Nanocatalytic Rechargeable Lithium Air Cathode

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Introduction

The secondary Li/Air battery offers the potential of extremely high specific energy of greater than 1700 Wh/kg and extended rechargeability. The overall reactions in the Li/Air cell can be represented by:

$$2\,Li + O_2 \rightleftharpoons Li_2O_2 \qquad E_o = 3.10\ V$$

The theoretical specific capacity is 3630 Wh/kg. The battery would have a simple construction, in principle, consisting of a Li metal anode, a separator containing an electrolyte, and a reversible "air breathing", graphene-based cathode on which the O_2 reduction to Li_2O_2, and the reverse process can take place.

Objective

The Phase I objective is to fabricate a rechargeable Li/Air battery cathode based on a graphene composite containing an electrocatalyst. A succinonitrile-based plastic crystal-type polymer-gel electrolyte phase serves as the separator between the graphene/oxygen cathode and the lithium anode.

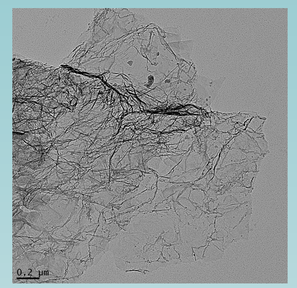
Phase I Tasks

The proposed 9-month Phase I development effort consists of the following tasks:

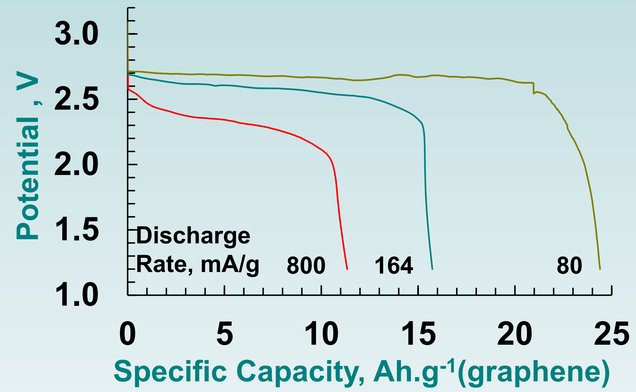
Task 1: Preparation of catalyst coated graphene materials
Task 2: Development of cathode structures
Task 3: Cathode performance evaluation in Li/Air Cells
Task 4: Assessment of performance potential in batteries

Progress achieved

- ***We synthesized graphene in-house using an established protocol***

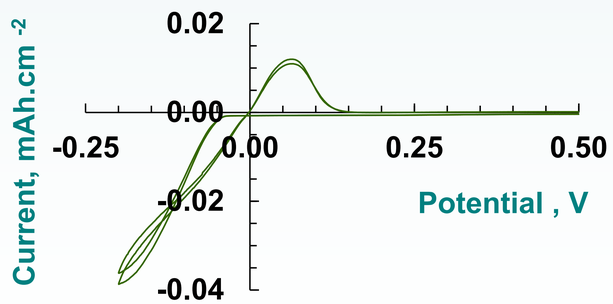


- ***We evaluated graphene in Li-O_2 cells containing a typical liquid electrolyte***



The electrode: 75.0 weight% graphene, 25.0 w% PTFE. Active area: 10 cm². Loading: ~0.9 mg (graphene)/cm². Electrolyte: 74.5 w% triethylene glycol dimethyl ether 25.5 w% $LiN(CF_3SO_{2)2}$

- ***We probed the lithium transport ability of the succinonitrile-based gel electrolyte***



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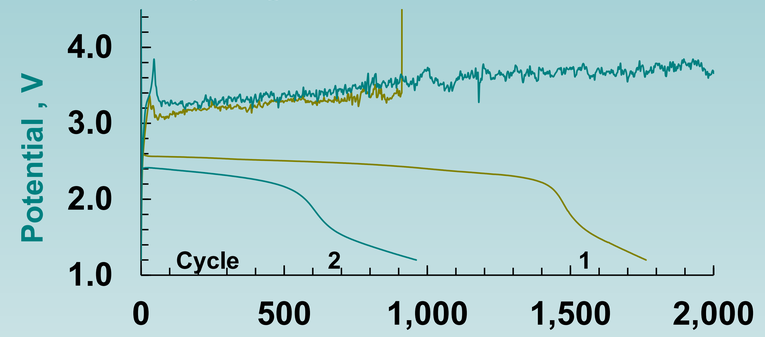
Progress achieved (continued)

The electrode: Stainless steel flag. Active area: ~1 cm². Electrolyte: 4.0 mol% $LiN(CF_3SO_2)_2$ in succinonitrile

- ***Rechargeability evaluation of Li-O_2 cells in the succinonitrile-based gel electrolyte is still In its early stages***



Future plans

- **Continuing work on the rechargeability of Li-O_2 cells in the succinonitrile-based gel electrolyte**
- **Optimization of the electrode and electrolyte compositions**
- **Development of improved device and testing protocol**
- **Submission of the final report**
- **Preparations for the Phase II study and beyond**

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