LA-UR-23-23684

Title:	Sigma Characterization Capabilities
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Intended for:	Talk for PNNL audience
Issued:	2023-04-10

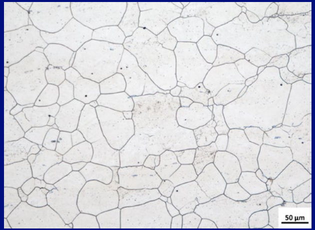
Los Alamos
NATIONAL LABORATORY

Sigma Characterization Capabilities

Presented by Rose Bloom

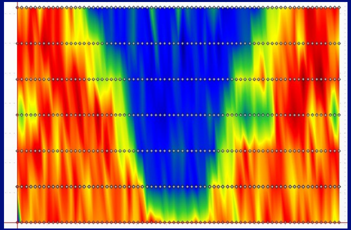
April 11, 2023

Outline



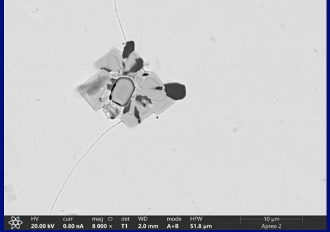
Optical Imaging

- Various scopes
- Various analytical software



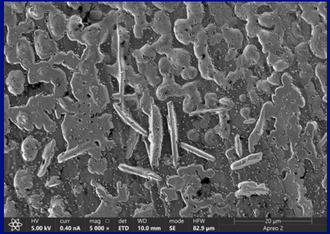
Hardness Testing

- Vickers/Knoop
- Rockwell



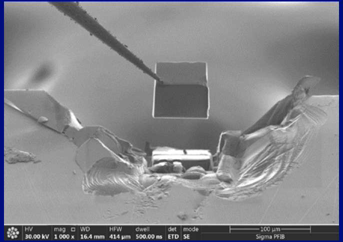
Miscellany

- LIBS
- XRF
- Profilometry
- Adhesion Testing
- Eddy Current



SEM

- EDS/WDS
- EBSD
- TKD

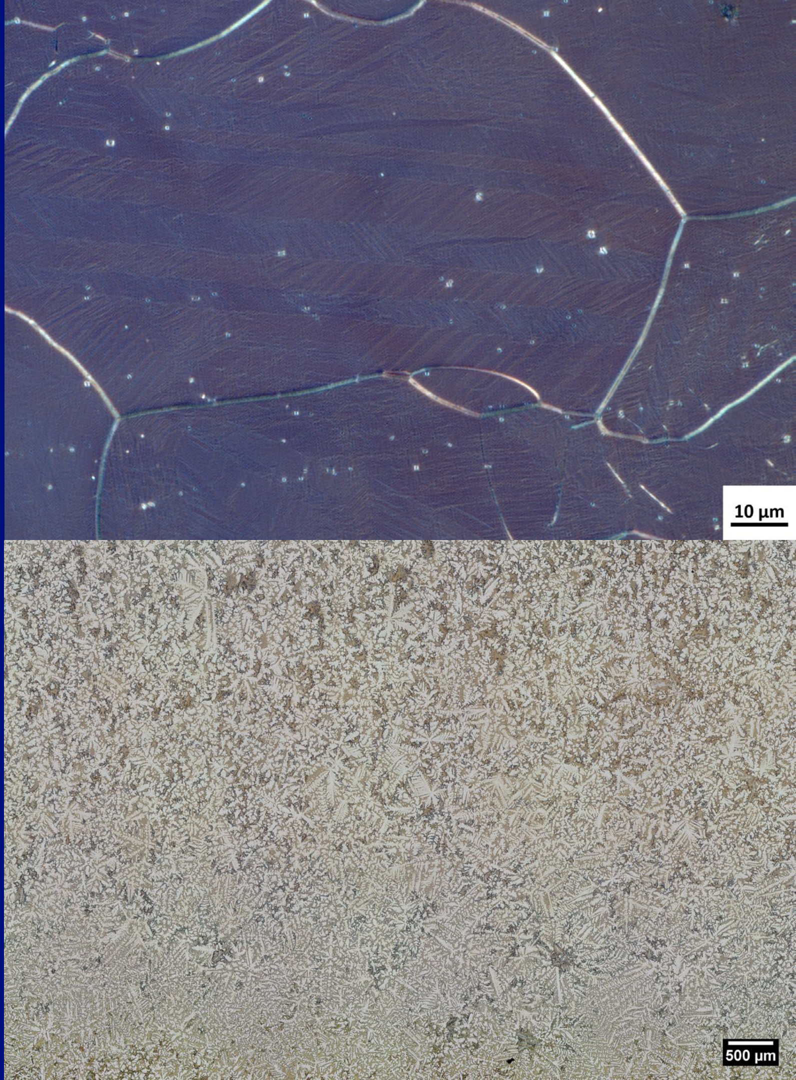


pFIB

- Micromachining
- TEM prep

Optical Imaging and Analysis

- Zeiss Axio Observer
- Zeiss Discovery V 2.0 Stereoscope
- Keyence VHX 7000
- U/Th preparation lab
- Beryllium preparation lab
- “Cold” preparation lab

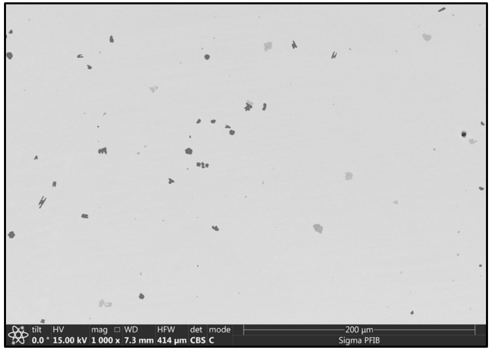


U$_6$ martensite (top)
U$_6$ dendrites (bottom)

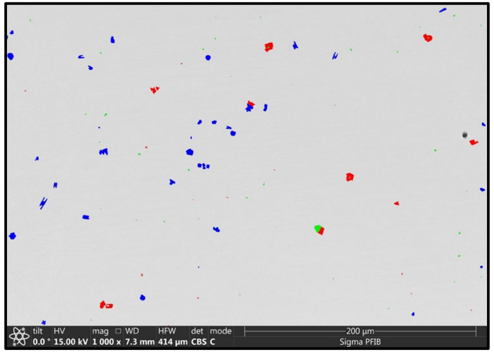
Imaging and Analysis

- Particle Size
- Phase Area Percentage
- Coating Thickness
- Grain Size
- Dendritic Arm Spacing
- Porosity
- Inclusions
- Fiber Length/Width Nodularity

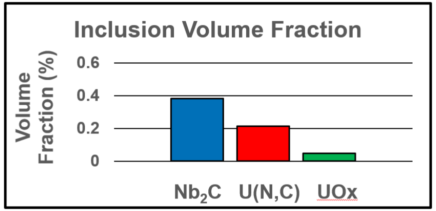
- Clemex
- MIPAR
- ImageJ
- MAMA



BSE image showing inclusions in direct cast DU

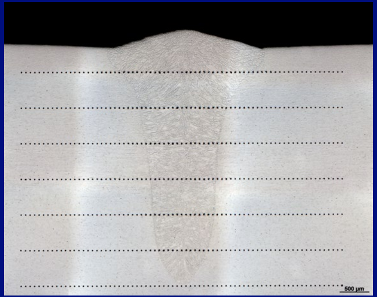


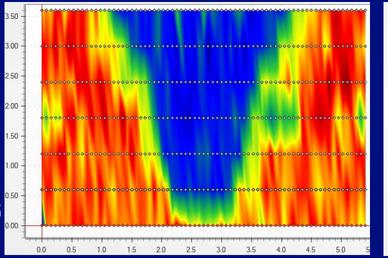
Inclusions segregated by morphology and assumed chemistry

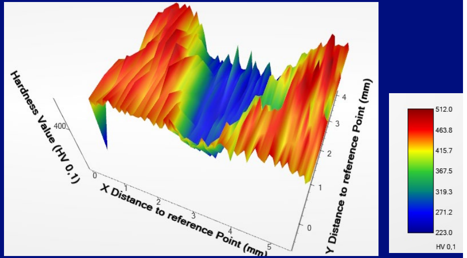


Hardness Testing and Adhesion Testing

- Struers DuraScan
- Struers DuraMin
- Struers Rockwell Hardness Tester
- 4000 Plus Bondtester

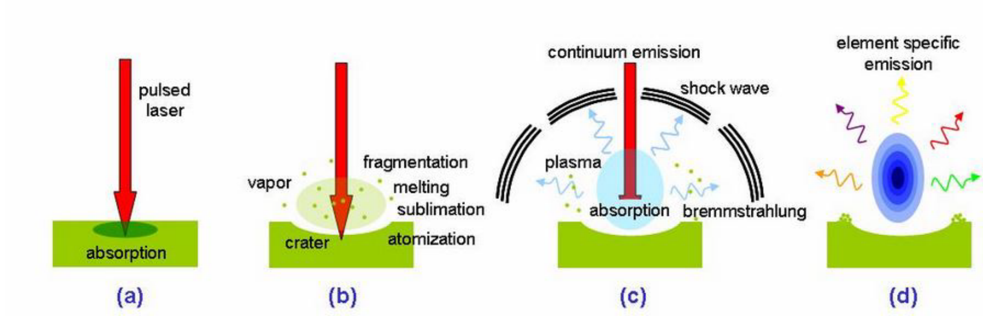


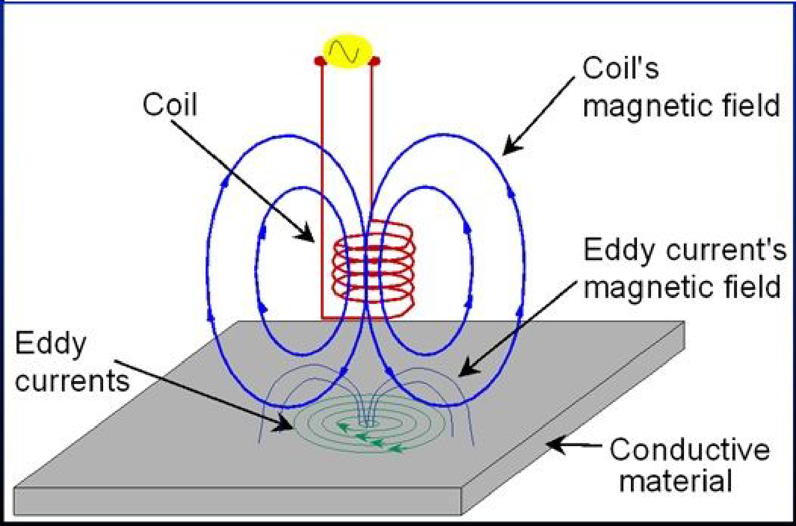




Miscellany

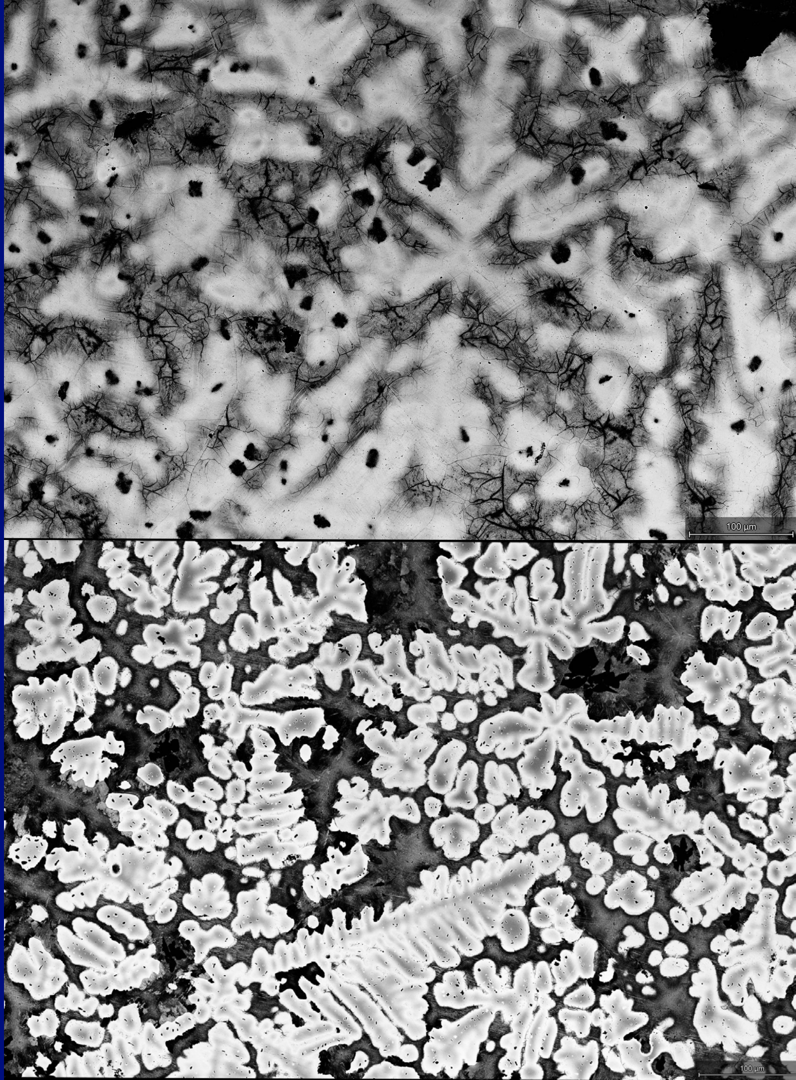
- EA 300 LIBS on Keyence VHX 7000
- Thermo Niton Analyzer XRF
- Keyence VR-5000 Profilometer
- Eddy Current





SEM EDS WDS EBSD

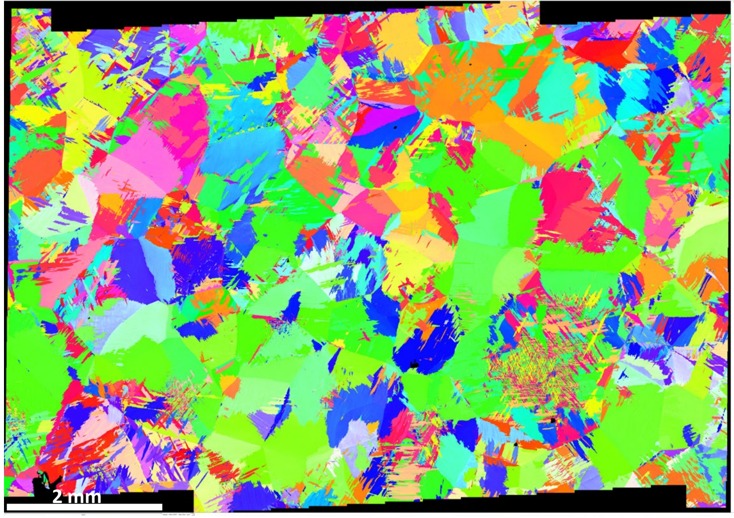
- FEI Apreo 2
  - Quantax X Flash EDS
  - Quantax X Sense WDS
  - Quantax e-Flash HD EBSD with on axis TKD capabilities
- FEI Xe G4 Helios pFIB
  - Oxford EDS Ultimax
  - Symmetry 2 EBSD detector



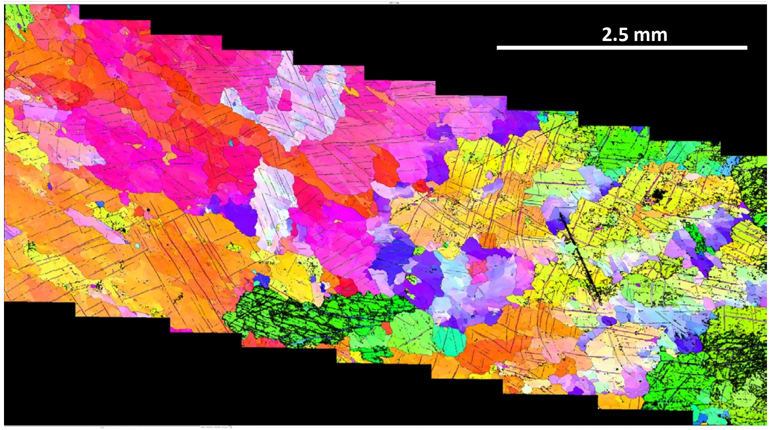
BSE of U_6 dendrites (top and bottom)

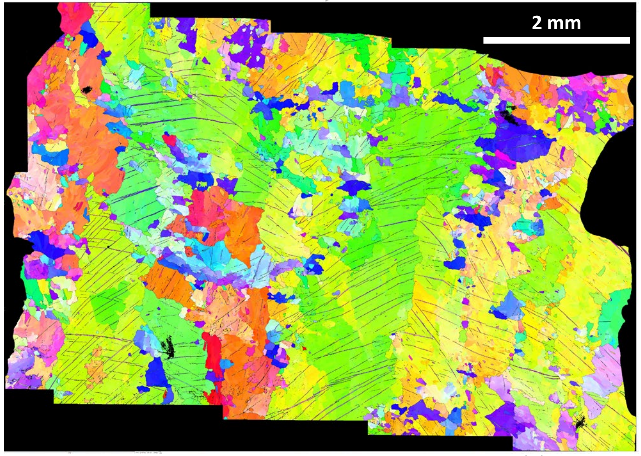
EBSD

- Oxford Symmetry S2 Large area EBSD
- Bruker Quantax e-Flash HD EBSD with on axis TKD capabilities



Formed Ti64 EBSD

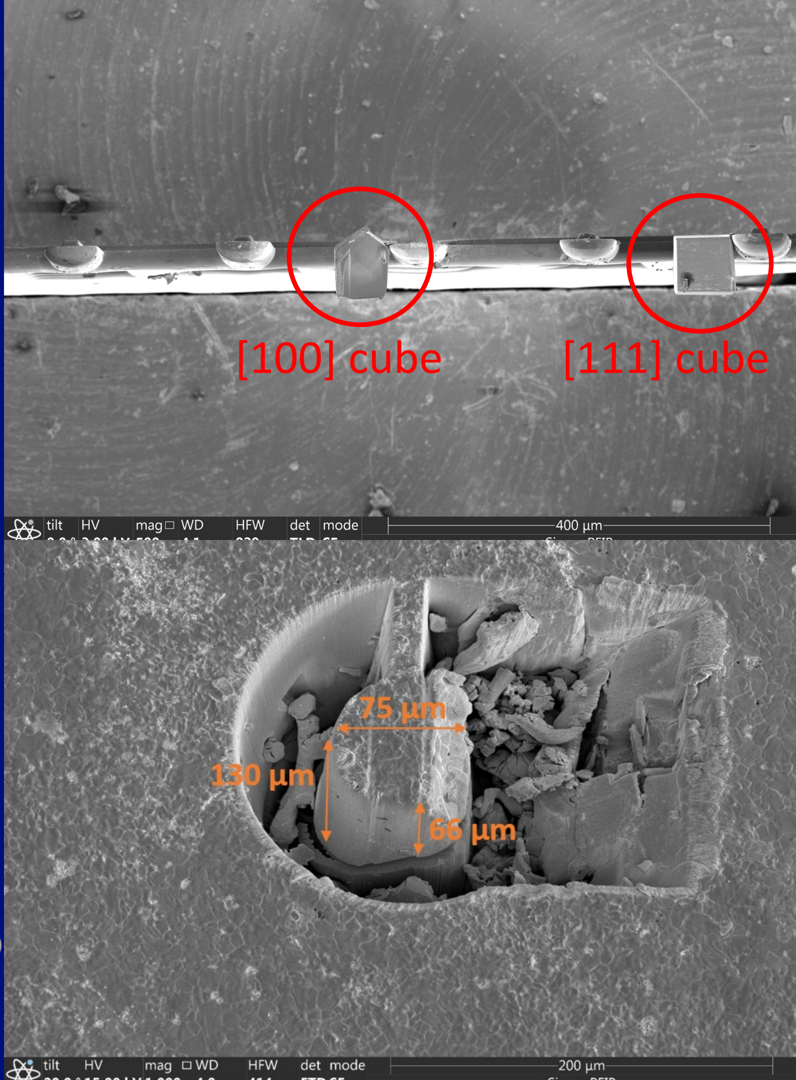




EBAM EBSD

FIB/pFIB

- FEI G4 Xe pFIB



Single crystal UO_2 cubes(top)
LEU oxide cylinder (bottom)

Bonus Characterization in Sigma

- ICPMS
- Bruker D2 Phaser tabletop XRD
- Mechanical Testing
- Quantitative XRF
- Auger
- AFM
- Gleeble
- XPS…potential
- MicroCT…potential
- Ultrasonic…potential