Electrolyte for Metal-Oxygen Battery and Method for its Preparation

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Technology Overview

Metal-air batteries utilizing alkali and alkaline earth metal anodes are a very popular research topic because the cathode active material, oxygen, does not have to be stored in the battery but can be accessed from the environment. This makes the battery much lighter, smaller and energy dense. The high energy density of the Li-air battery system has spurred considerable interest in developing it for a large number of applications, including portable power and renewable energy (RE).

In portable applications, discharge rate performance of the oxygen cathode becomes an issue. Transport of oxygen to the active reduction sites in the cathode is rate limiting due to the fact that the flux of oxygen gas is low in most liquid phases. This technology addresses how to increase this flux and therefore the rate capability of the battery.

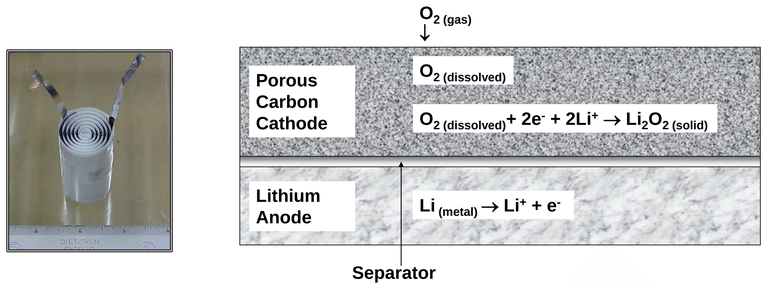
In RE applications, batteries store generated energy for later use and improve grid stability by acting as a buffer to compensate for the intermittent nature of renewable energy resources. Li-air batteries, with such a large energy capacity, can play a significant role in reducing the footprint of energy storage, and the ARL electrolyte improves the performance of such cells.

Technology Agreements

- CRADAs and patent licenses are sought.
- $Li\text{-}O_2$ technology is currently being developed by various labs. Low viscosity electrolytes allow for high discharge capacity and better rate capability. Further development of membrane technology is needed to fully realize the chemistries potential.
- This technology is currently at a TRL of 4, and it has been patented (US Patent 7,585,579).

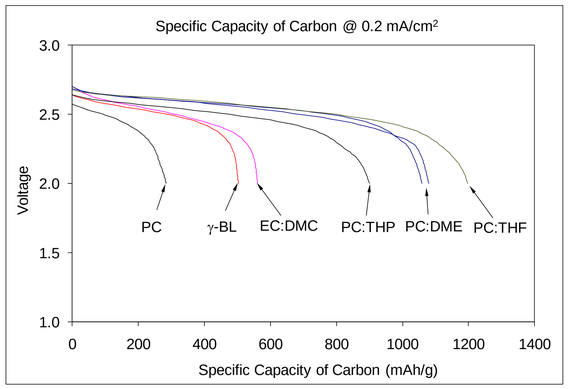
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Metal-Oxygen Battery Development



Proof of Concept

- We have evaluated the $Li\text{-}O_2$ technology extensively and determined areas of needed improvement.
- We identified transport of O_2 as a major factor in $Li\text{-}O_2$ battery performance.
- TRL 4 - We developed prototype cells that gave high specific energy in a wound-plate cell design. See image above.



Technology Applications

Commercial:

- Back-up power in moderate rate applications.

Military:

- High specific energy primary batteries for stationary applications.
- Less weight for the Soldier to carry.
- Military market comparable to Zinc-Air and BA5590.

Technology Advantages

- Active material cost is low for this chemistry.
- Two-times greater energy density as compared to current batteries.
- Does not use large amounts of transition metal oxides for cathode material.
- Improves battery discharge rate performance

Technology Differentiation

- This technology improves both discharge rate performance and temperature-related performance of the $Li\text{-}O_2$ battery.
- The Li-O2 battery is low cost and has good performance relative to existing battery products.

Examples:

- A soldier currently carries about 50 lbs of batteries and should carry another 10 lbs but must sacrifice batteries for food and ammunition. The invention reduces the overall battery weight by 20lbs.
- As the market for load-leveling energy storage grows, new technologies that can safely store large amounts of energy will need to be developed. Material cost will be a significant consideration for large MWh-sized batteries.

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