HEAT AND MASS TRANSPORT GROUP

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DEPARTMENT OF Engineering Physics
UNIVERSITY OF WISCONSIN–MADISON

MOLTEN FLUORIDE SALTS FOR THERMAL AND FAST SPECTRUM REACTORS: FHRs, MSRs, AND FUSION SYSTEMS

1. Salt Experimental Work
   - Salt preparation and characterization
   - Phase diagram, density, contact angle, viscosity, optical properties
   - Electrochemistry, graphite H-transport
2. Related Modeling Work
   - Solidification and tritium transport
   - TH coupling to mass transport

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NSUF/GAIN Nuclear Thermal-Hydraulics Workshop
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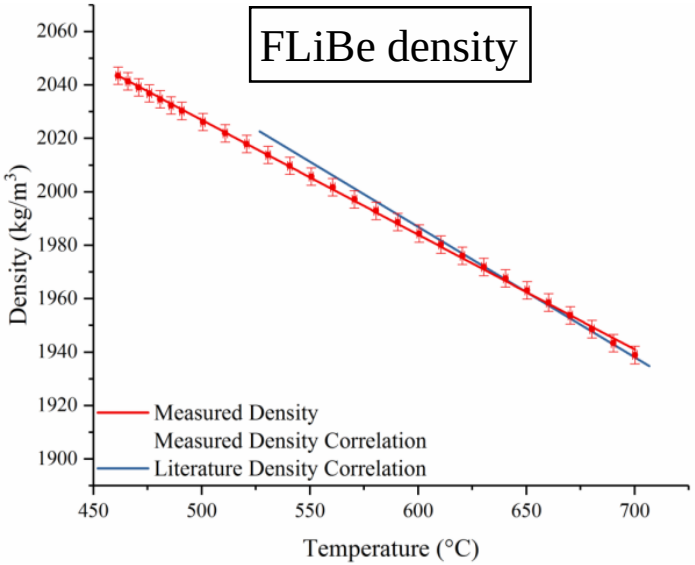
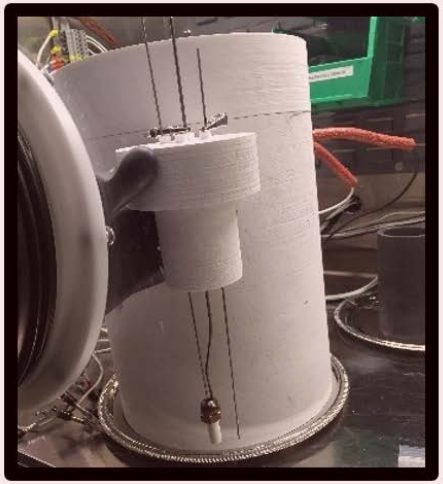
Idaho National Laboratory

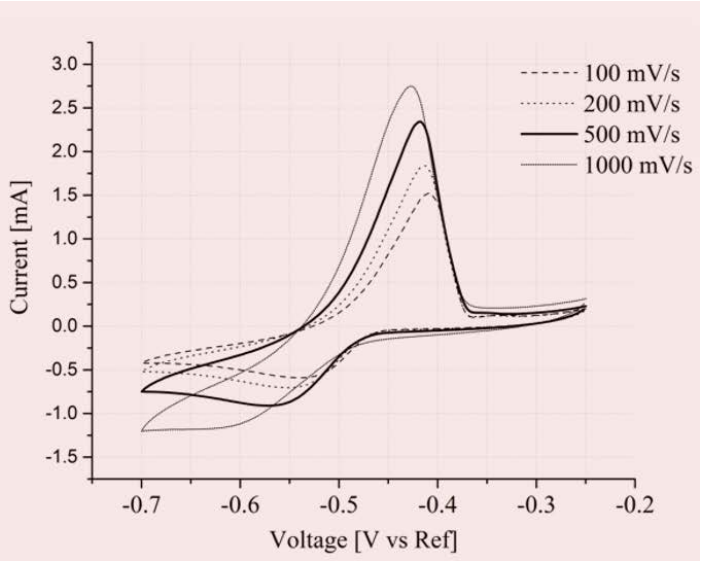
Current Facilities

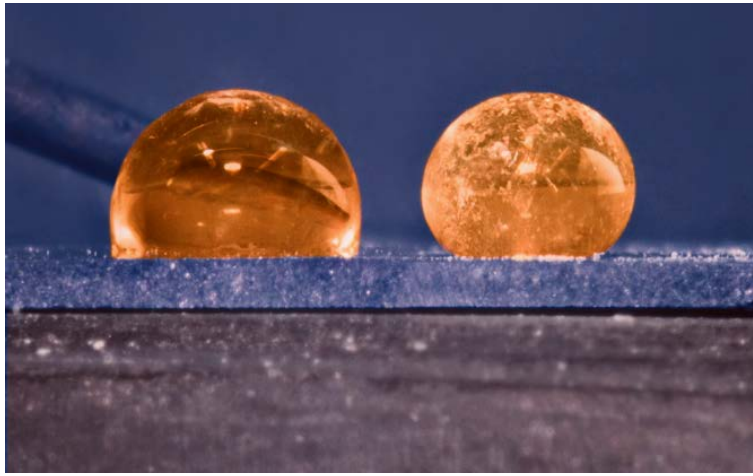
Heat and mass transport studies in fluoride salts for FHR, MSR, and fusion blankets

1. Salt preparation and characterization: DSC, ICP-MS, ICP-OES, XRD, XPS
2. Liquid density (FLiBe run shown on right)
3. Contact angle measurement (two droplets)
4. Solidification studies: salt freezing experiment in stationary spherical geometry
5. SAM for system thermal hydraulics: salt natural circulation transient analysis
6. Electrochemical probe: cyclic voltammetry (below)





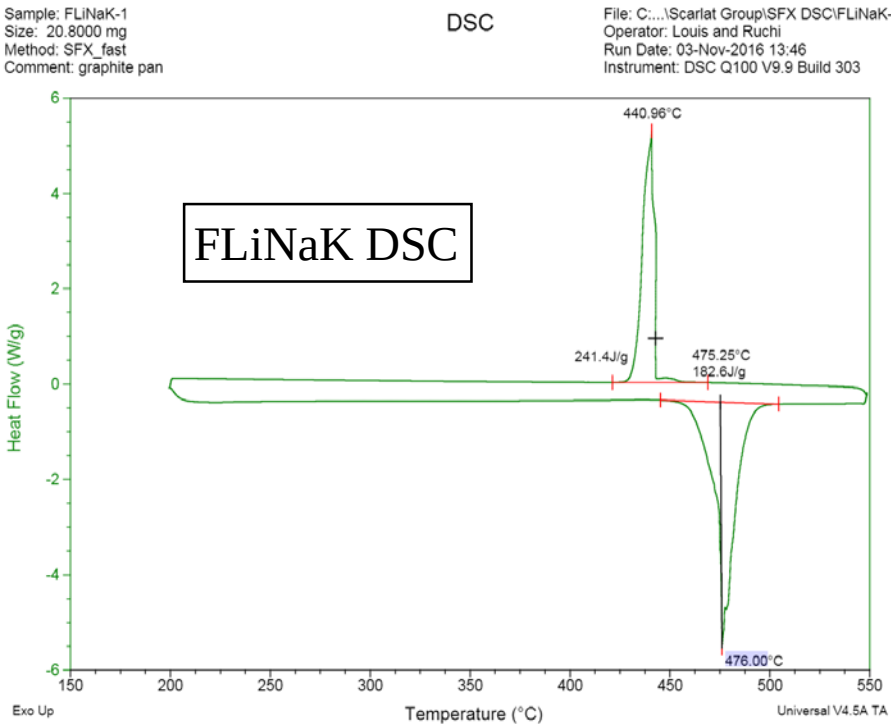


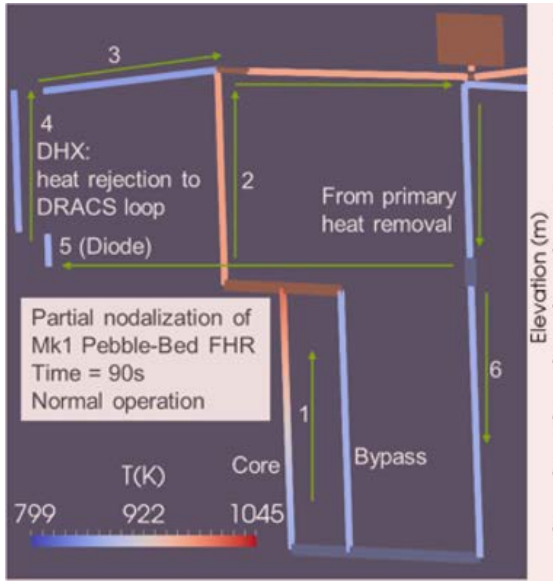


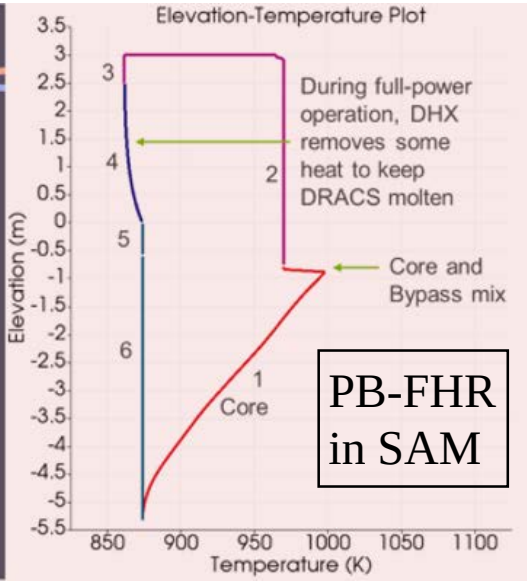
Ongoing/Previous Work

1. Melting point and density of KF-ZrF4 melts (with Terrestrial Energy)
2. IR characterization and radiative heat transport (NEUP 2017)
3. Electrochemical/Optical Sensors (NEUP IRP 2017)
4. Solidification (NEUP 2016)
5. Electrochemistry and tritium transport (NEUP 2015)
6. Salt-graphite interaction, and tritium uptake in graphite (NEUP 2014 IRP)

All projects under QA plan guidelines specified by DOE/NEUP, modeled after applicable parts of NQA-1





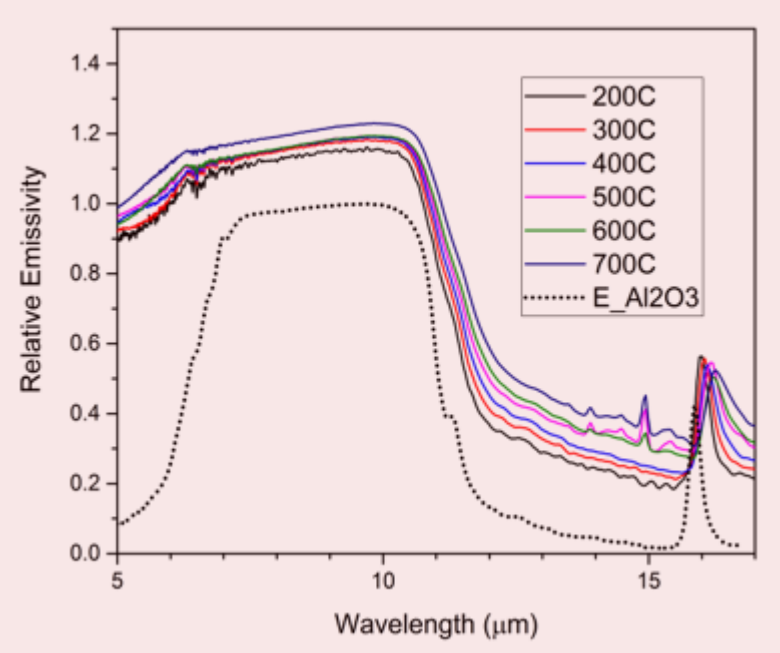


Future Planned Work

- High throughput experimentation for salt characterization and property measurements

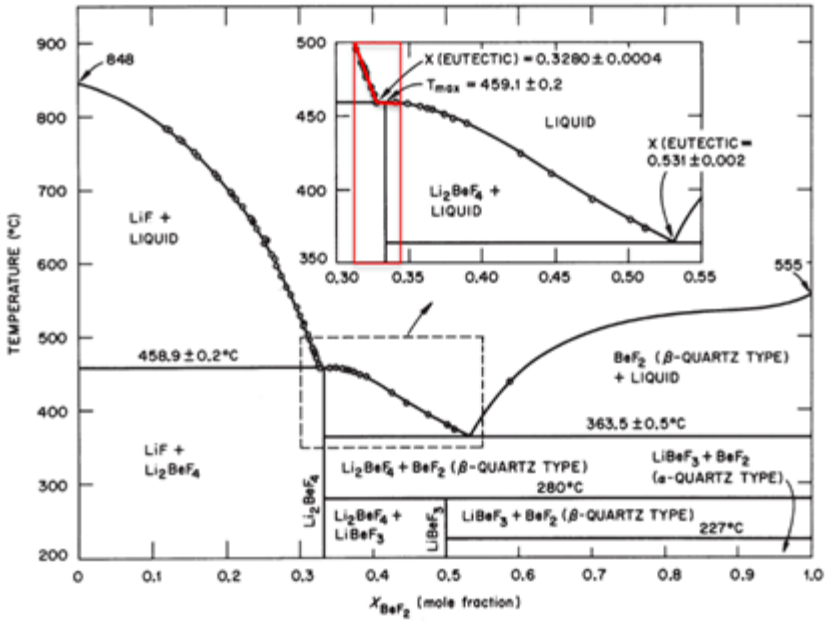
- Liquid viscosity
  - Project to start Fall 2017

- Radiative heat transfer studies
  - Project to start Fall 2017



Post Density Measurement FLiBe ICP-MS analysis results

Quantity	Li (Li-7)	Be (Be-9)	Other Metals
Mass (μg/g)	147764±2387	91750±4236	1130.90
Metal Mass (%)	61.40±0.99	38.13±1.76	0.47
Mol (%)	67.43±1.09	32.57±1.50	-



FLiBe ICP-MS results on phase diagram

- Optical characterization: currently developing measurements in the infrared

Access as a User Facility

- Some UW labs are included in NSUF
- The Heat and Mass Transport lab at UW-Madison could be accessed by adding it to the suite of facilities already included at the UW partner facility
- Our facilities can be used by 1) funding a research project in our group and 2) through a fee-for-service contract for specific data collection