Nitrogen/Oxygen Battery
A Transformational Architecture for Large Scale Energy Storage

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N$_2$/O$_2$ Battery Project Overview

- Provide a low cost, environmentally benign electrochemical platform for load leveling and for grid-integrated storage of energy generated by wind, solar and other sustainable but variable sources.

Two Configurations:
2) Ambient Temp. Mediated Redox Flow Configuration.
Reversible Reduction of N₂ in Molten Salt

$$6\text{Li} + \text{N}_2 \rightarrow 2\text{Li}_3\text{N} + 2\text{BN} \rightarrow 2[-\text{Li}-\text{N}-\text{B}-\text{N}^- + 2\text{Li}^+] = 2\text{Li}_3\text{BN}_2$$

+6e⁻↑ reduction

6Li⁺

-6e⁻↓ oxidation

6Li⁺ + N₂ + 2BN

The dinitridoborate anion (BN₂)₃⁻ can be viewed as N³⁻ absorbed to a neutral diatomic BN molecule*

Nemeth, [cond-mat.mtrl-sci] 1 Apr 2014
Ambient Temp. Reduction of N\textsubscript{2}. Redox Flow Configuration

![Diagram of redox flow configuration](image)

Zeolite

Ch. Baerlocher and L.B. McCusker, Database of Zeolite Structures
http://www.iza-structure.org/databases/
Summary/Conclusions

*We have achieved the high rate charge/discharge of the $\text{N}_2/\text{N}_3^-$ anode at 550 C by using $\text{Li}_3\text{BN}_2$ mediator. However materials problems inhibit further development of the $\text{N}_2/\text{O}_2$ battery at this temperature.

*We have achieved $\text{N}_2$ reduction at ambient temperature using a radical anion mediator inside a zeolite catalyst and on $\text{C}_3\text{N}_4$. Reaction rate is slow and product yield is low. Reversibility not yet tested.

*Investigations of high energy mediators have yielded spinoff technologies:


Membrane Separator for Redox Flow Batteries that Utilize Anion Radical Mediators, Technical Advance SD13270

Catalyst for Nitrogen Reduction at Ambient Conditions, F. Delnick, C. Liang, G. Veith, C. Narula, Provisional Patent SD-13272.0/S 136369
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