doi:10.1017/S1431927613005345
Microsc. Microanal. 19 (Suppl 2), 2013

Rough Surface Depth Profiles for the Characterization of Real World Corrosion and Deposition

Benjamin Naes, David Willingham, Mark Engelhard, Christine Mahoney, Bruce McNamara, Bruce Reid, and Albert Fahey

National Security Directorate, Pacific Northwest National Laboratory, 902 Battelle Blvd., Richland, WA 99352 USA

In order to determine the nature, and in some cases, the history of layer deposition on industrial surfaces such as pipes, reaction chambers, container walls, etc. some consideration has to be given to the geometry and condition of the original surface as well as the character of the deposited layers. We have investigated corrosion layers formed by exposure of polished Al coupons to $UF_{6\ gas}$ [1]. Although the Al coupons were reasonably flat and smooth they were not "atomically" flat as must Si surfaces are that are used in the manufacture of semiconductors; the most common target of depth-profile analyses. In addition, the deposited layers did not form uniform films but rather were thick (of order 1-2 micrometers), apparently of non-uniform composition and appeared fractured with dendritic growths appearing from the surface (Figure 1).

Analyses of various prepared coupons were performed by XPS, Dynamic SIMS, SEM, and ToF- SIMS. Depth profiles as well as surface measurements were made. It was found that Al, U, F, and O appear together in layers that intrude significantly into the Al. In addition, isotopic differences could be observed in coupons prepared with different enrichments of ^{235}U in the UF_6. Image depth profiles were acquired along with interferometric crater measurements to correlate SIMS data with the observed roughness of the film and coupon.

Understanding the rates of deposition, and the mechanisms will lead to an ability to determine the history of operation of a facility. Data shows that despite significant topography a depth profile indicating regions of differing composition can be obtained (Figure 2). Further investigation into accounting for surface roughness in the depth profile should yield sharper boundaries and a more detailed view of the layers.

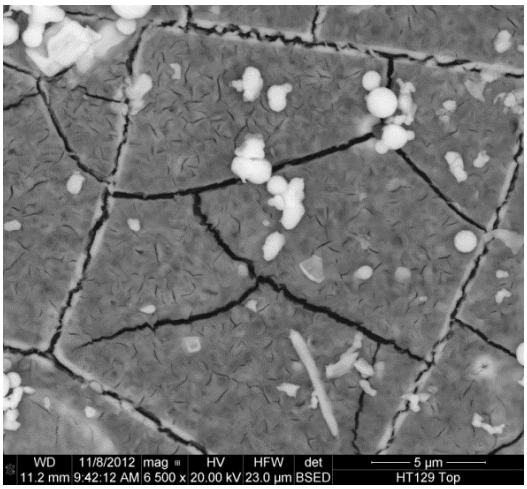

Figure 1. Backscattered electron image of UF deposited on Al.

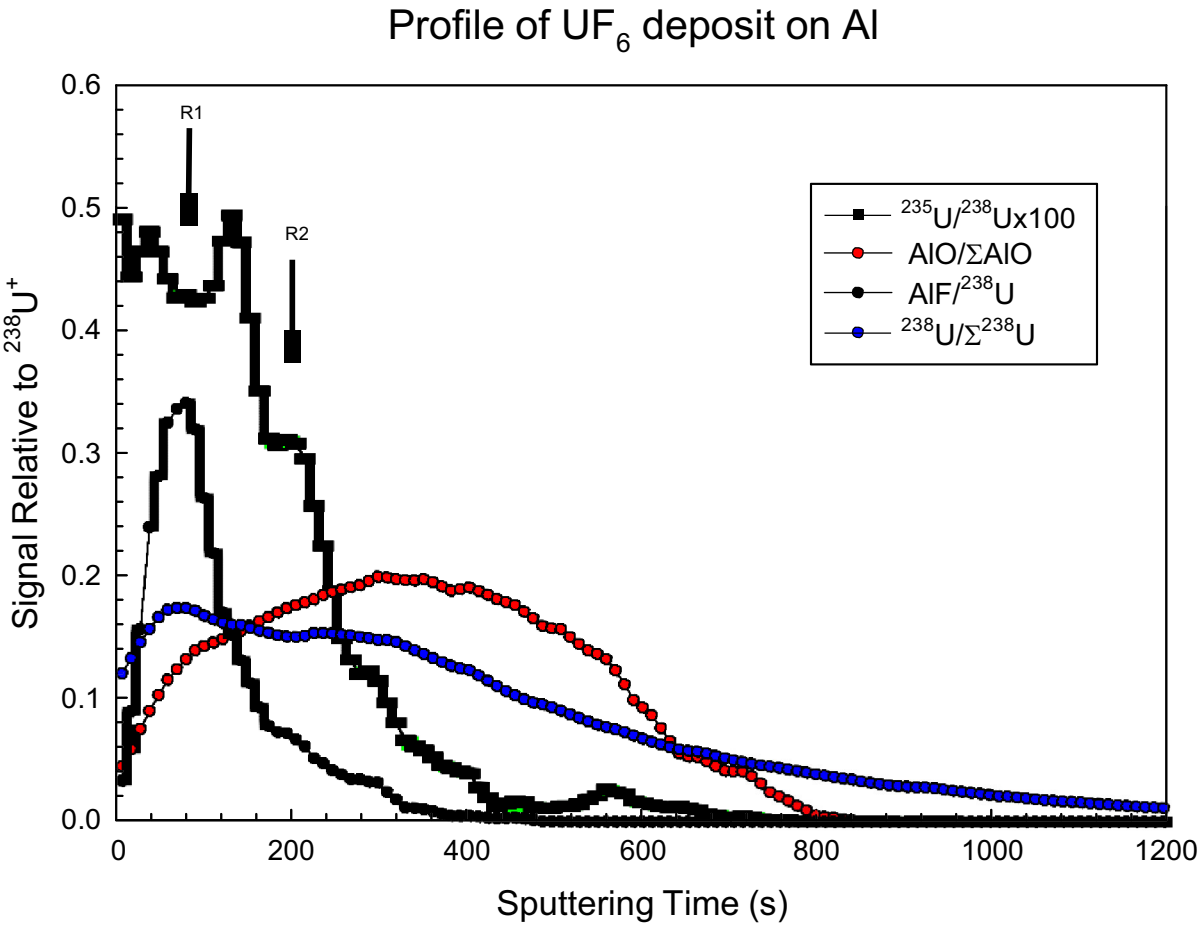

Figure 2. SIMS profile showing AlF, AlO, U and the $^{235}U/^{238}U$ ratio. Two regions (R1 and R2) of U isotopic ratios can be seen. The profiles do not have sharp transitions between regions due to reactions during deposition and surface roughness.

[1] Saniger, J. M. et al. Corrosion Science, 30 (8/9), 903-913, 1990

https://doi.org/10.1017/S1431927613005345 Published online by Cambridge University Press