

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:



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 O₂ reduction to Li₂O₂, 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.

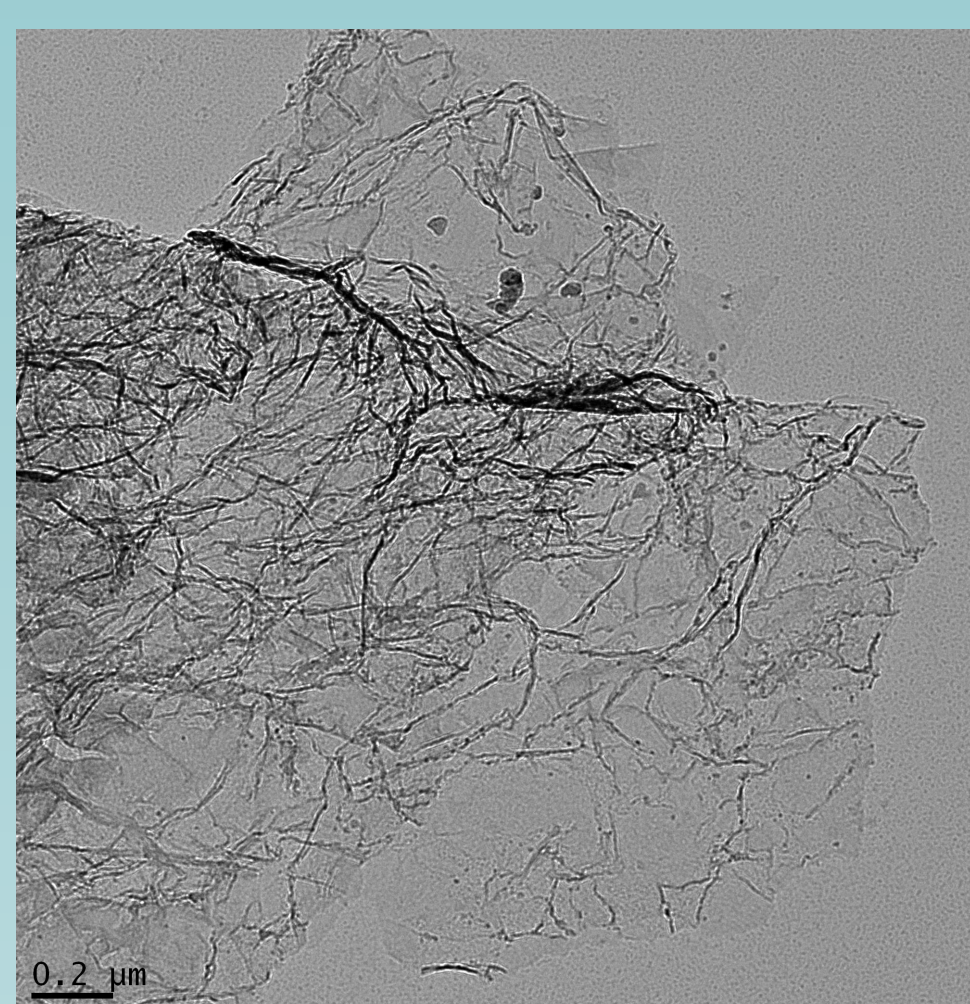
Phase I Tasks

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

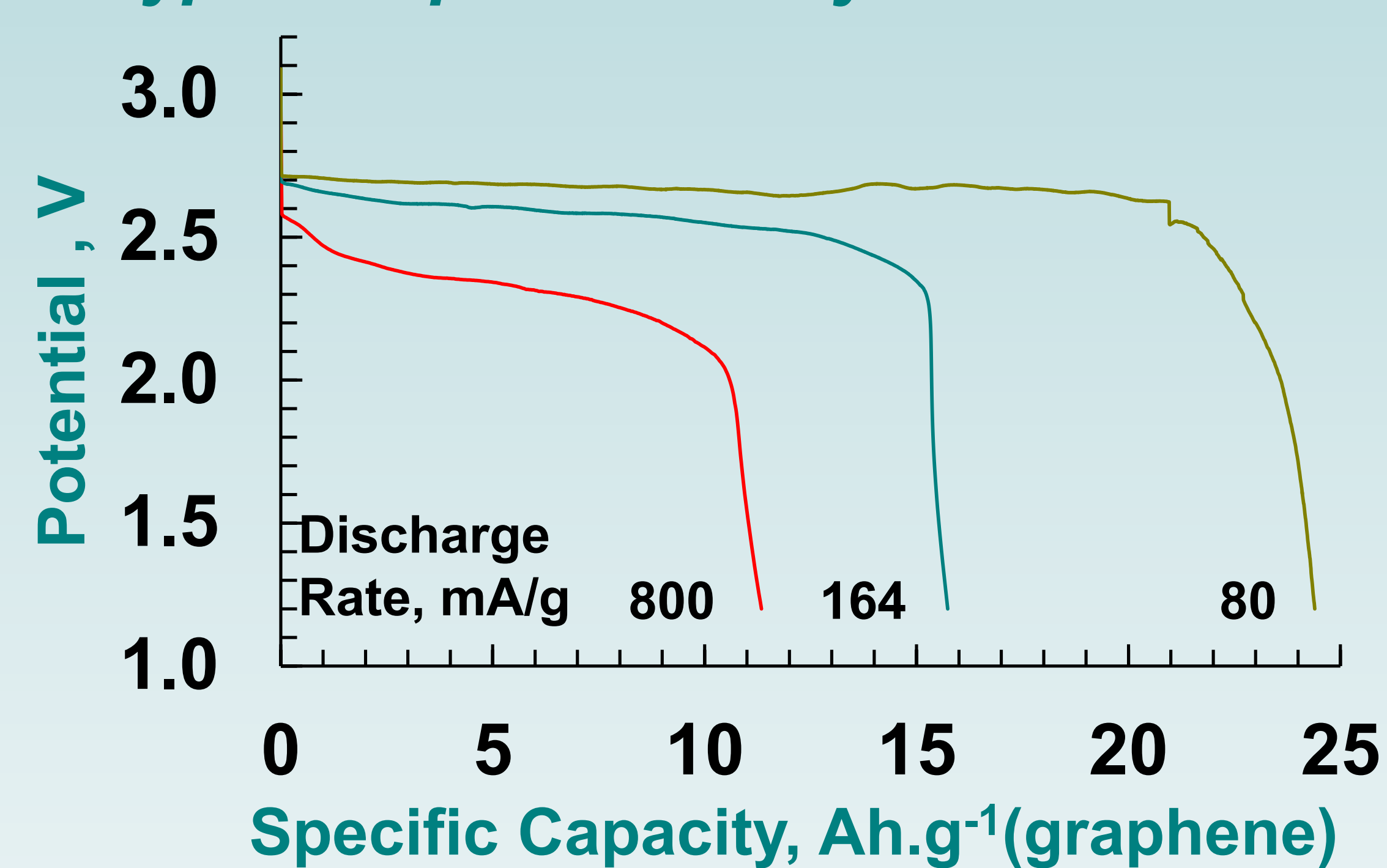
- Task 1: Preparation of catalyst coated graphene materials
- Task 2: Development of cathode structures
- Task 3: Cathode performance evaluation in Li/Air Cells
- Task 4: Assessment of performance potential in batteries

Progress achieved

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

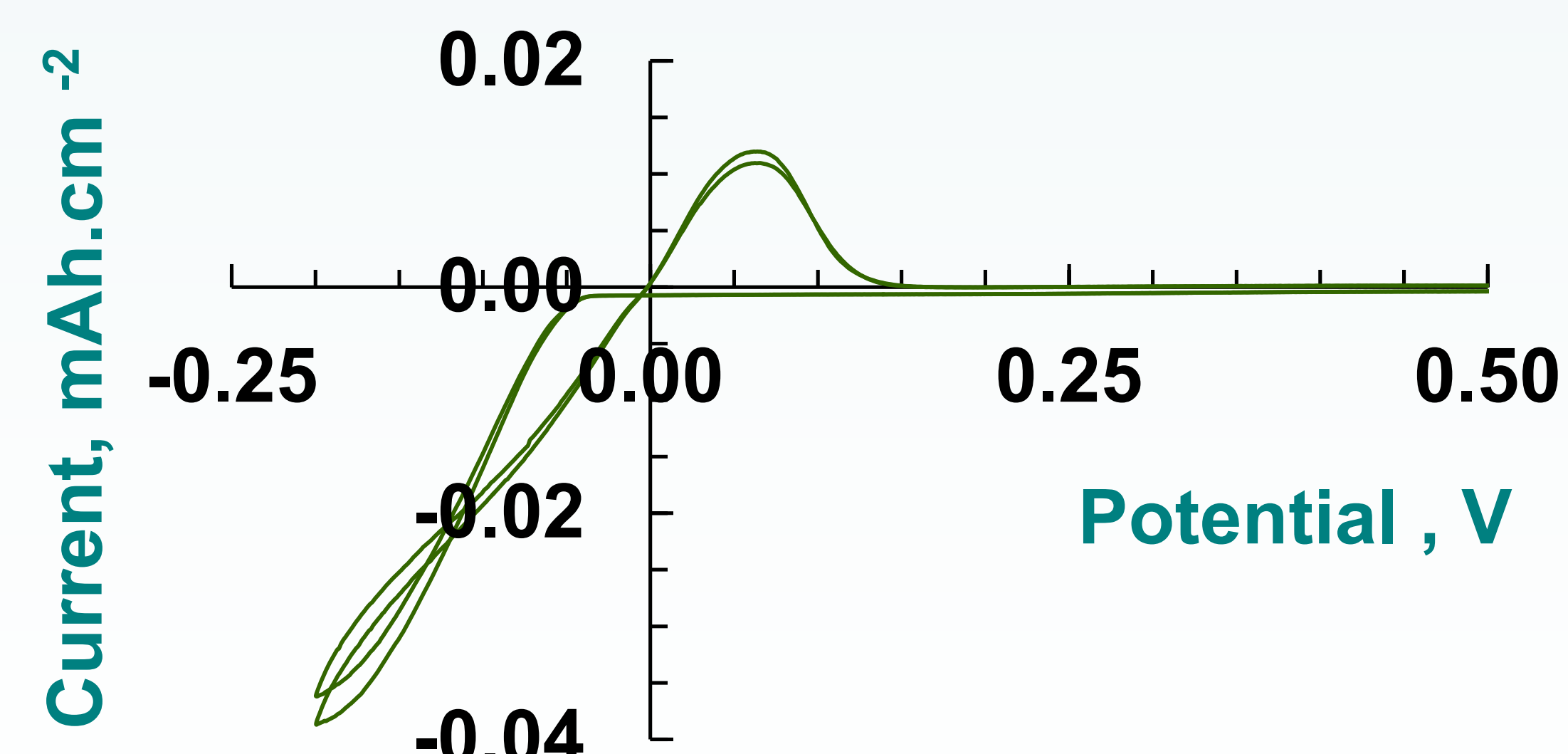


- *We evaluated graphene in Li-O₂ cells containing a typical liquid electrolyte*



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(CF₃SO₂)₂

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

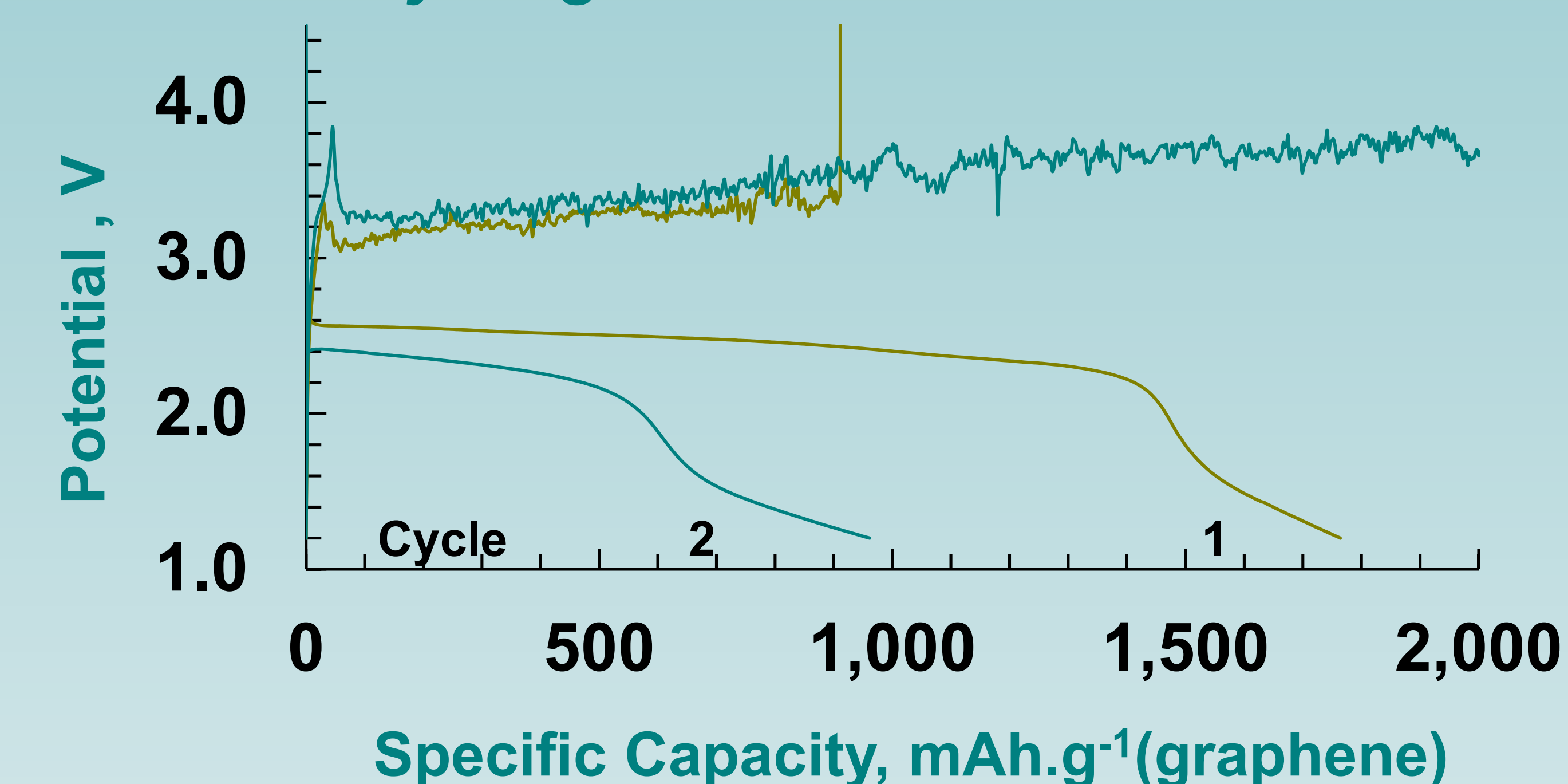


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Progress achieved (continued)

The electrode: Stainless steel flag. Active area: ~1 cm². Electrolyte: 4.0 mol% LiN(CF₃SO₂)₂ in succinonitrile

- *Rechargeability evaluation of Li-O₂ cells in the succinonitrile-based gel electrolyte is still in its early stages*



Future plans

- Continuing work on the rechargeability of Li-O₂ 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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