

Radiation & Radioactive Materials Research

Materials Deformation

Dr. Pamela Burnley

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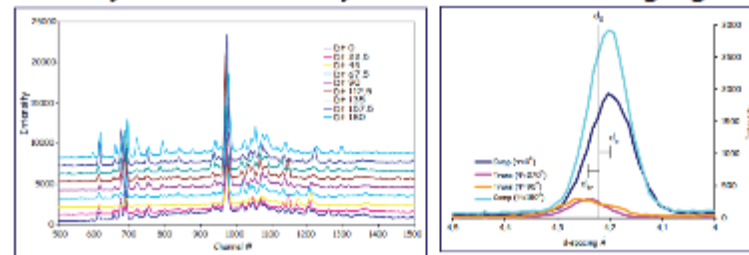
Expertise:

High Pressure Rock Deformation

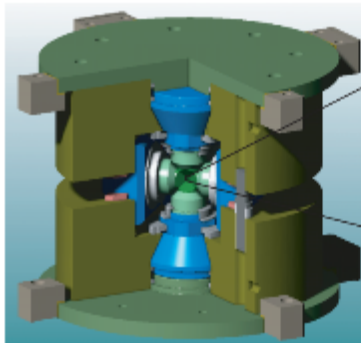
High Pressure studies of Deformation and the Acoustoelastic effect



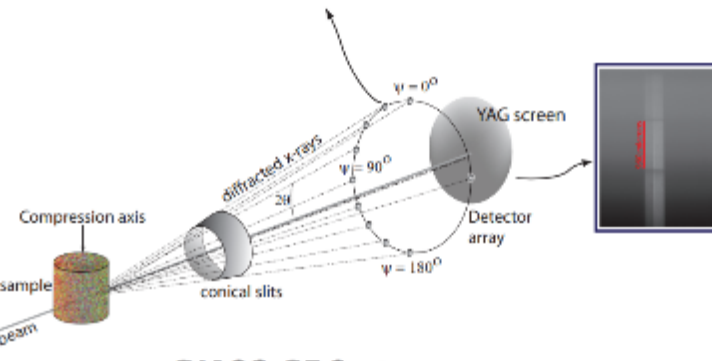
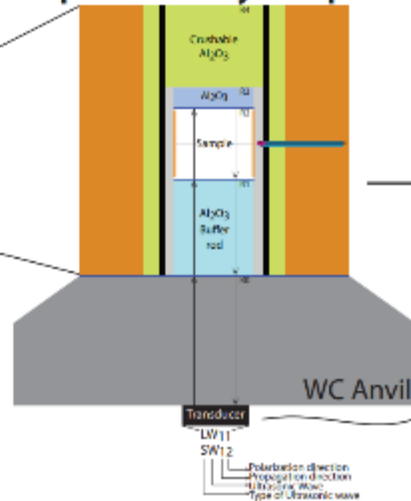
Synchrotron X-ray diffraction and imaging



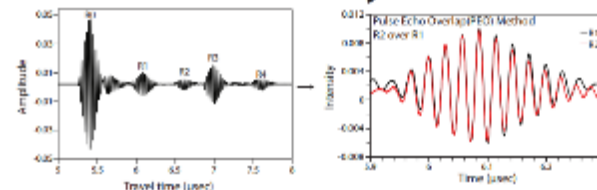
D-DIA module



Ultrasonic D-DIA Modified Sample Assembly Components



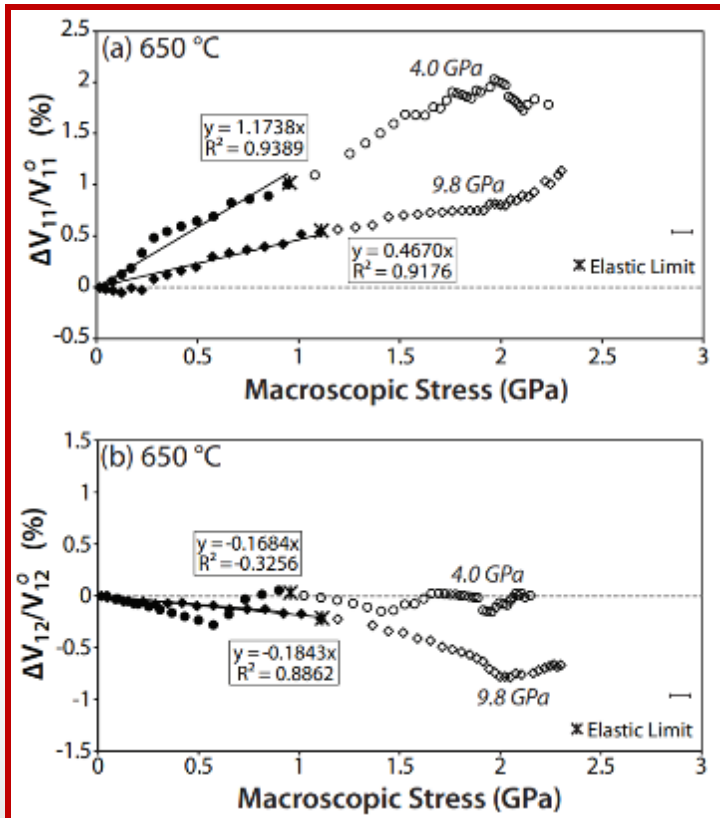
DIASCOPE System



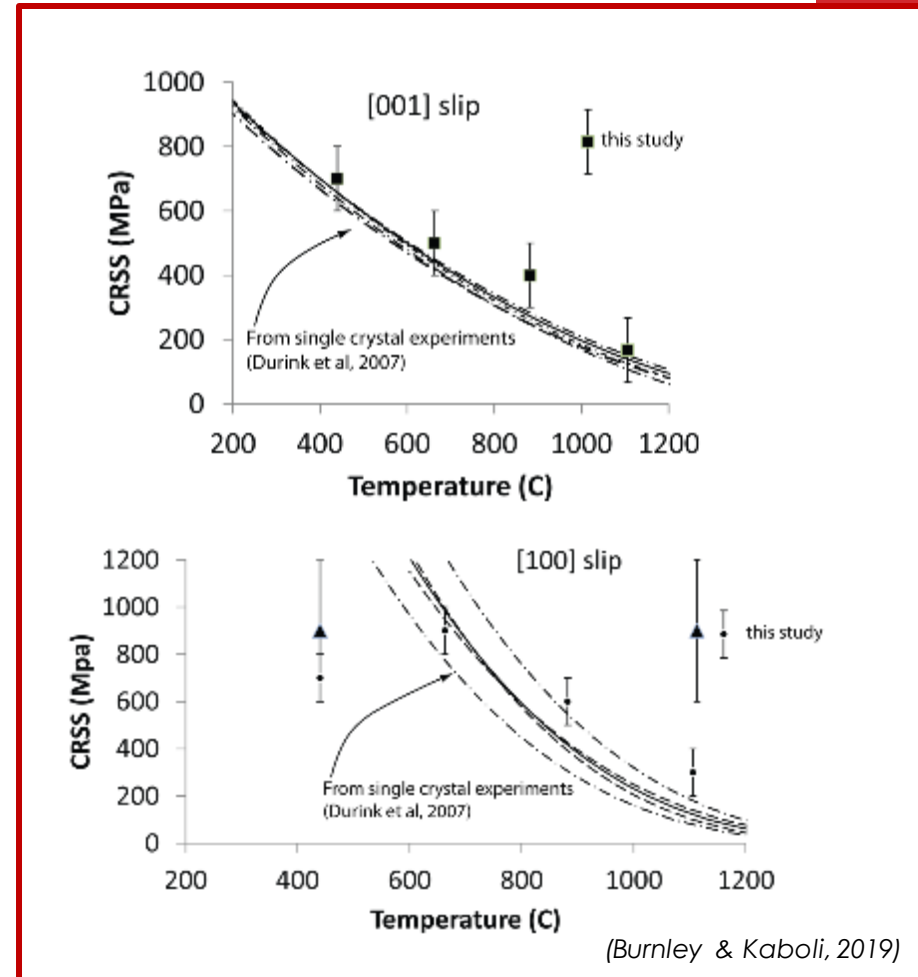
High Pressure studies of Deformation and the Acoustoelastic effect

Details of multiple slip systems derived from a single multi step experiment

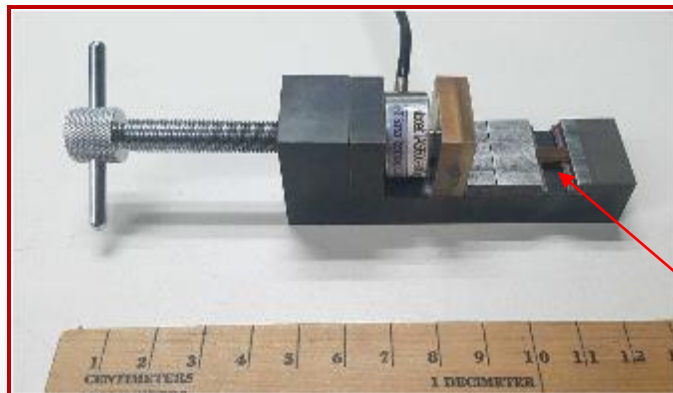
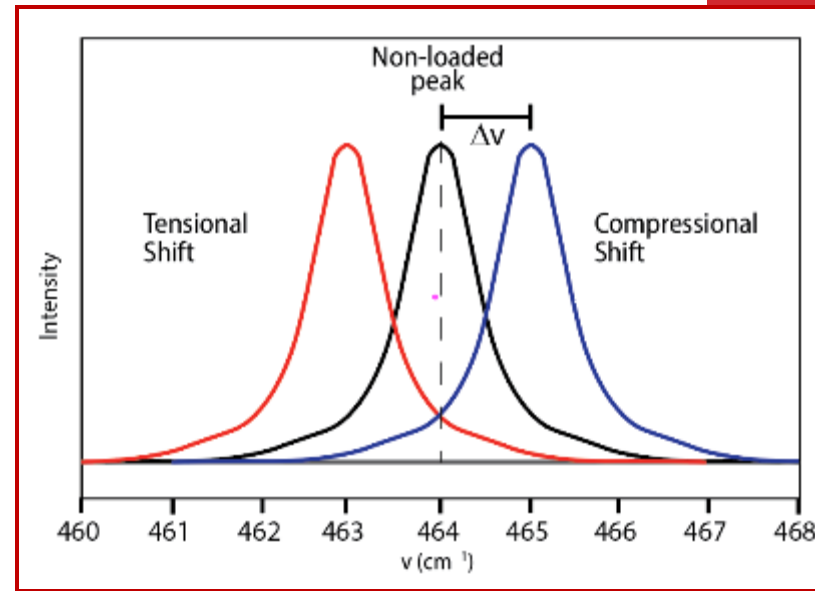
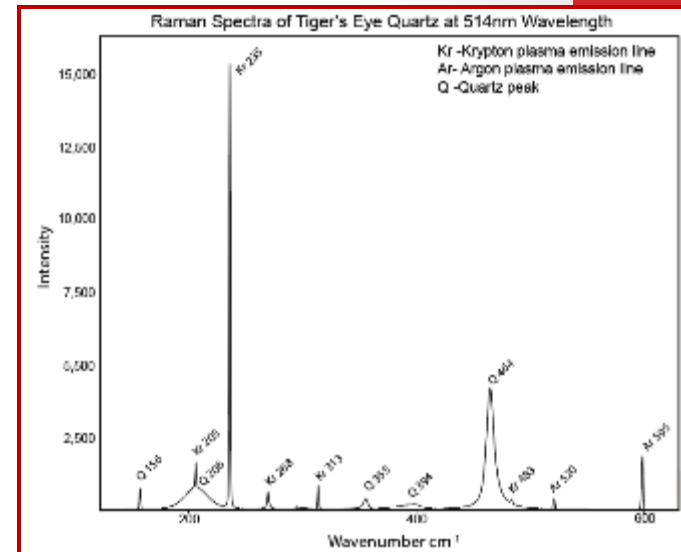
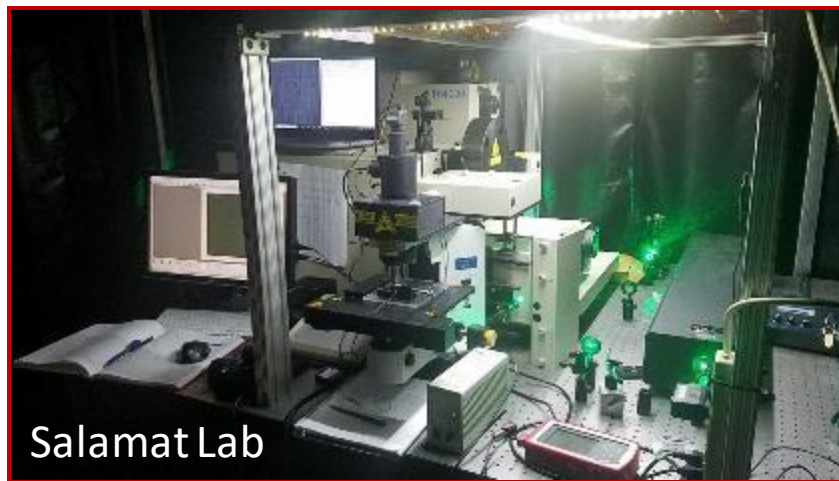
Compression- and shear-wave velocities are a function of compressive stress



(Traylor, Whitaker & Burnley, in prep)



Raman spectroscopic measurements of stress distribution

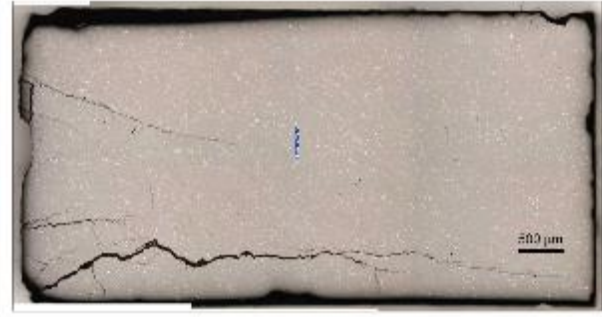
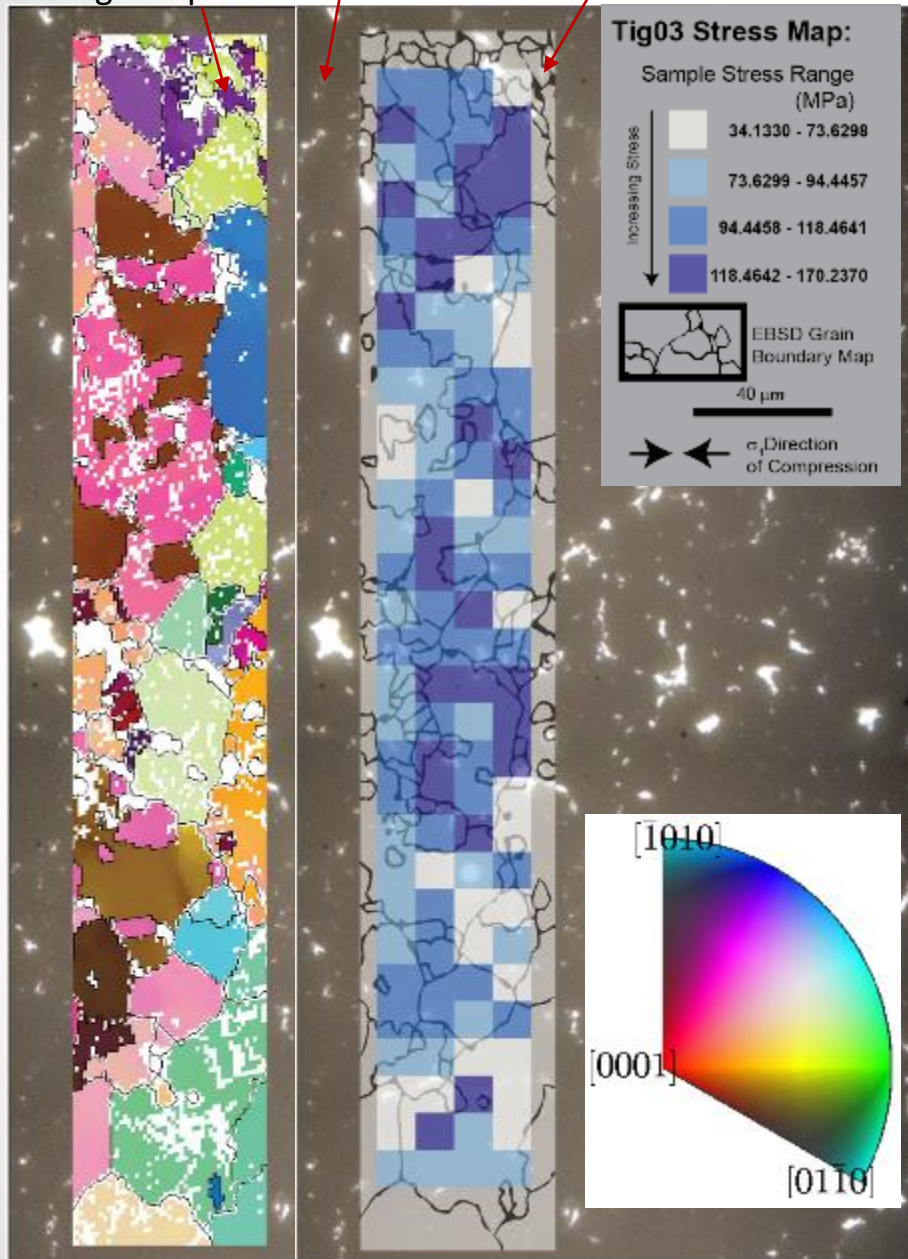


sample

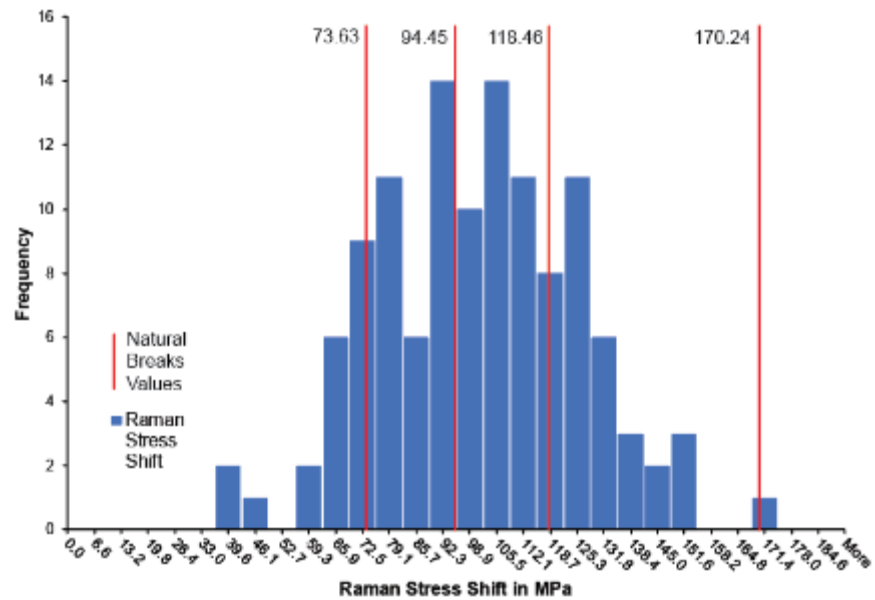
EBSD Orientation Image Map

optical image

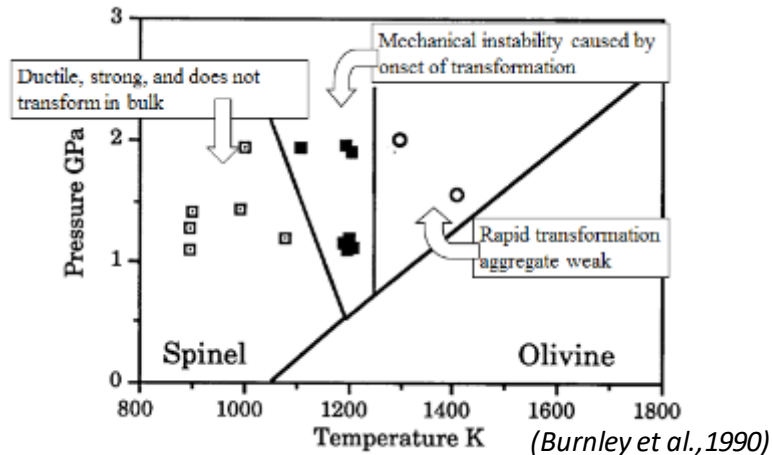
Stress map



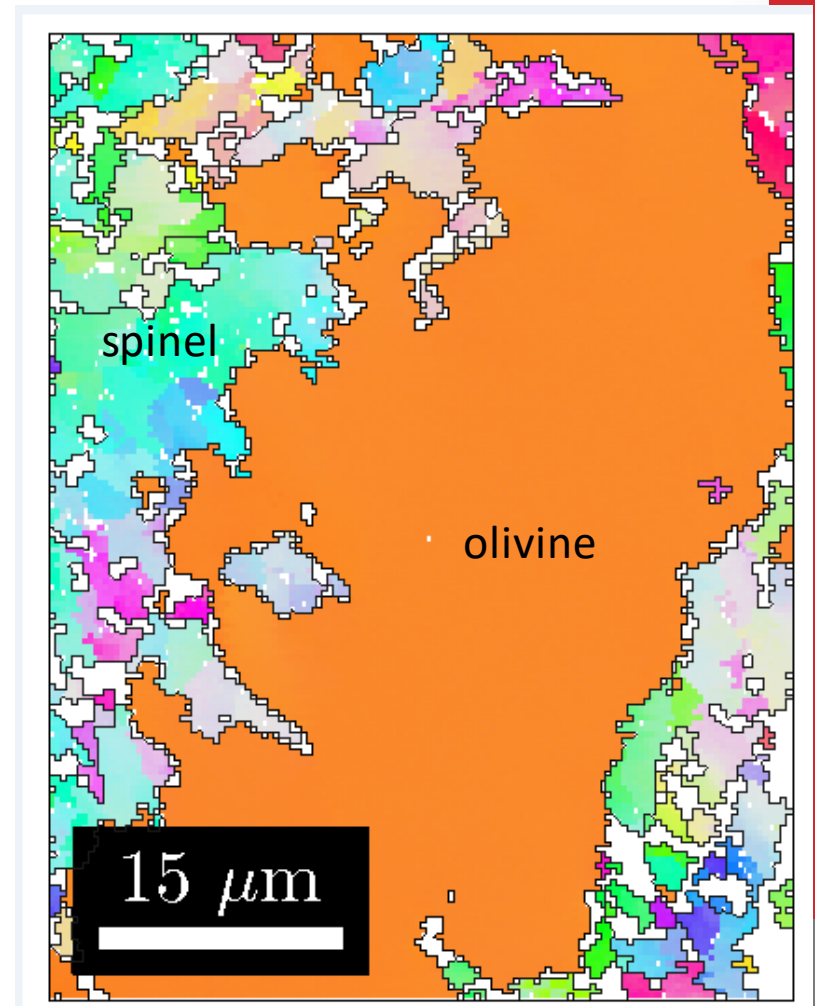
▶ Peak shifts converted to sample stress using single crystal measurements



Interaction of Phase Transformation and Deformation



- Growth of spinel in metastable olivine creates mechanical instability
- New microstructural analysis clarifies nature of instability



Electron Backscatter Diffraction
Orientation Image Map
(Burnley et al., in prep)

Radioactive Materials and Radiation

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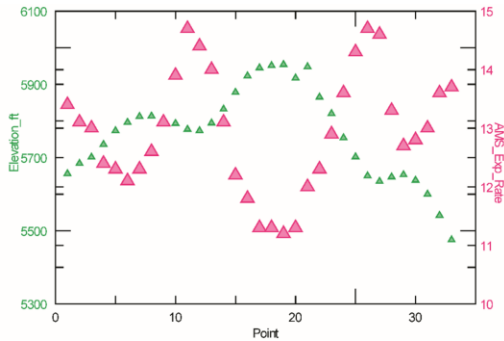
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Expertise:

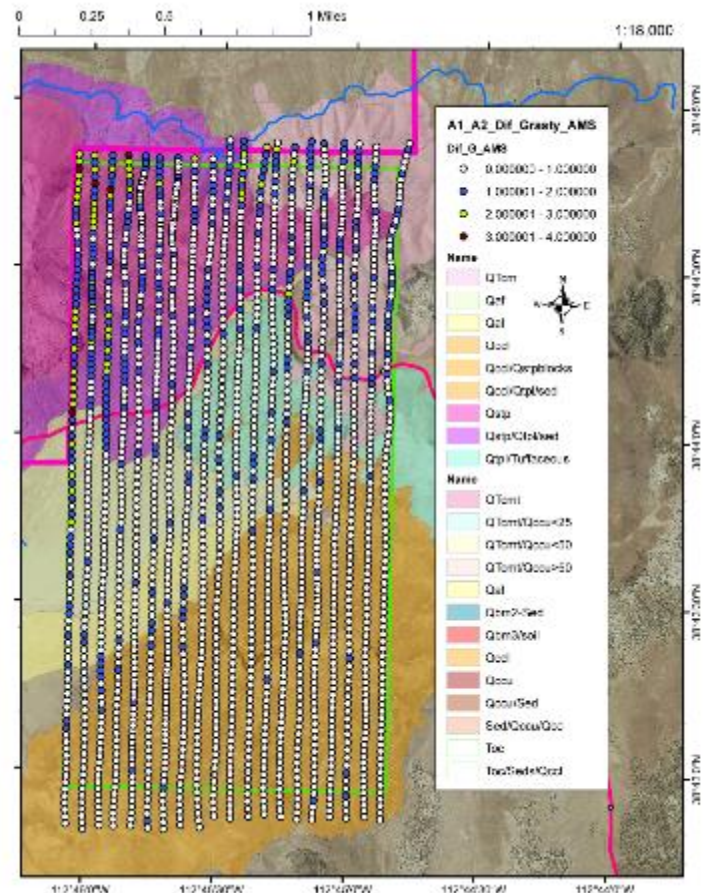
Gamma ray background radiation

γ -ray Background Radiation



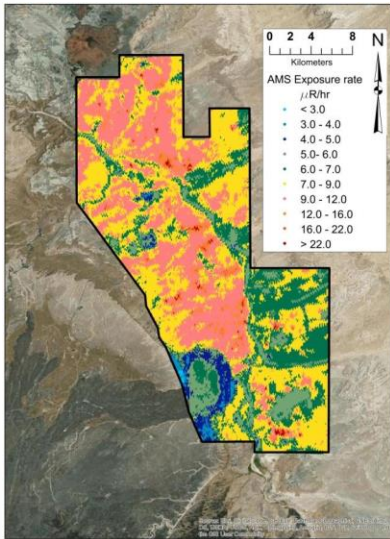
- Predictive model based on legacy NURE data & geologic map units
- Most points within $1\mu\text{R/hr}$
- Largest deviations associated with steep topography
- Led to D. Haber's PhD research on topographic corrections

Difference between AMS flight data and predictive model

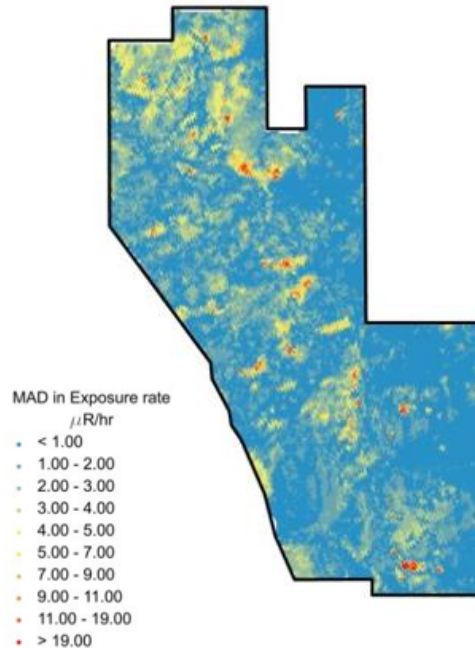


γ -ray Background Radiation

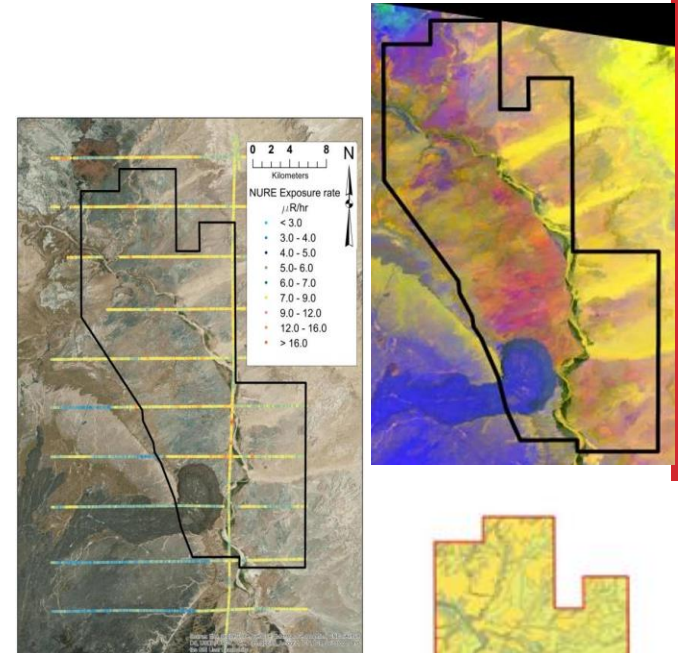
AMS flight data
Cameron, AZ



Difference between
AMS data and model



Model based on ASTER data,
NURE survey & geologic map



(Adcock et al. 2019)

Highlights Uranium
mines

Radiochemistry

Paul M. Forster

Department of Chemistry and Biochemistry

Radiochemistry

Expertise:

-Structure determination (X-ray and neutron diffraction, total scattering)

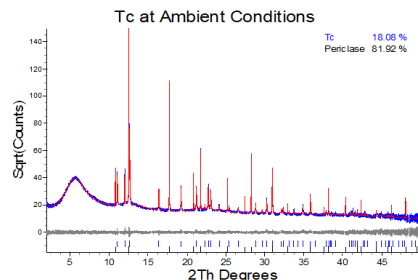
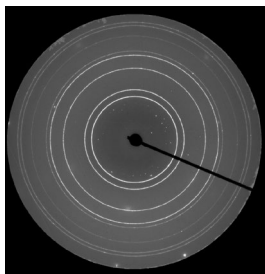
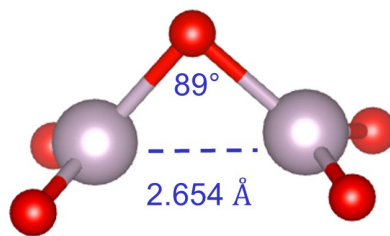
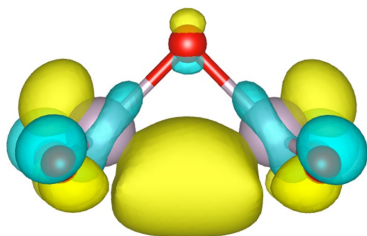


Figure 1 One-hour XRD of technetium metal and magnesium oxide.

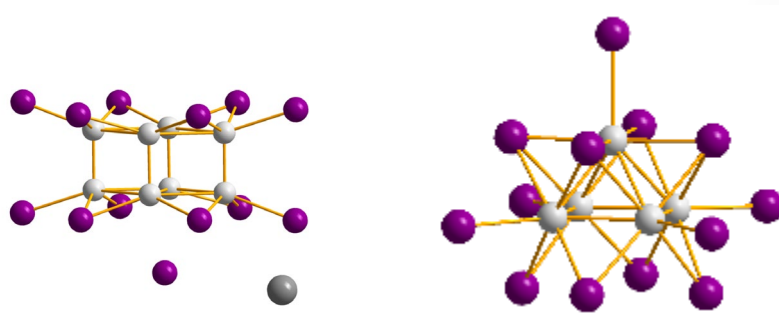
-Structure-property relationships, integrated simulation



Probable identification of a gas phase technetium oxide molecule

-Hydro/solvothermal synthesis

Technetium iodide compounds prepared solvothermally



Paul M. Forster

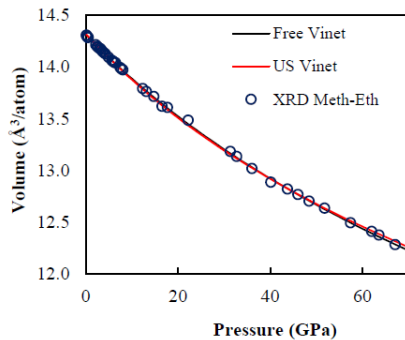
Department of Chemistry and Biochemistry

Radiochemistry

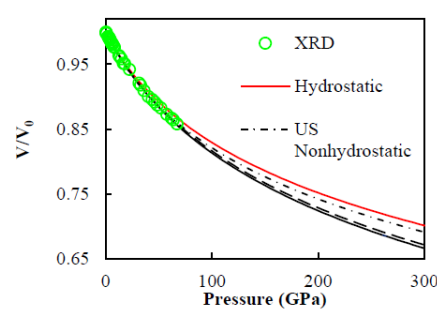
Relevant projects:

First diffraction-based equation of state for elemental Tc

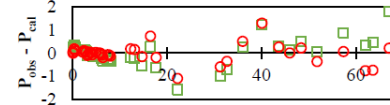
a) EOS of technetium



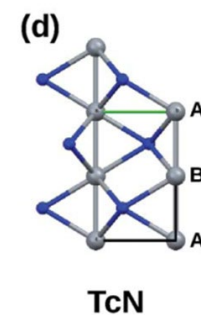
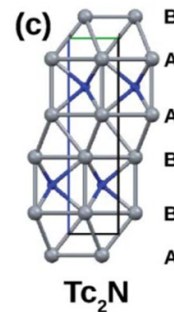
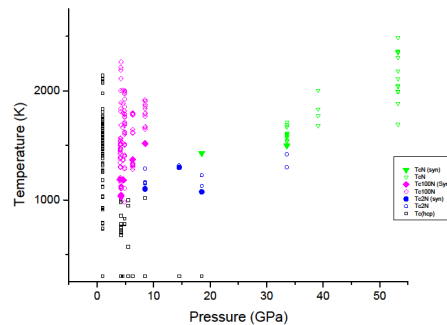
b) EOS of technetium



c) Pressure Difference



Discovery of new binary Tc nitrides



Paul M. Forster
Department of Chemistry and Biochemistry
Radiochemistry

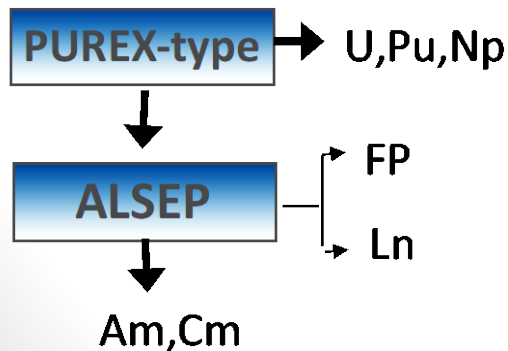
Art Gelis

Director, Radiochemistry Program

Actinide Separations and Recovery

Design and Testing of Advanced Separation Processes using Additive Manufacturing

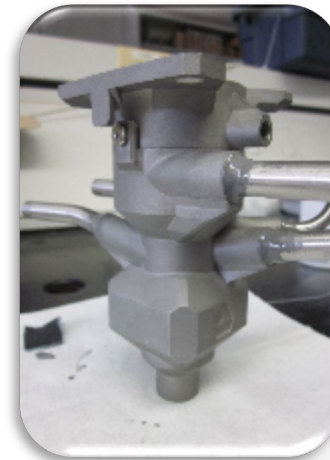
- Liquid-Liquid Extraction and Separation of Plutonium, Uranium, Minor Actinides, Lanthanides and Fission Products
- Twenty-seven 3D-printed acrylic centrifugal contactors (CC), fabricated at Argonne National Lab are available at UNLV
- Contactors can be 3D-printed in stainless steel or any alloy
- Solvent extraction separations can be tailored to a specific goal
- Example: **Actinide Lanthanide SE**paration process - **ALSEP**, designed and tested for DOE-NE



10+1 acrylic CC

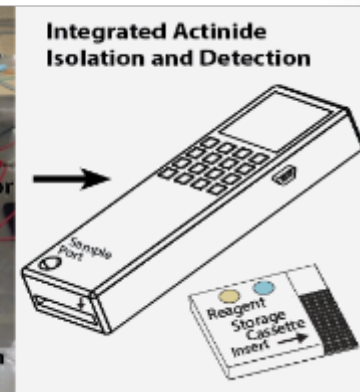
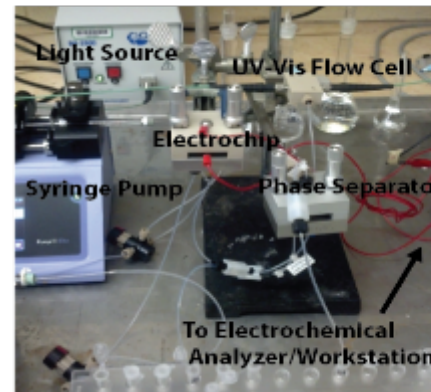
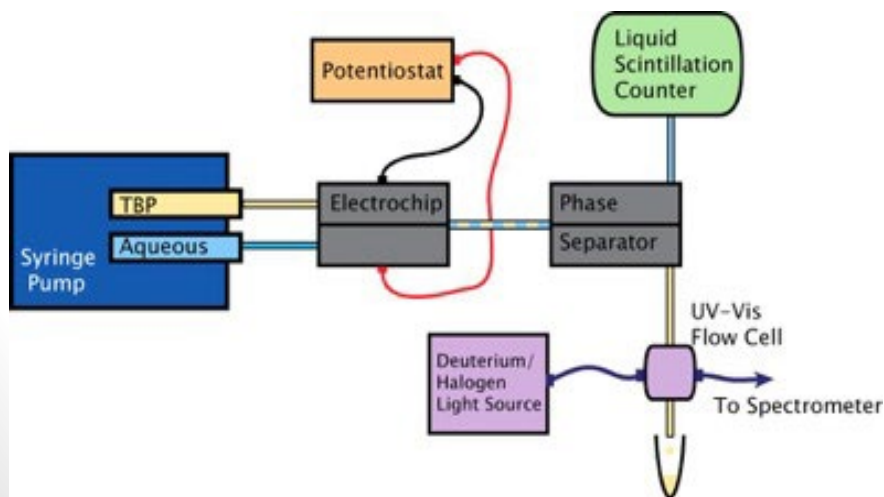
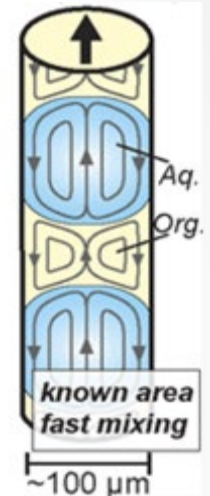


Steel CC

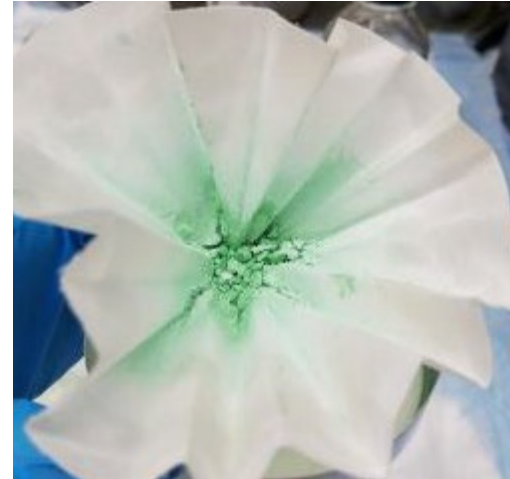
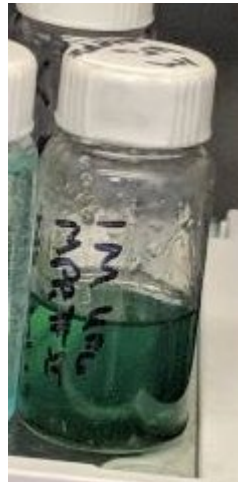
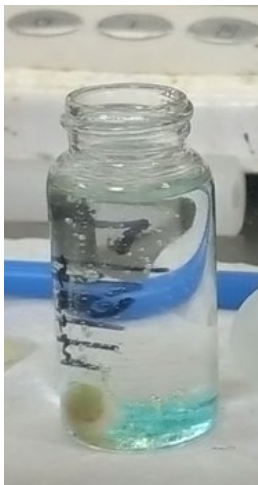


Microfluidic Systems for Rapid Radionuclide Separation and Detection

- Microfluidic device to combine aqueous and organic phases, rapidly mix, then separate phases, following by analysis
- Selective Extraction of radionuclides on a very small scale
- Can be implemented either as a bench-top setup or as a portable detector
- Potential applications: rapid Pu separation and detection from Uranium and FP for safeguards; "dirty bomb" analysis



Strategic Materials Analysis and Recovery – David Hatchett and Ken Czerwinski

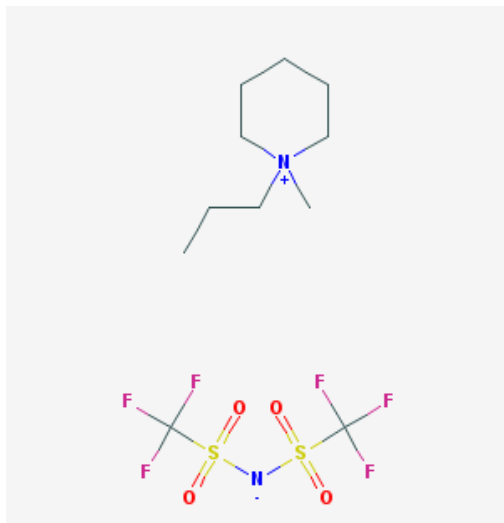


Dissolution of UF_6 into IL at 0 hours, 24 hours, 30 days, and the recovery of UF_6 salt.

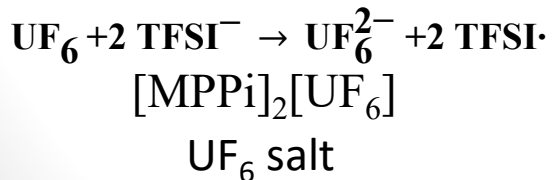
Expertise:

- Actinide, Lanthanide, and Li materials recovery from Ionic Liquids (ILs).
- Electrochemical, Spectroscopic, and thermal analysis of Radioactive materials.
- Radiochemistry and Analytical Chemistry.

Strategic Materials Analysis and Recovery – David Hatchett and Ken Czerwinski



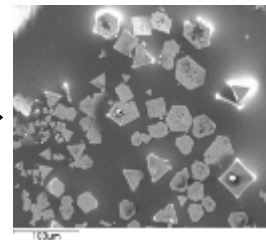
[MPPi][TFSI]



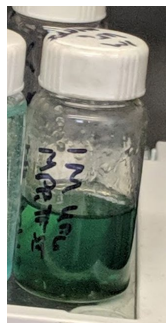
Electrochemistry



Low Concentration
0.1 M

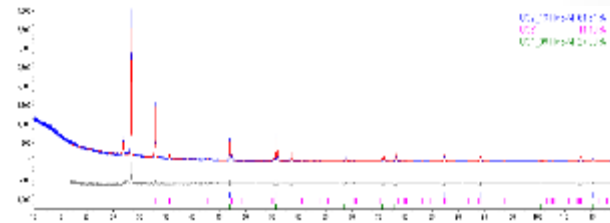


U metal
Crystallites

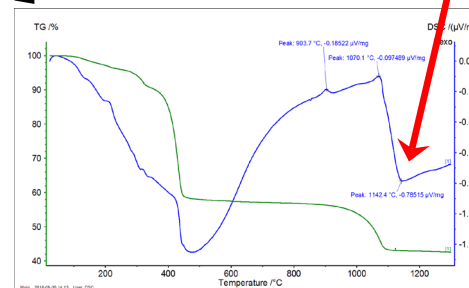


High
Concentration
0.95 M

UF₆ salt



Air
U metal



Paths to U recovery from UF₆ dissolved in IL

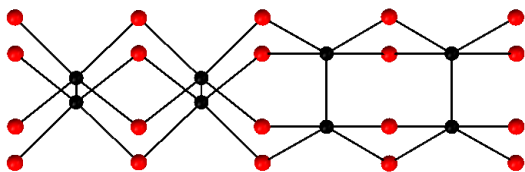
Technetium and Uranium Chemistry

Frederic Poineau, PhD
Radiochemistry

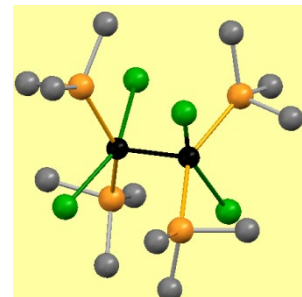
→ Synthetic and coordination chemistry

Technetium binary and ternary halide compounds

Compounds with multiple metal-metal bonds



TcCl_2 : a unique structure-type



$\text{Tc}_2\text{Cl}_4(\text{PMe}_3)_4$

→ Chemistry relevant to remediation and fuel cycle applications

Separation, vitrification, and waste forms (alloys)



Demonstration of the separation of uranium from technetium for fuel cycle application

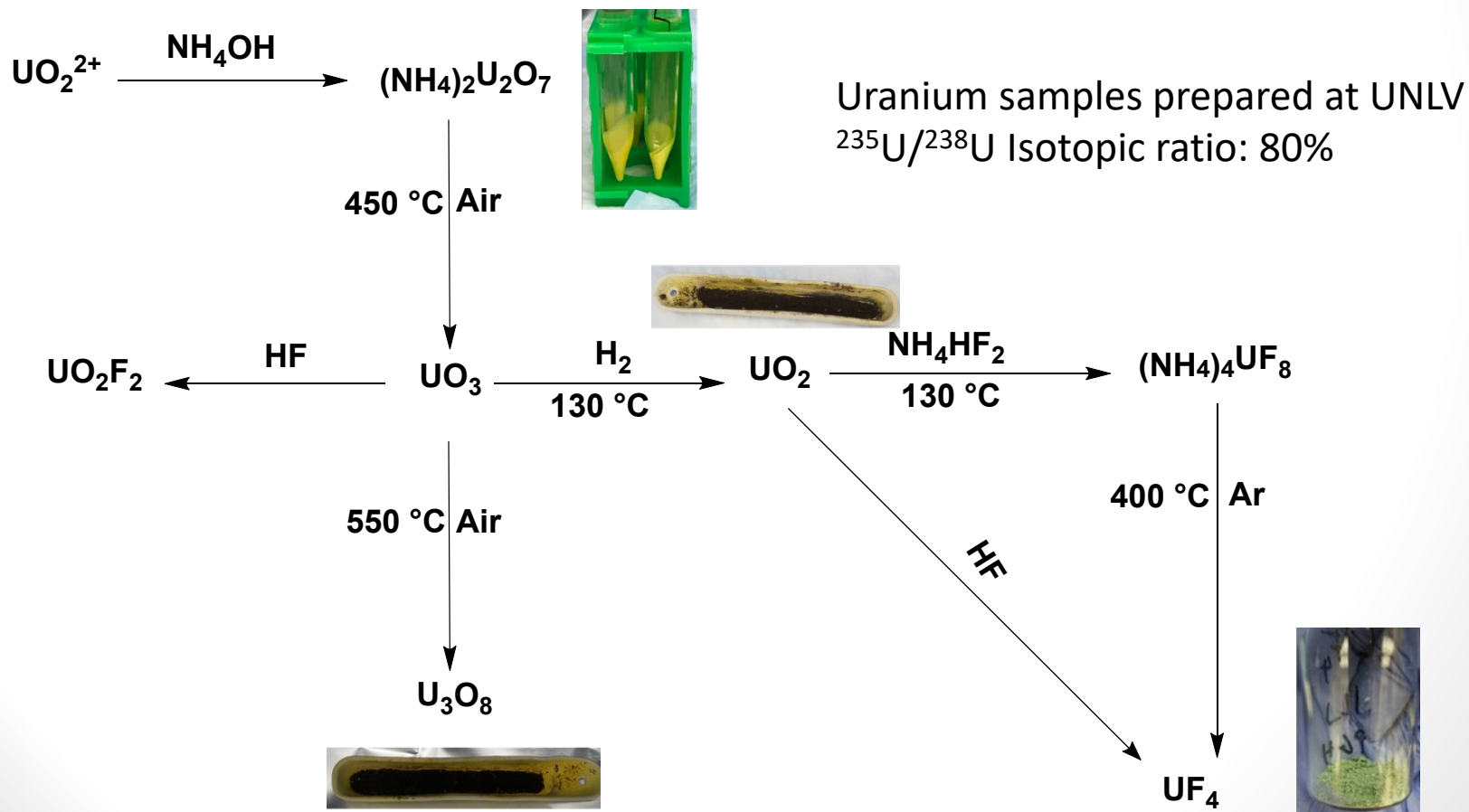


Preparation of U-Tc alloys by arc melting

→ Collaborative work relevant to nuclear forensics

Analysis of Uranium Isotopic Ratios by Thermal Ionization Mass Spectrometry (TIMS)

- Uranium compounds found throughout the fuel cycle (UO_2 , U_3O_8 , UF_4) prepared at UNLV
- $^{235}\text{U}/^{238}\text{U}$ isotopic ratio measurements using TIMS at LANL

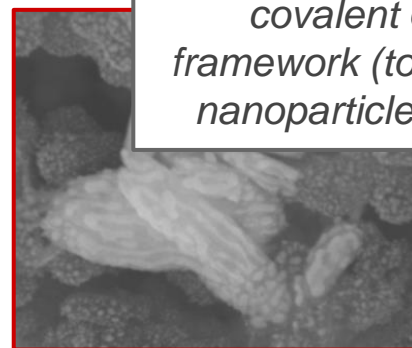
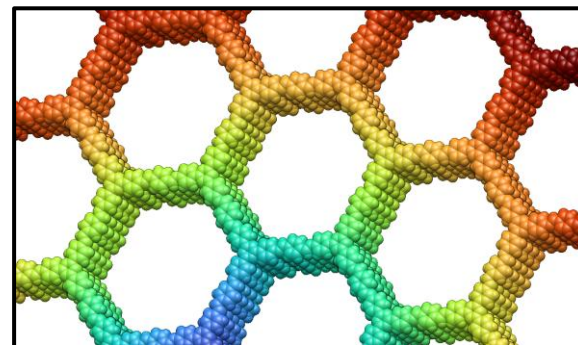


Inorganic Radiochemistry

- **Dr. Matt Sheridan**
- Asst Professor - Radiochemistry
- Department of Chemistry and Biochemistry
- Email: matthew.sheridan@unlv.edu
- Research works:
<https://scholar.google.com/citations?user=axFxtuQAAAAJ&hl>



- **Materials chemistry:**
metal organic frameworks (MOF), covalent organic frameworks (COF), oxide electrodes, uranium and actinide nano-materials
- **Electrochemistry & photochemistry:**
actinide redox chemistry, photoactive materials, molten salts, artificial photosynthesis
- **Radiochemistry:**
fuel cycle chemistry, actinide separations, actinide coordination chemistry, scintillation materials



covalent organic framework (top); uranium nanoparticles (bottom)

Sheridan Group Projects

Developing New Materials: MOFs, COFs, actinide complexes and nanoclusters

Studying Redox Radiochemistry: Molten salt electrochemistry, actinide oxide materials semiconductor properties

The actinides—uranium (U), neptunium (Np), plutonium (Pu), and americium (Am)—undergo rich redox chemistry

