

Ion Milling and Sputter Deposition for the HEDS of Oxide-free Plutonium

Sullivan Figurskey¹, Alex Preisser¹, Gordy Field¹, Jeff Stanford¹

¹Lawrence Livermore National Laboratory, Livermore, USA; *figurskey1@llnl.gov

In Pu research, the creation of an oxide free surface is notoriously difficult to produce; but more so, it is difficult to maintain. The importance of oxide-free surfaces increases as the ratio of potential oxide layer thickness relative to the bulk grows, with oxide layers typically stabilizing at hundreds of nanometers thick in dry air, and increasing exponentially with relative humidity. In High Energy Density Science (HEDS) research with Pu, where analytical samples well below 10um are commonplace, an oxide layer of any measurable thickness can have significant downstream effects on data accuracy and reliability. To this end, development efforts utilizing Ar ion milling and DC magnetron sputter deposition have now allowed for the production Pu samples with minimal oxide layers. Additionally, this work has allowed these samples to be transported, assembled on the benchtop, and processed for data, in air and outside traditional containment barriers (e.g. gloveboxes), all while maintaining that minimal oxide layer.

The research to be presented will cover the development, implementation, and practical results of the ion milling of Pu surfaces, as well as the DC magnetron sputtering of both Al and Cu onto Pu surfaces. With a focus on the characterization of the interface between the Pu and the coating element, the current and future analysis results will include FIB/SEM cross-sectioning (Figure 1 below) and EDS. Additionally, X-ray diffraction examining lattice mismatch, white light interferometry for surface roughness, and lifetime studies of samples in air will be discussed as permitted.

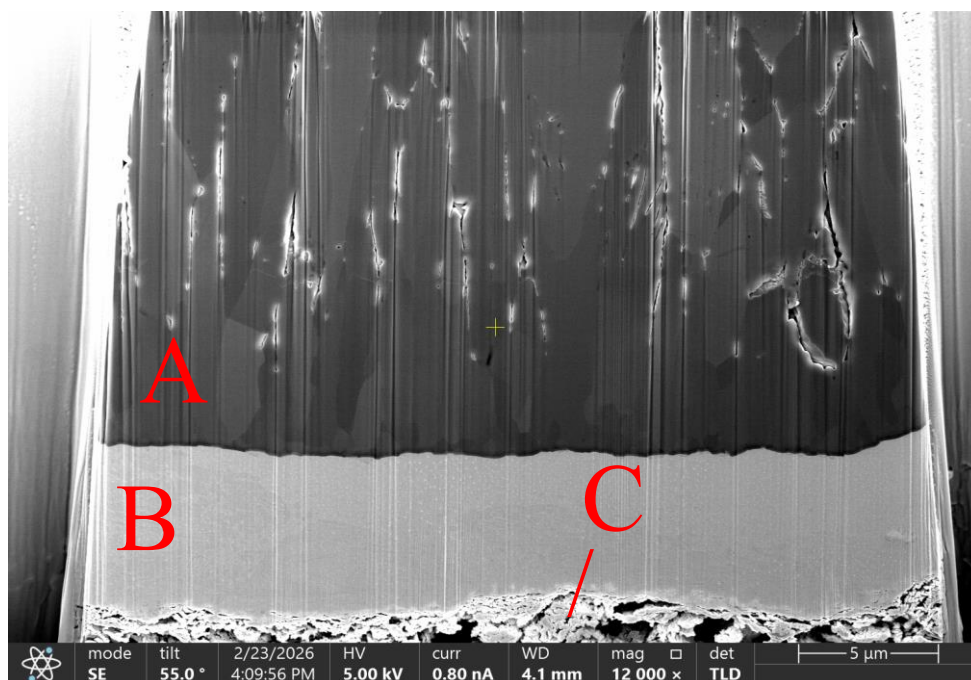


Figure 1. Vertical cross-section SEM image of an Al-coated Pu sample, showing A) the dark Al coating, B) the light Pu substrate, and C) the oxidized Pu encroaching from the unprotected face below