Investigation of Iron-and Organic-based Bipolar Redox Molecules for Non-aqueous Flow Batteries

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Scope of Project

Previous work has shown ferrocenylphthalimide (FcPI) to perform well in charge/discharge cycling using static H cells. However, in this work, FcPI is used as a single redox couple to further investigate its performance by employing it in a flow cell battery. This poster displays the results from various conditions of flow battery testing in an attempt to optimize or discredit its ability to perform under flow conditions. The variables tested are as follows:

- Electrolyte choice and concentration
- Membrane/separators selection
- Active species concentration
- Pump speed

Methods and Materials

- N-Ferrocenylphthalimide was synthesized via the reaction mechanism shown above
- Cyclic voltammetry and bulk electrolysis were performed using a BASI Epsilon potentiostat
- Galvanic cycling on flow batteries was performed using a Solartron 1287 potentiostat
- Flow batteries built using:
  - 2.5" nominal thickness carbon felt, plasma treated on each side
  - Teflon gaskets and copper current collectors
  - Naion 117 (pretreated w/ TBA-OH), Fumasep FAP 45, and Tonen membrane/separators
  - Peristaltic pumps with Norprene tubing and polypropylene reservoirs

Flow Battery Testing

Cycle Two Charge/Discharge Profile

Electrochemical Testing-CV and BE

Conclusions and Future Work

The FePI compound has been modified by inserting an α-methyl group between the ferroceny1 and the phthalimide moiety. This addition not only improves the solubility of the electroactive species in the TBAF4/DOL electrolyte, but it is also suspected to stabilize the compound as it undergoes electrochemical testing. Furthermore, another modification has been made to N-ferrocenylphthalimide compound that could provide yet another source of stabilization. These new compounds will be rigorously studied using the same techniques as described in this poster and will be presented at the MRS Fall meeting in Boston.