

**Graduate student seminars  
Wednesday, November 11  
4pm  
Hill Hall 202**

**Analysis of U-7wt%Mo Dispersion Fuel Microstructures using Automated Image Processing**

**Ryan Collette**

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**Abstract:** The High Performance Research Reactor Fuel Development (HPPRFD) program is actively developing low enriched uranium (LEU) fuel substitutes for high performance reactors fueled with highly enriched uranium (HEU) that have not yet been converted. The uranium-molybdenum (U-Mo) fuel system was selected for this effort. In this study, fission gas pore segmentation was performed on U-7wt%Mo dispersion fuel samples at three separate fission densities using an automated image processing interface developed in MATLAB. Pore size distributions were attained that showed both expected and unexpected fission gas behavior. In general, it proved challenging to identify any dominant trends when comparing fission bubble data across samples from difficult fuel plates. The smaller pore size and porosity from the samples fabricated with a magnesium matrix may indicate that the magnesium matrix imparts more stress on the fuel particles. The results exhibited fair agreement with the fission density vs. porosity correlation developed by the Russian reactor conversion program.

**Bio:** Ryan Collette is a PhD student in the Nuclear Science and Engineering Program at the Colorado School of Mines. His research is focused on the microstructural characterization of uranium-molybdenum nuclear fuels. A native of Merrimack, New Hampshire, Ryan received a M.S. in Nuclear Engineering from the Colorado School of Mines and a B.S. in Nuclear Engineering from Rensselaer Polytechnic Institute.

**Safeguards Uncertainty Quantification with the Safeguards Control (SGC) Model**

**Nicholas Shugart**

Graduate Research Assistant  
King Research Group  
The Colorado School of Mines

**Abstract:** Preventing the use of nuclear material in the development of weapons is critical for global security and the expansion of nuclear power worldwide. The ability to quantify the cumulative impact of safeguards measurement uncertainties across the nuclear fuel cycle will allow a better understanding of possible weakness in current safeguards methodologies, and will inform future safeguards technology development efforts. Safe Guards Control (SGC) is a computational toolbox that provides the capability to include safeguards measurements and the associated uncertainties in any fuel cycle model. SGC will provide safeguards planners with a tool to refine future safeguards development. This presentation discusses the recent work in developing SGC to characterize uncertainty within the entire fuel cycle, regardless of the input code.

**Bio:** Nicolas Shugart is a PhD Candidate at the Colorado School of Mines working on his degree in Nuclear Engineering. He gain his undergraduate degree in Engineering Physics from CSM, and then transferred to the nuclear program, where he earned his Master's degree working on the neutronic and thermo-hydraulic analysis for the GSTR's relicensing effort before transitioning to his current project.

### **Americium: The Last Hexavalent Actinide**

**Kevin McCann**

Graduate Research Assistant  
Braley Research Group  
The Colorado School of Mines

More significant development of nuclear energy will require scientific advances in the proper management and disposal of used fuel. To reduce the long-term toxicity hazard associated with nuclear waste, the most viable approach is to recover long-lived actinides for transmutation to short-lived radioisotopes. If transmutation of uranium, neptunium, plutonium and americium in a fast neutron spectrum reactor is to be completed, these actinides should be selectively recovered from fission products and curium prior to assembling them into fast reactor fuel. Separation of americium has nearly identical chemical behavior to short-lived lanthanide radioisotope fission products and curium. Oxidizing americium from Am(III) to Am(VI)O<sub>2</sub><sup>2+</sup> may improve actinide separation efficiencies by changing the americium coordination environment from a bare, trivalent cation, similar to the lanthanides and curium, to the linear dioxo cation. Copper (III) periodate, an unconventional oxidizer, has been shown to oxidize Am(III) to Am(VI)O<sub>2</sub><sup>2+</sup> in molar nitric acid solutions. However, nitric acid reduces copper (III) periodate in the process. Using stop-flow UV – Visible spectroscopy, reduction of copper (III) periodate was monitored in nitric acid solutions in order to optimize extraction of Am(VI)O<sub>2</sub><sup>2+</sup> by diamyl amyolphosphonate (DAAP). The effect of nitric acid concentration, contact time, and DAAP concentration on oxidized Am extraction was assessed. Furthermore, potential isotope effects on the extraction chemistry was investigated by comparing the results between <sup>241</sup>Am and <sup>243</sup>Am. Differences in <sup>241</sup>Am and <sup>242</sup>Am extraction are currently suspected to stem from the higher specific activity of the <sup>241</sup>Am increasing the local concentration of reducing radical species. Results show that Am recovery using DAAP extractant and copper (III) periodate oxidant is possible and assessment of more complicated systems containing additional actinides or fission products is probably appropriate.

#### **Biography:**

Earned a B.S. in chemistry from University of Portland in 2009

In 2013 earned a Master's in applied chemistry at the Colorado School of Mines

Stayed at School of Mines to complete a Ph.D. studying the chemistry of the f-elements

Was recently awarded an SCGSR fellowship to finish his dissertation research at a national lab (Pacific Northwest National Lab)