

New Approaches to Measurement and Metrology for NMs in Complex Matrices

- Panelists
 - Jim Ranville, Colorado School of Mines
 - Micah Green, Texas Tech
 - Franz Geiger, Northwestern University
- Moderators
 - Jason Unrine- University of Kentucky
 - Elijah Petersen- NIST
 - Zeev Rosenzweig –NSF

Consistently identified as a priority in national research strategy, year after year



- However progress on *ex vacuo* techniques has been slow!
- Few funding opportunities specifically targeted at this area.

These tools will fuel progress across the board

Crosscutting tools for *in situ/in vivo* characterization and detection

Implications

- **Human and ecosystem effects**
- **Environmental fate**
- **Environmental and occupational exposures**
- **Waste treatment and recycling**

Applications in complex media

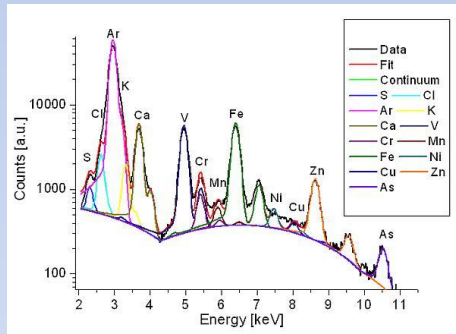
- **Environmental remediation**
- **Agriculture**
- **Food science**
- **Nanomedicine**
- **Adaptive coatings**
- **Nanogeochemistry**

Challenges

- Characterizing particle surfaces in different environments/complex media
- Sensitive (ng/L) and specific detection and compositional characterization, particularly small sizes (<30 nm)
- Standardization for regulatory purposes
- Sample preservation and storage
- Ultrafast measurements that operate on the single particle level to characterize nanoscale heterogeneity *ex vacuo*

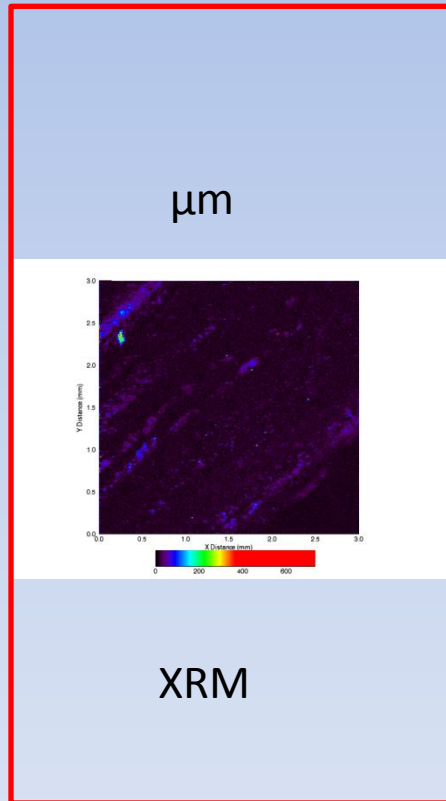
Characterization at different spatial scales

cm

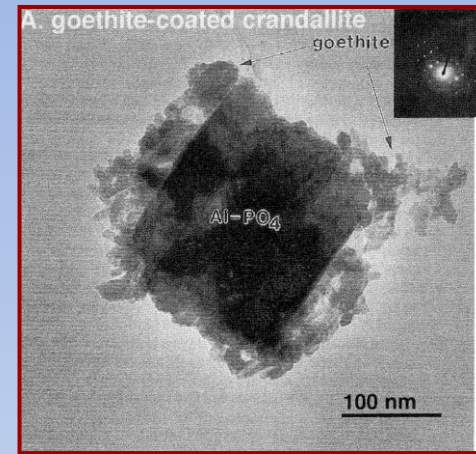


XRF

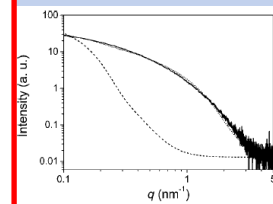
μm



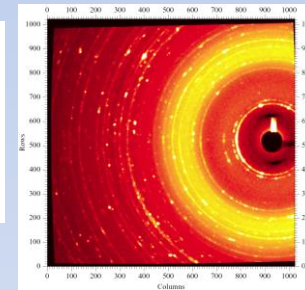
XRM



nm

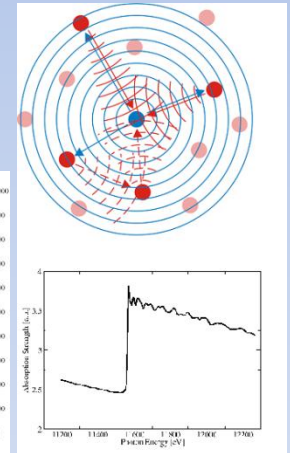


SAXS



XRD

\AA



XAFS

Bulk measurements versus single particle measurements

Paths forward

- **Jim Ranville** - Trace level detection/characterization of inorganic nanomaterials
- **Micah Green** – Trace level detection/characterization of carbonaceous nanomaterials
- **Franz Geiger** – Characterizing nano-bio interfaces using direct probes