribute of nano-porous materials, aerogel in this case, fluid commodities such as oxygen, hydrogen, methane, etc. can be stored in a molecular surface adsorbed state at densities on par with liquid, at low to moderate pressure, and then supplied as a gas, on-demand, to a point of interest. High pressure gas must be stored in vessels with heavy thick walls and cryogenic liquids require complex storage systems to limit boil-off and are not well suited for overly dynamic situations where the tank orientation can change suddenly (e.g. in an airplane or car); the CFC addresses these issues, while still providing excellent energy storage capability.

BENEFITS

- Compact fuel storage
- Light weight
- Low to moderate storage pressures
- Fast charge-up times
- On-demand, fast discharges

APPLICATIONS

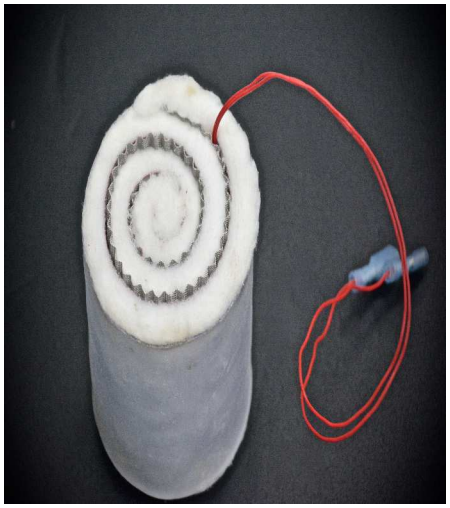
- Spacecraft
- Space Habitats
- Aircraft
- Transportation
- Fuel Cells
- Medical

technology solution

THE TECHNOLOGY

Storage and transfer of fluid commodities such as oxygen, hydrogen, natural gas, nitrogen, argon, etc. is an absolute necessity in virtually every industry on Earth. These fluids are typically contained in one of two ways; as low pressure, cryogenic liquids, or as a high pressure gases. Energy storage is not useful unless the energy can be practically obtained ("un-stored") as needed. In the present case, the goal is to store as many fluid molecules as possible in the smallest, lightest weight volume possible; and to supply ("un-store") those molecules on demand as needed in the end-use application. The CFC concept addresses this dual storage/usage problem with an elegant charging/discharging design approach.

The CFC technology includes ingenious packaging in its design. Tightly coiling aerogel blanket into a cylinder allows for a larger amount of the storage media (aerogel) to be densely packaged into a manageable geometry. A spirally-integrated conductive membrane also acts as a large area heat exchanger that easily distributes heat through the entire cylinder to discharge the CFC quickly, and can be interfaced to a cooling source to charge it up; this feature also allows the cryogenic fluid to easily penetrate the cylinder for fast charging. Another important note is that the unit can be charged up with cryogenic liquid or from an ambient temperature gas supply, depending on the desired manner of refrigeration. Another novel feature is the heater integration. Two promising methods have been fabricated and tested that evenly distribute heat throughout the entire core, both axially and radially.



Cryo-Fluid Capacitor

The Cryo-Fluid Capacitor could be used on space habitats

More Information

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