An Update on the Round Robin for Molten Salt Chemical and Thermal Properties Characterization

Organizers: University of California, Berkeley; University of South Carolina; Oak Ridge National Laboratory
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Team: Sara Mastromarino (UC Berkeley); Christian Sclafani (UC Berkeley)

Introduction:

Under the informal umbrella of the **Molten Salt Thermal Properties Working Group (MSTPWG)** Oak Ridge National Laboratory (ORNL) UC Berkeley, and the University of South Carolina are organizing a **Round Robin on Chemical and Thermal Property Characterization of Molten Salts. The goal of** this round robin 1.0 is to have the properties of a set of two salt compositions (FLiNaK and ~50% NaCl-KCl) measured by different groups, using their standard techniques. The results for each property will be inter-compared to understand the ability to reproduce measurements, appropriateness of techniques and possible sources of error.

Communication:

This round robin focuses on creating a research community within which best practices can be shared. For example, discussion channels are created through the slack platform, as shown in Fig. 1 below, and blind-blind peer review of procedures are facilitated by the organizers.

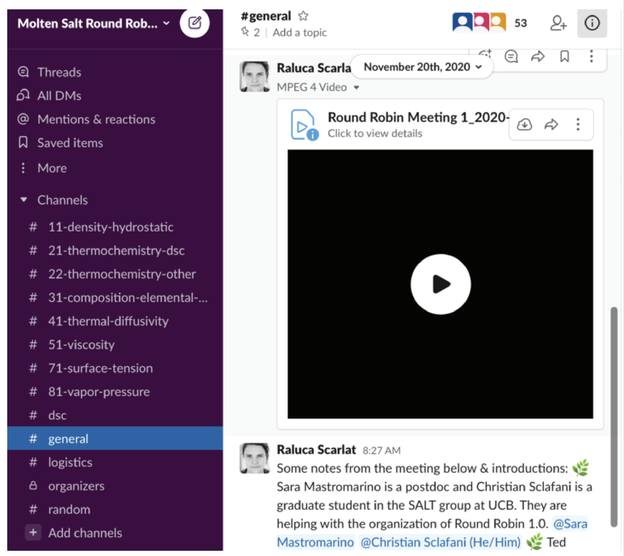


Figure 1. Illustration of slack channel communications. Discussion channels for each property measurement can be seen in this image.

Timeline:

- **Nov. '20 – Dec. '20**
  - Organizational Meetings
  - Salt Preparation
- **Jan. '21 – Mar. '21**
  - Procedure Collection
  - Procedure Peer Review
  - Salt Sample Distribution
- **Apr. '21 – Jun. '21**
  - Experimentation
  - Data Comparison
  - Round Robin 1.0 Report Publication

Objectives:

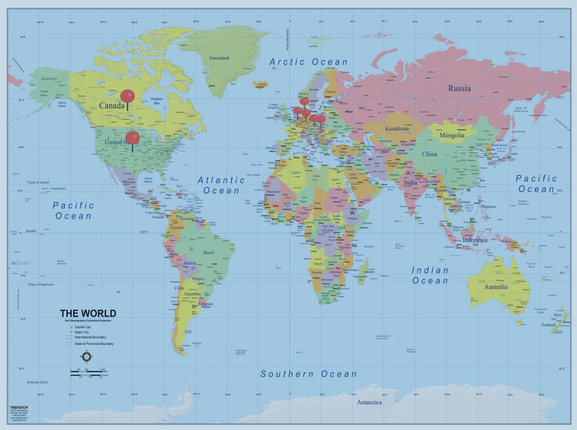
We hope the Molten Salt Round Robin 1.0 will lead to: (1) The development of standard procedures, (2) the generation of calibration standards, (3) uncertaintity quantification, including: identification of error sources, identification of measurement technique limitations, and demonstration of reproducibility, (4) verification of properties (for the samples being measured) and (5) the sharing of best prac-

Table 1. Summary of properties and measurement techniques. Table 1 shows a summary of the properties, techniques, and number of participants making these measurements.

Property Measurement	Measurement Method	Number of Participants
Density	Hydrostatic	7
	Displacement	1
	Pump Probe Spectroscopy	1
Elemental Composition/ Identification	ICP-MS/OES	5
	LECO	1
	LIBS	2
	Electrochemistry	2
Thermochemistry	Calorimetry	14
	Electrochemistry	2
	High Temp XRD	1
Thermal Conductivity	Laser Flash	3
	Pump Probe Spectroscopy	1
	Hot Wire	2
	Variable Gap	1
Viscosity	Falling Ball	2
	Rotational/ Torsional	4
	Pump Probe Spectroscopy	1
	Capillary Rise	1
Vapor Pressure	Knudsen Cell	1
	Pump Probe Spectroscopy	1
Surface Tension	Sessile Drop	2
	Maximum Bubble Pressure	1
	Pump Probe Spectroscopy	1
Others	Speed of Sound	1
	Electrical Conductivity	1

Participants:

There are a total of 22 organizations, from 7 countries, collaborating together in this round robin effort. Of these 22 organizations, 14 are located in the United States of America, 3 in Canada, 1 in Germany, 1 in the Czech Republic, 1 in the Netherlands, 1 in Denmark, and 1 in Slovakia.



THE SALT RESEARCH GROUP
Berkeley UNIVERSITY OF CALIFORNIA Nuclear Engineering
https://SALT.NUC.berkeley.edu

Logistics:

1. ORNL provides **100g batches** of purified FLiNaK and purified NaCl-KCl. Samples are stored, see Fig. 2 below, and distributed by UC Berkeley, as sealed and packaged by ORNL.

2. Participating institutions/ groups are welcome to make measurements on **either or both salt mixtures**, and on **as many of the different properties as they wish**. End of life disposal of the samples are assured by the participants which receive the samples.

3. Participants are provided a **participant identification number** by UC Berkeley and all public disclosure of measurements are ascribed to said identification number, for said institution. This allows for the open distribution of measurement results, without identifying the institution where the work was performed. This safeguard is employed so as to not unnecessarily point out groups who's results do not seem to conform with those of the others. This does not prevent representatives of the institutions from publicy identifying themselves.

4. The results of the round robin testing are statistically analyzed by the organizers of the round robin. An **ORNL report** is developed and provided to all participants and other interested parties. It is hoped this work will also result in one or more **journal articles** on various related subjects, co-authored by all participants.

5. Other possible **products**: reference salt materials, standard methods, and a **Round Robin 2.0.**

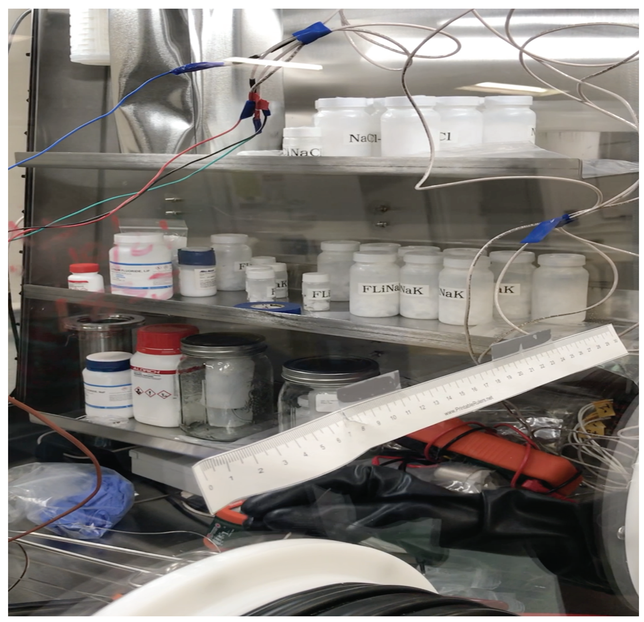


Figure 2. Salt Samples stored under inert gas within a glovebox at UC Berkeley. It is important to store the samples in an inert environment to maintain their original, as shipped from ORNL, purity.