

TECHNOLOGY FACT SHEET

HIGH CAPACITY METAL/AIR BATTERY

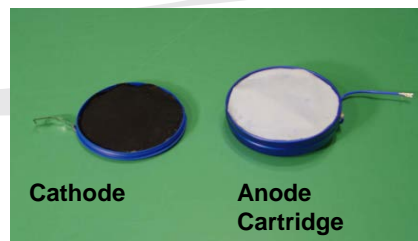
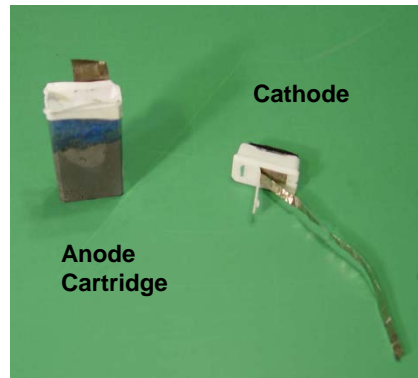
(Jiang, Walker, Chu)

Introduction

This invention represents a new entrant to the metal/oxygen family of primary batteries (non-rechargeable). Researchers at the U.S. Army Research Laboratory-Sensors and Electron Devices Directorate (ARL-SEDD) in Adelphi, Maryland designed, constructed and tested molybdenum/air batteries in a variety of compact cell formats, as shown in the images below (**Source: ARL-SEDD**). Metal/oxygen batteries are typically lighter and have more energy than ordinary primary batteries because they use abundant air as the cathode (oxygen) source. Molybdenum enhances this advantage by offering higher energy density than zinc, the most commonly used metal/air battery on the market.

Concept

The original objective of this development effort was to create materials and technology for a new metal/air battery that can be used to provide power for a three-day mission by an individual soldier. However, due to the success of the experimental trials, ARL researchers now envision this new technology as a promising power supply for a wide range of commercial and military applications, including electric vehicles (EVs). EVs are becoming more and more attractive with the advancement of new cells with higher power and superior energy density (i.e. greater acceleration, range and cargo loads with less battery weight). Molybdenum/air technology has the potential to store almost as much energy as a tank of gasoline.



Invention Overview

- ❖ Has 2.5 times greater energy capacity than current state of art zinc/air battery
- ❖ Method is simple to practice and adaptable for mass production
- ❖ Multiple applications including consumer electronics and electric vehicles
- ❖ TRL 4 – Fully functioning prototypes using different small cell formats
- ❖ Laboratory test data available through ARL Director's Research Initiative report, "Novel Molybdenum/ Air Fuel Cell with Nano-sized Carbon Composite for Anode Electrode"
- ❖ Patent application filed: 12/416,309, 1 April 2009

Doing Business with ARL

- ❖ ARL-SEDD is a leader in partnering with domestic firms
- ❖ Successfully developed and implemented innovative tools to ease the technology transfer process
- ❖ Tools includes Patent License Agreements (PLAs); Cooperative Research and Development Agreements (CRADAs); Test Services Agreement (TSA); and others
- ❖ Visit www.arl.army.mil for more information

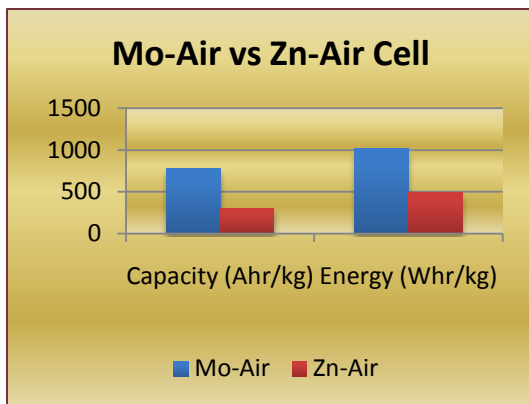
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Features/Capabilities/Intellectual Property

The state-of art metal/oxygen battery is zinc/air. However there are a number of known limitations with this battery chemistry:

- Evolution of hydrogen gas wears wastes energy capacity and reduces operating performance
- Additives incorporated to retard hydrogen evolution (e.g. Pb, Hg) create a disposal hazard
- Short shelf life since zinc/air chemistry self discharges when not in use
- Capacity of about 300 Ah/kg results in frequent cell change out during periods of high use

The ARL invention overcomes solves these problems by using molybdenum as the primary anode material. Molybdenum/air chemistry is safer since it does not result in the evolution of hydrogen gas. Nor does it self discharge, which allows these cells to be stored for long periods of time in warm and cold weather. And with a capacity of 770 Ah/kg, these cells store about 2.5 times the energy as zinc/air, as shown in the chart below. Moreover, the molybdenum anode can be altered easily with other metals to tailor operating characteristics.



Other features/capabilities/intellectual property offered by this invention include the following:

- Designed with replaceable anode when molybdenum is exhausted
- Easily adaptable to existing zinc/air process lines
- Scalable for use in large and small format batteries
- IP includes novel design and battery product

Potential Markets/Applications

The ARL molybdenum/air battery is a promising power supply for military and consumer marketplaces and wherever zinc/air batteries are used. Potential applications include the following:

- Portable computers
- Cellular phones
- Hearing aids
- Electric vehicles

Key Advantages & Benefits

- ❖ Enables longer, safer operation
- ❖ Longer shelf life by eliminating self-discharge
- ❖ Uses commonly-available materials of construction
- ❖ Wide assortment of potential applications, particularly those where zinc/air batteries are used currently
- ❖ Inventor team available to work with commercialization partner

Contact Information

This technology was developed by ARL-SEDD. It is now available for licensing and CRADA opportunities.

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