



Project Title

Characterization of morphology using the MAMA software

Project Reference Code: DNDO-LANL-Wilkerson

Hosting Site

Los Alamos National Laboratory
Los Alamos, NM

Project Description

Studies under *Chemical Forensic Science* have been carried out to understand signatures of chemical speciation and morphology associated with uranium oxides prepared under conversion processes. Subsequent storage of these materials under high humidity conditions may yield temporal changes in morphology and chemical speciation. For example, signatures measured from a high-purity α - U_3O_8 sample indicated that the material oxidized and hydrated to schoepite species after storage under high humidity conditions over time.¹⁻³ Chemical impurities were detectable in other uranium oxides samples initially, but some of these signatures could not be detected after storage. Recent studies of uranium process materials, such as diuranates, are revealing a useful understanding of morphologic and chemical signatures that may support analysis of unknown materials, as well. Our team has characterized a large number of relevant uranium materials for chemical and morphologic features relevant to nuclear forensic analyses.

Analysis of images collected by scanning electron microscopy is useful for characterizing texture and surface features, particle structure and size, and grain boundaries, but descriptions of particulate material morphologies and comparisons between images are subjective. A number of approaches for characterization of morphologies of actinide materials are being considered, including a lexicon of descriptors and a new software package.⁴ The Morphological and Microstructural Analysis (MAMA) software package is being designed for quantification of morphological signatures. The user is able to identify, distinguish, and quantify particles or sets of particles in microscopy images using the software. The segmentation feature of the software allows the user to select from preset equations and to adjust the parameters of the equations to automatically apply particle-particle and particle-background division. The user may then manually adjust segment lines to more accurately fit the image and distinguish between different particle types and the background. The software also offers quantification of parameters to describe the particles and/or particle subsets in the sample. Exporting the raw data allows for further analysis using other mathematical tools.

The goal of this summer project will be to learn to use the MAMA software program, and then incorporate the most up-to-date developments in the software to analyze a range of images measured from uranium materials. The student also will learn how the materials were synthesized and measured. At the end of the summer session, the student will prepare a poster of this work for presentation at the

Los Alamos National Laboratory Student Symposium in August 2016. These analyses will be appropriate for publication in reports to DHS and future publications.

References

1. Tamasi, A. L.; Boland, K. S.; Czerwinski, K.; Ellis, J. K.; Kozimor, S. A.; Martin, R. L.; Pugmire, A. L.; Reilly, D.; Scott, B. L.; Sutton, A. D.; Wagner, G. L.; Walensky, J. R.; Wilkerson, M. P. *Anal. Chem.* **2015**, *87*, 4210-4217.
2. Tamasi, A. L.; Cash, L. J.; Mullen, W. T.; Ross, A. R.; Ruggiero, C. E.; Scott, B. L.; Wagner, G. L.; Walensky, J. R.; Zerkle, S. A.; Wilkerson, M. P. *J. Radioanal. Nucl. Chem.* **2016**, *309*, 827-832.
3. Tamasi, A. L.; Cash, L. J.; Mullen, W. T.; Pugmire, A. L.; Ross, A. R.; Ruggiero, C. E.; Scott, B. L.; Wagner, G. L.; Walensky, J. R.; Wilkerson, M. P. *J. Radioanal. Nucl. Chem.* **2016** DOI 10.1007/s10967-016-4923-1.
4. Tamasi, A. L.; Cash, L. J.; Eley, C.; Porter, R. B.; Pugmire, D. L.; Ross, A. R.; Ruggiero, C. E.; Tandon, L.; Wagner, G. L.; Walensky, J. R.; Wall, A. D.; Wilkerson, M. P. *J. Radioanal. Nucl. Chem.* **2016**, *307*, 1611-1619.

Disciplines

Inorganic Chemistry
Nuclear Engineering
Analysis

Mentor(s)

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The name and contact information of the hosting site internship coordinator is provided for further assistance with questions regarding the hosting site; local housing availability, cost, or roommates; local transportation; security clearance requirements; internship start and end dates; and other administrative issues specific to that research facility. If you contact the internship coordinator, identify yourself as an applicant to the DNDO Summer Internship Program.

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