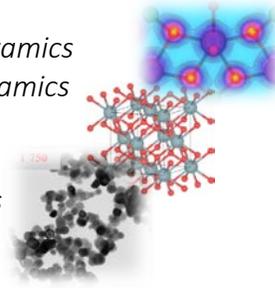


Studying Thermodynamics and structures of f-block condensed matters

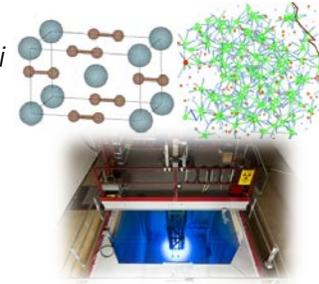
Ln/An material/minerals

- REE minerals/ceramics
- High entropy ceramics
- Silicate minerals
- An oxalates
- Pu-bearing solids



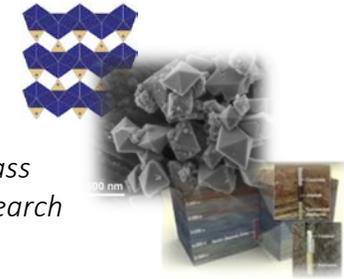
Alternative nuclear fuels

- U-C, U-N, U-Si
- PuO_{2+x}
- CeO_2
- UO_2
- Cladding
- Molten salts



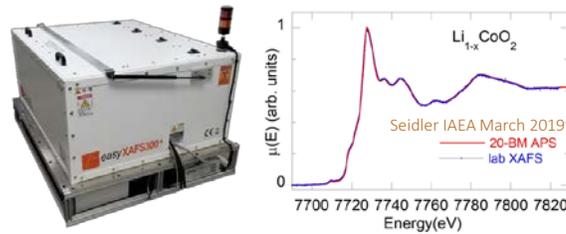
Nuclear waste forms

- An silicates
- An phosphates
- U Pyrochlore
- Ceramics & Glass
- Repository research



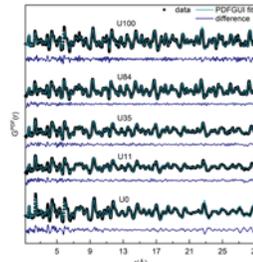
Lab capability I: in situ Structural studies (wide ranges of P-T)

Lab-based light source (XAS)

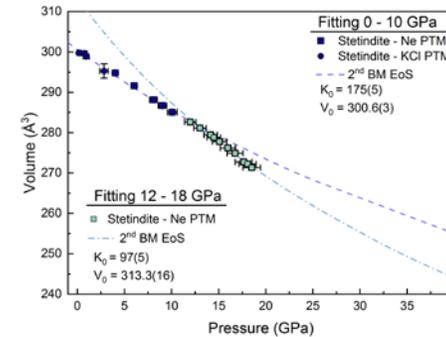
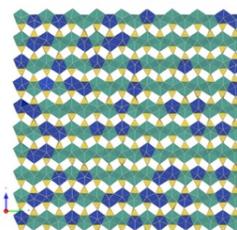


Funded by DOE NEUP GSI, commissioned in 2021

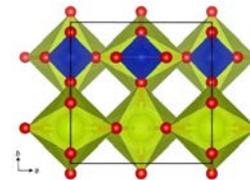
- Reasonable XANES/XAFS and great XES for transitional metals, REE, and actinides (Th, U, Np, and Pu) for chemical states and local structures.



Neutron PDF determines atomistic model of An silicate solid solution



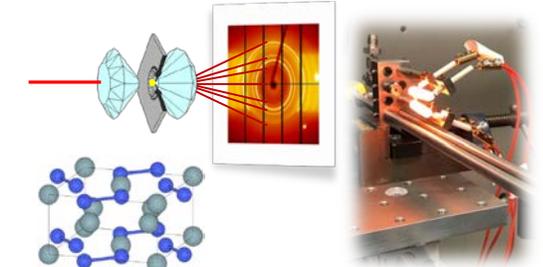
EOS and high P structures of silicate minerals ($CeSiO_4$) and U-Si intermetallic



Synchrotron-based X-ray scattering and absorption

For structure from Å to micron

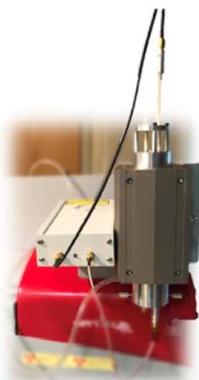
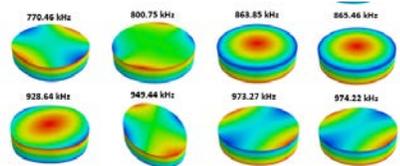
- Pair distribution function
- X-ray diffraction
- XANES and XAFS
- In situ capability (high T and P)



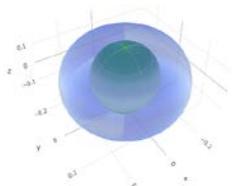
Lab capability II:

Elastic Characterization (RT – 800 C)

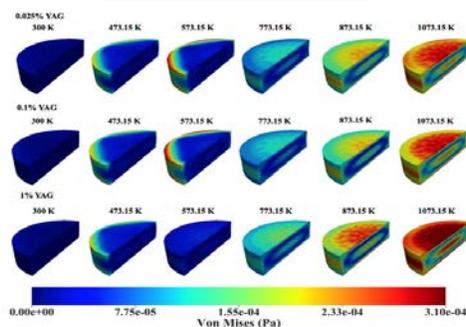
High T Resonant Ultrasonic Spectroscopy



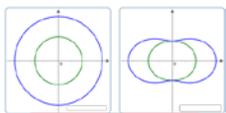
- Elastic behavior up to **800 C**
- Bulk, Shear, Young's Moduli and Poisson's ratio



Thermal stress distribution of a laser emitter Ce:YAG



Poisson's ratio

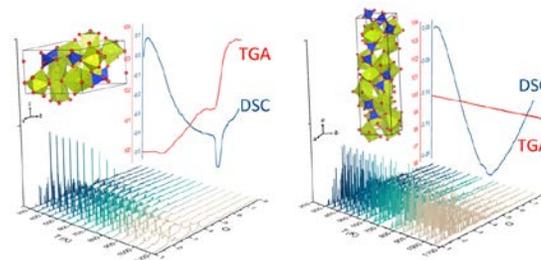


- C_p , Grüneisen parameter, Debye temperature
- Mechanical performance at high temperature
- Help evaluate thermal stress

Lab capability III:

High Temperature Thermodynamic Analysis (RT – 2400 C)

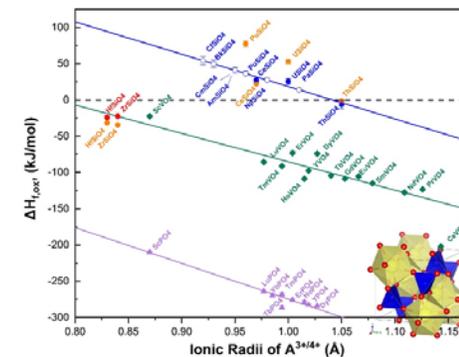
High T Differential Scanning Calorimetry – Thermogravimetric Analysis



- For thermal stability
- Phase transition
 - Thermal stability
 - TGA up to **2400 C**

Application in aerospace thermal coating material stability study

Drop solution Calvet calorimetry



For thermodynamic stability

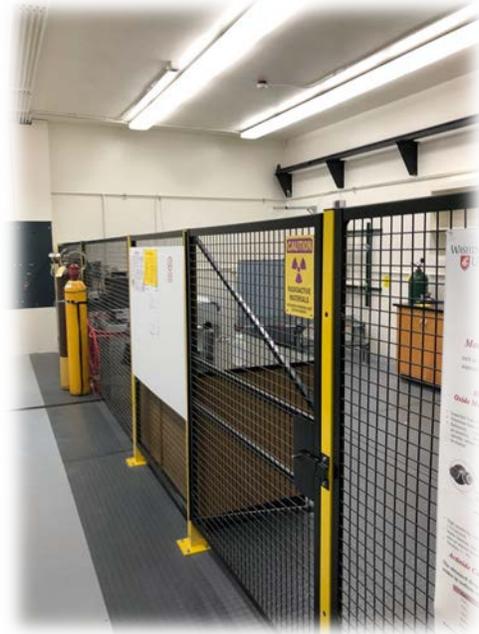
- Heats of formation, ΔH_f
- Heats of mixing, ΔH_{mix}
- Heats of reaction (500 – 1000 C)

Energetic landscape of waste form ABO_4 (zircon structure)

Calorimetry Lab at WSU

Basement lab (B21), located in a Nuclear Reactor building

- Temperature fluctuation < 0.5 °C
- Equipped with a rad glove-box for handling Pu (powder processing and pelletizing)
- Large quantity of ^{232}Th , ^{238}U ;
- Moderate amounts of Np, Pu, (Am, Cm, Cf and other transuranium) (~ 100 Ci/yr)



Fence gated



Lab inside