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Real-Time Characterization of Salt Aerosol Particles

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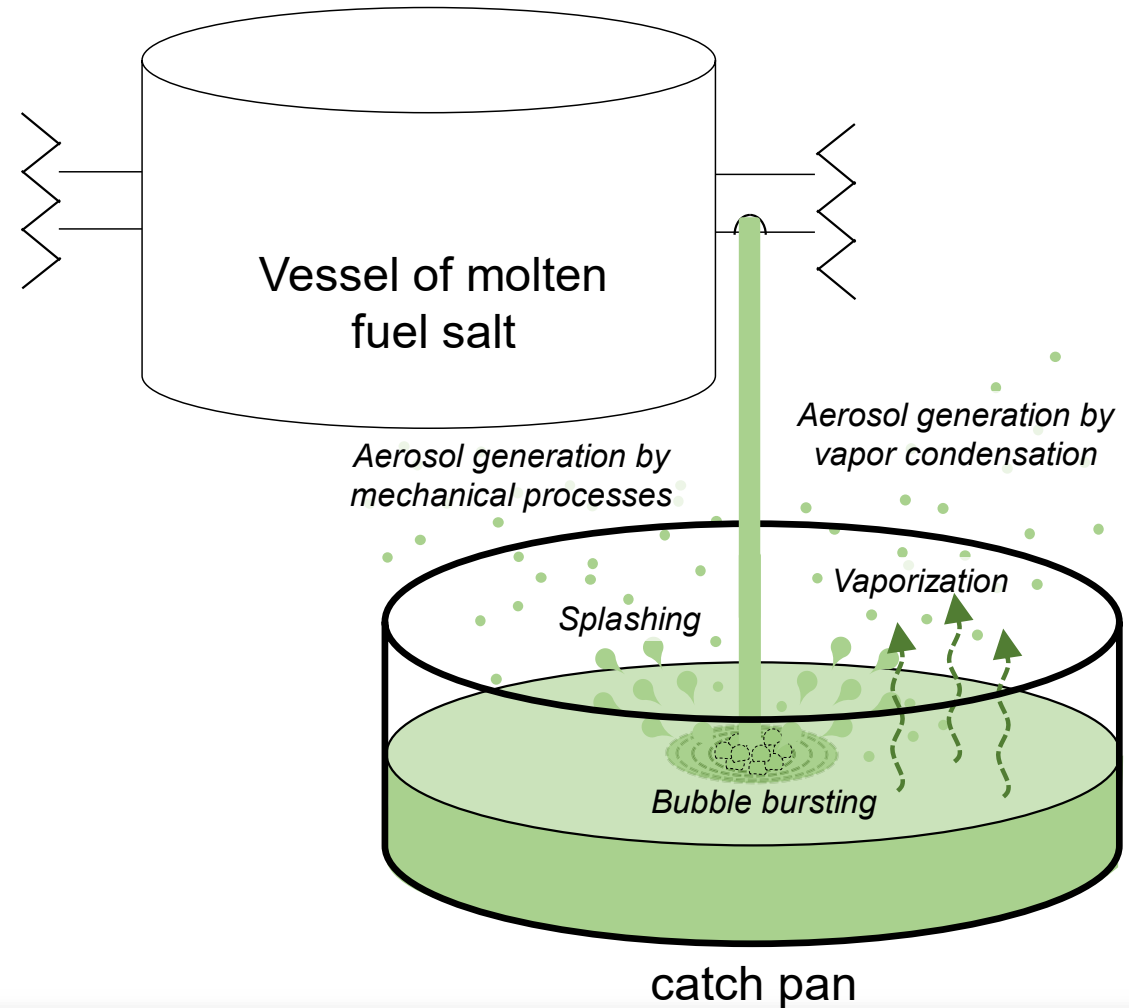
2024 Molten Salt Reactor Workshop

5 November 2024

Safety assessments for MSR licensing

- Credible accident scenarios (e.g., fuel salt spill) are evaluated using validated models that simulate accident progression
- Model development and validation require experimental data on processes likely to affect safety outcomes
- Formation of radionuclide-bearing aerosols is particularly important to accident consequence
- Significant data gaps on aerosol formation mechanisms from molten salt systems

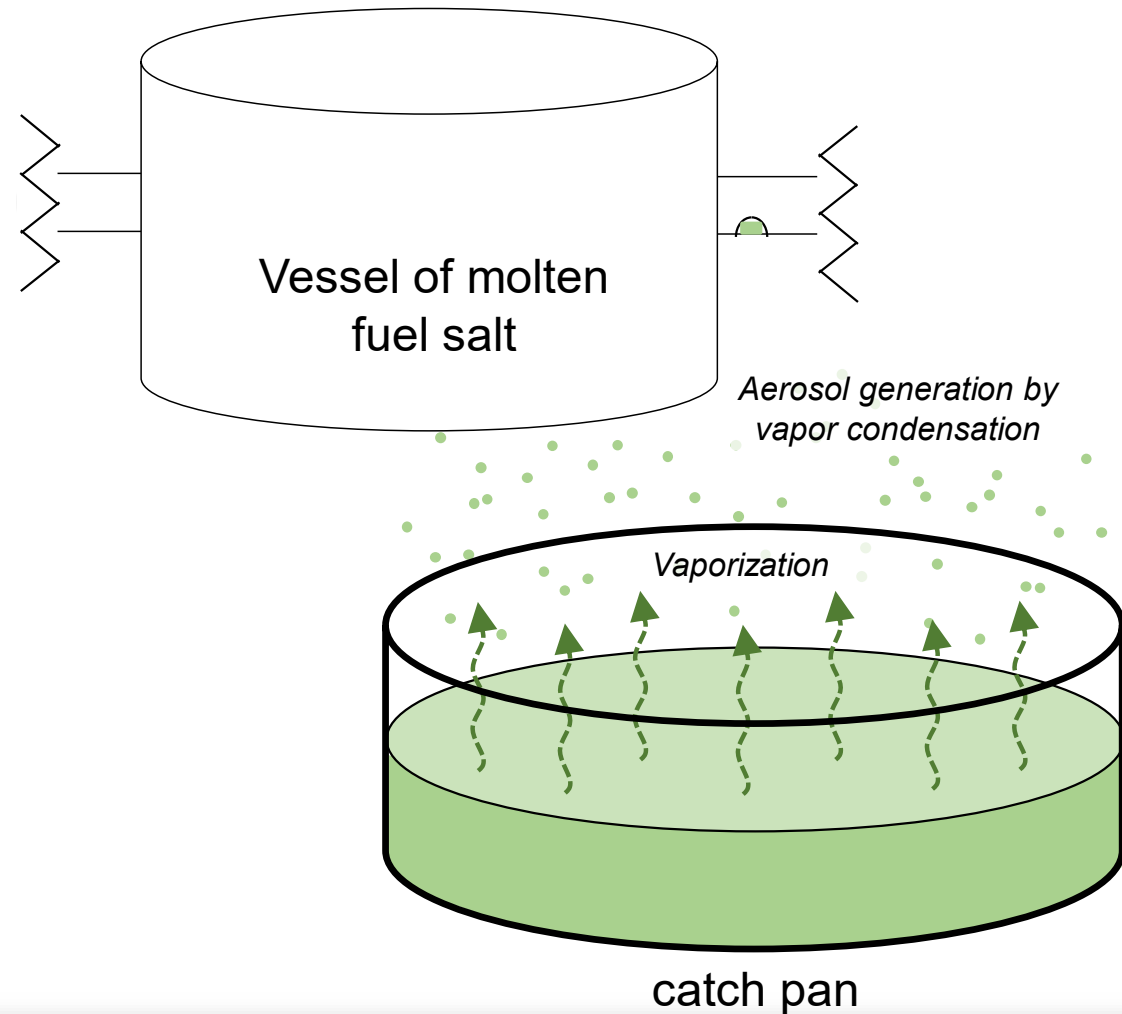
Relevant aerosol formation processes during fuel salt spill accident



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Relevant aerosol formation processes after fuel salt spill accident



Salt aerosol generation and real-time characterization

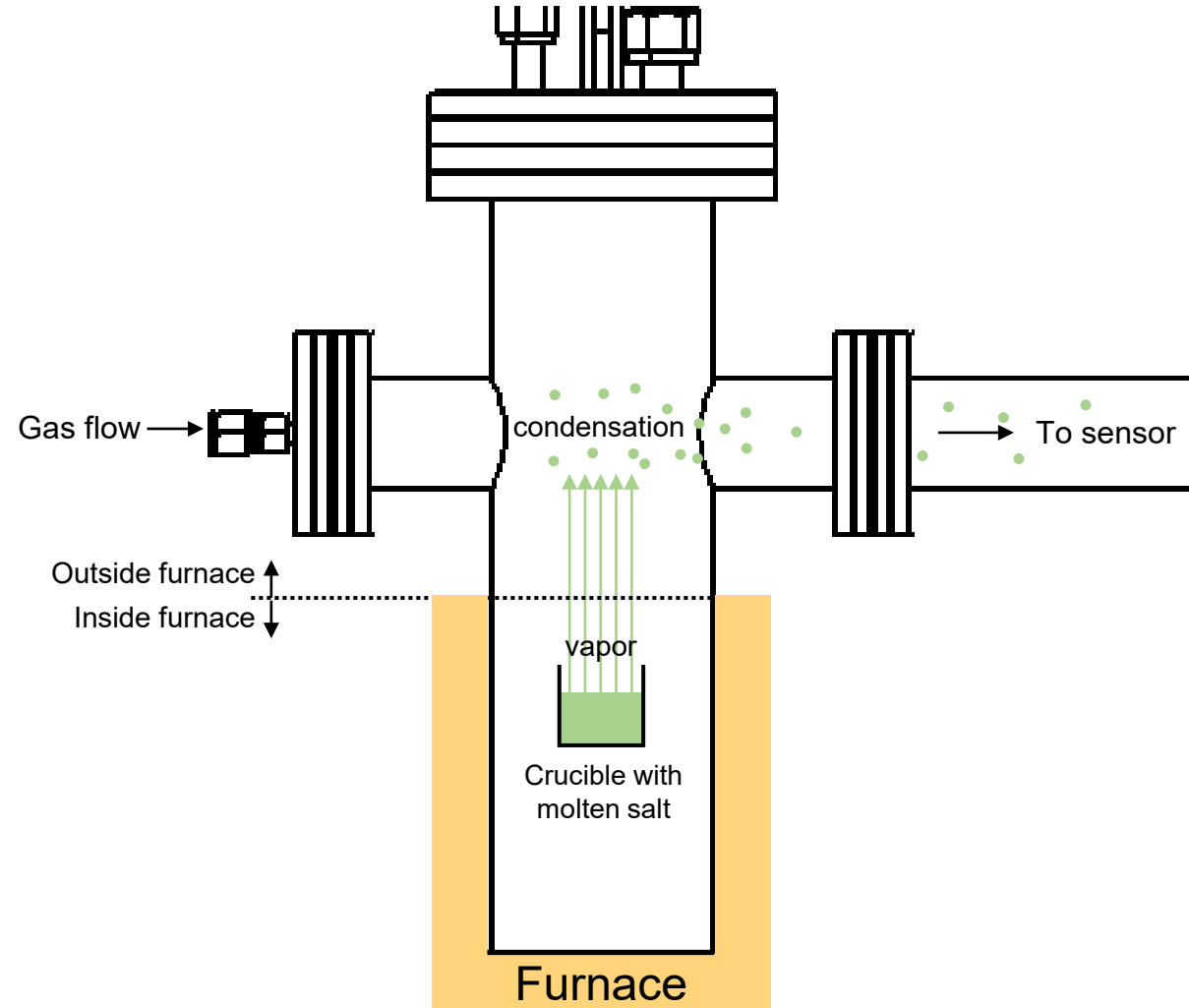
Objective: Develop and demonstrate method for measuring salt aerosol particle size and concentration in real time

- Generate salt aerosol particles by condensing salt vapor in a cool gas stream
- Use optical light scattering spectrometer manufactured by Palas to characterize generated salt particles
- Demonstrate with cesium iodide salt

Challenges:

- Sensor compatibility with corrosive and high temperature gas streams
- Maintaining measurement accuracy when gas composition and temperature change

Schematic of salt aerosol generation system



Salt aerosol generation and real-time characterization

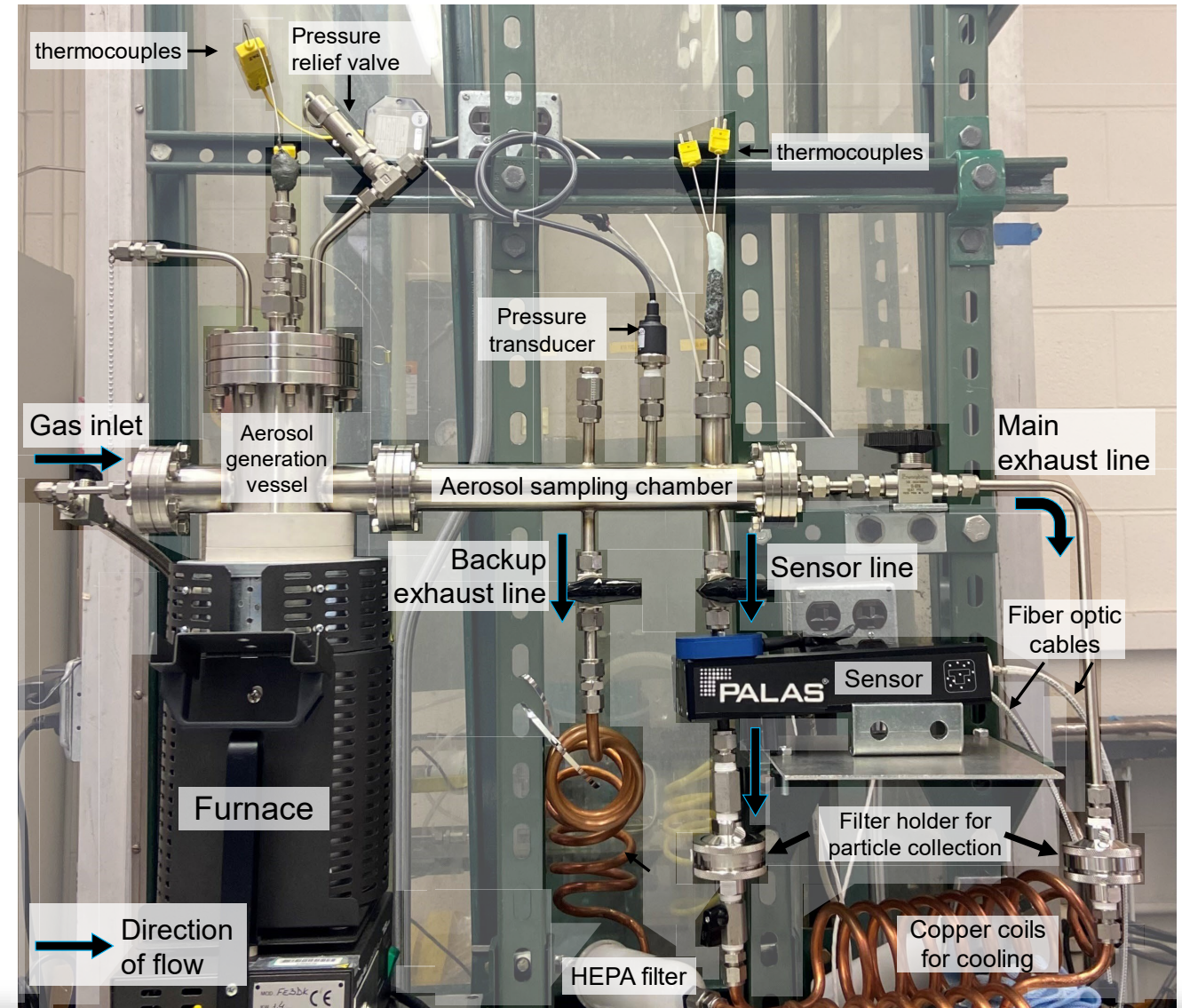
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Argonne salt aerosol generation and measurement system

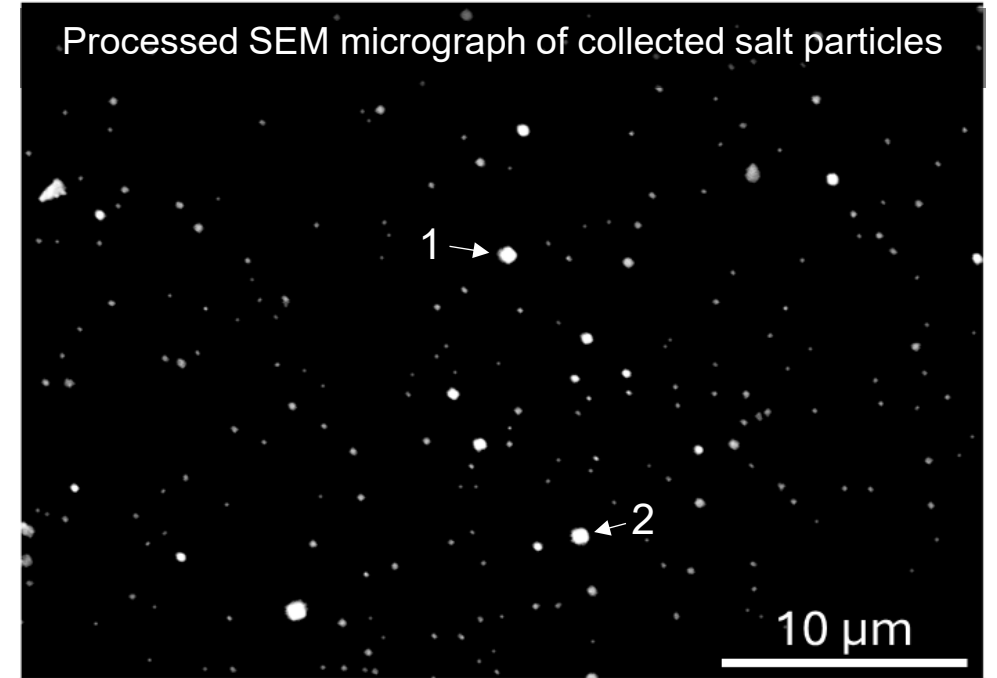
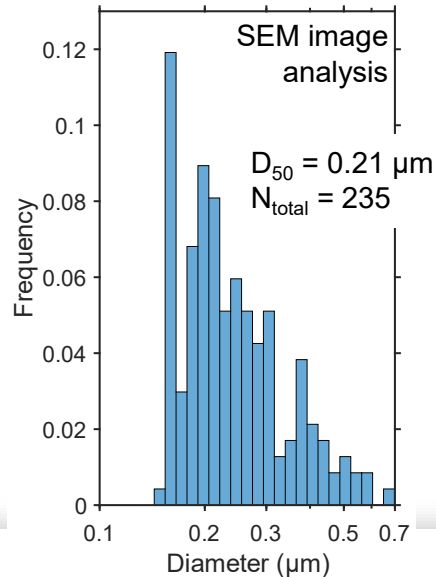
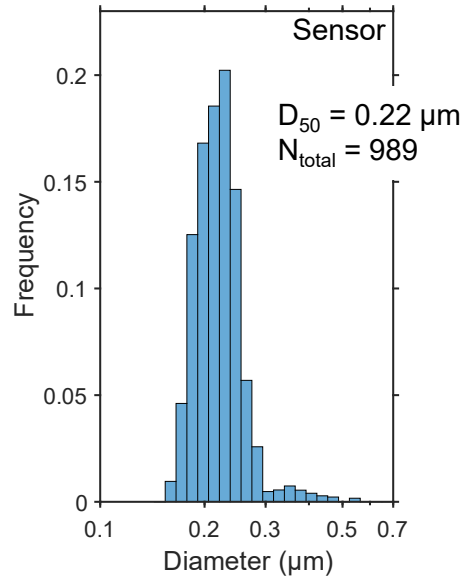


Demonstration of sensor accuracy

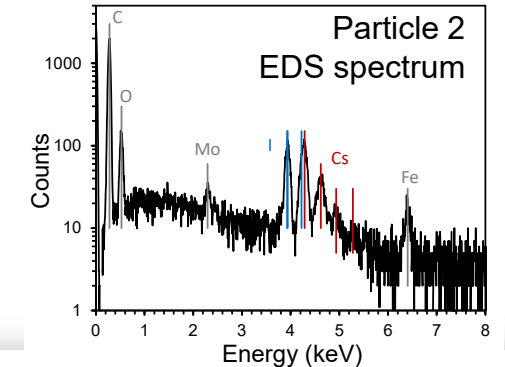
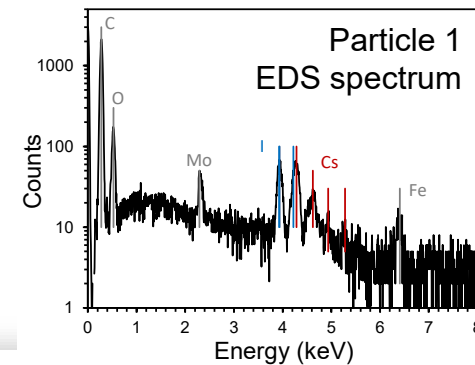
Concentration and size accuracy demonstrated by comparing sensor results to those obtained by independent methods

- Independent particle concentration determined gravimetrically by weighing particles collected on filter
- Independent particle size distribution measurement made by SEM-EDS analyses of particles collected on adhesive

Particle size distributions



Individual particle composition



Future work on real-time aerosol characterization

- Conduct separate effects tests on aerosol formation to generate experimental data that can be used to parameterize process models
 - Static versus sparged salt
 - Salt and gas composition and temperature
 - Presence of humidity and oxygen in atmosphere
- Employ real-time aerosol characterization method in engineering scale tests that simulate salt spill accidents

Demonstration of gas sparger in water



Report: Thomas, Sara (2024) “Method for Real-Time Salt Aerosol Concentration and Size Measurements for Molten Salt Reactor Safety Assessments.” Argonne National Laboratory Report ANL/CFCT-24/25.

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