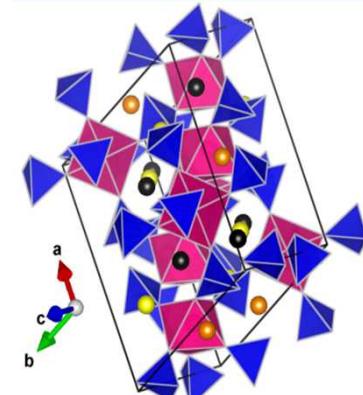
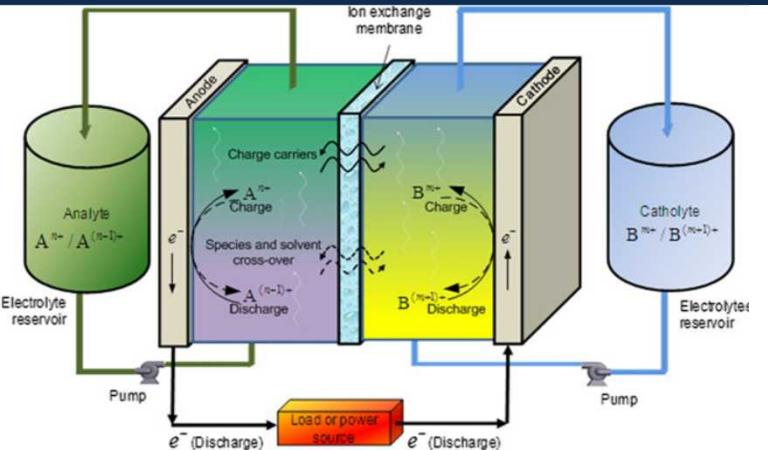


Exceptional service in the national interest



Aqueous Na-ion Redox Flow Battery with Ceramic NaSICON Membrane

September 2016

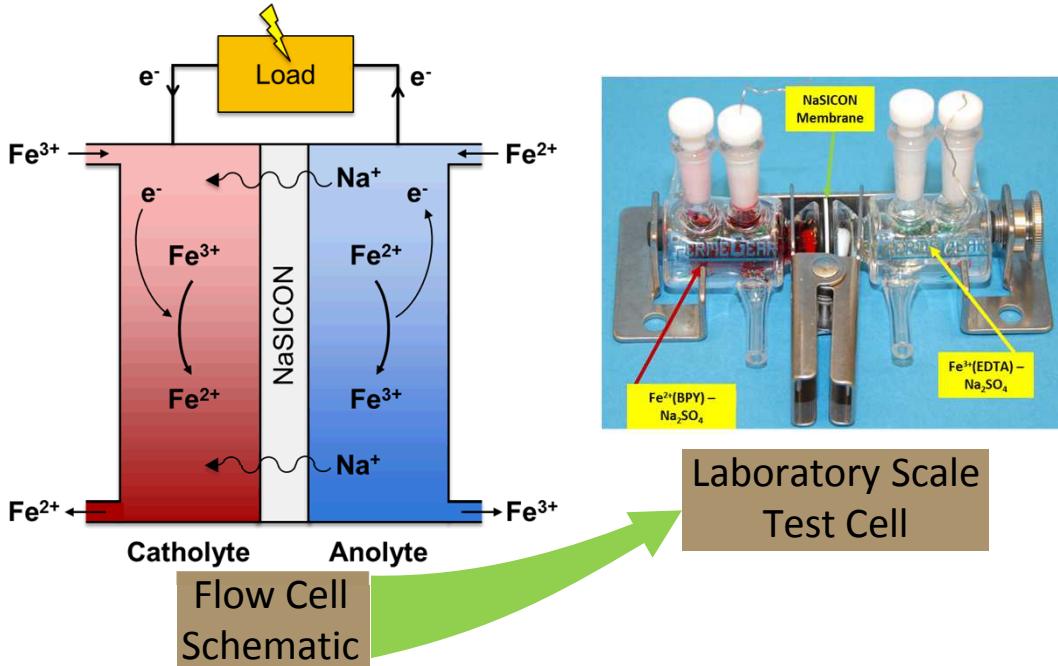
Eric Allcorn, Ganesan Nagasubramanian and David Ingersoll



Sandia National Laboratories is a multi-mission laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND NO. 2011-XXXX

Motivation: Use of a non-porous ceramic ion-exchange membrane eliminates species/solvent cross-over

- Improved cell life and efficiency
- Flexibility of separate supporting electrolyte media for anolyte / catholyte



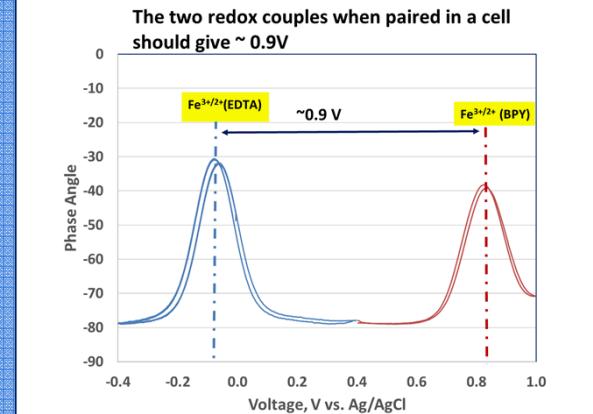
NaSICON Ceramic

- High Na-ion conductivity enables operation with low polarization
- Water compatibility allows for development of safe, inexpensive, non-corrosive, environmentally friendly aqueous redox couples
- Good mechanical, thermal, electrochemical stability

*Acknowledgement to the financial support of Dr. Imre Gyuk and the DOE Office of Electricity Delivery and Reliability

Proof of concept

Redox couples of chelated transition metal complexes ferric-EDTA and ferrous-bipyridyl



Full cell utilizing NaSICON membrane shows ~100mV polarization relative to theoretical voltage based on material CVs

Full Cell CV @ 5 mV/sec
 $\text{Fe}^{3+}(\text{EDTA}) // \text{NaSICON} // \text{Fe}^{2+}(\text{BPY})$
 $0.4\text{M Na}_2\text{SO}_4$

