

OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

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April 7, 2004

Mr Tom Steffner
Better Than New LLC.
211 Healing Bluff Road
Chattanooga, TN 37419

Re: Electron microscopy of BTN-treated sagittal saw surface

Dear Mr. Steffner:

This is a report on the results of the electron microscopy work performed on a BTN-treated saw blade under the High Temperature Materials Laboratory User Program proposal #2003-043. The attached PowerPoint slides show the electron micrographs acquired on the HTML's JEOL 2010F field emission TEM, and energy-dispersive x-ray spectra acquired using the Noran detector system on that instrument.

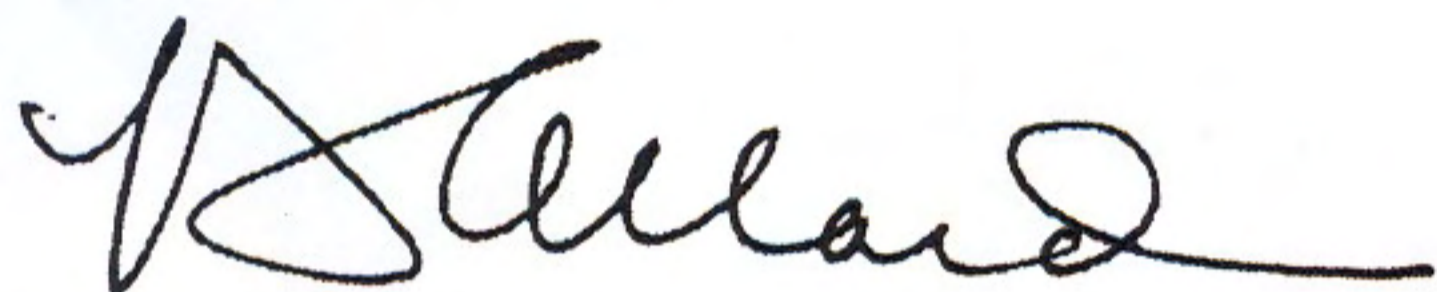
Electron-transparent thin samples were prepared using the Hitachi FB-2000 focus-ion-beam milling instrument (FIB). A small piece of the supplied saw blade was sectioned and mounted in the FIB so that the surface of a sawtooth was normal to the incident gallium ion beam. To protect the surface of the sawtooth, a very thin glue layer was deposited just prior to insertion of the sample into the FIB. A tungsten overlayer was deposited over the glue layer, to further protect the surface during milling. A small slice about 15 microns x 10 microns x 4 microns thick was lifted out of the surface using an in-situ "microsampling" technique. This thin slice was mounted on the edge of a grid bar of a beryllium TEM grid, and the 4-micron-thick dimension was final milled to electron transparency (~50nm).

Figure 1 shows a low magnification image of the cross section through the tungsten and glue overlayers, and into the sawtooth alloy. A higher magnification image of the boxed area is shown in Fig. 2. There is a clear surface layer on the alloy, about 6nm thick. ED spectra from areas marked A and B in Fig. 2 are shown in Fig. 3. The presence of

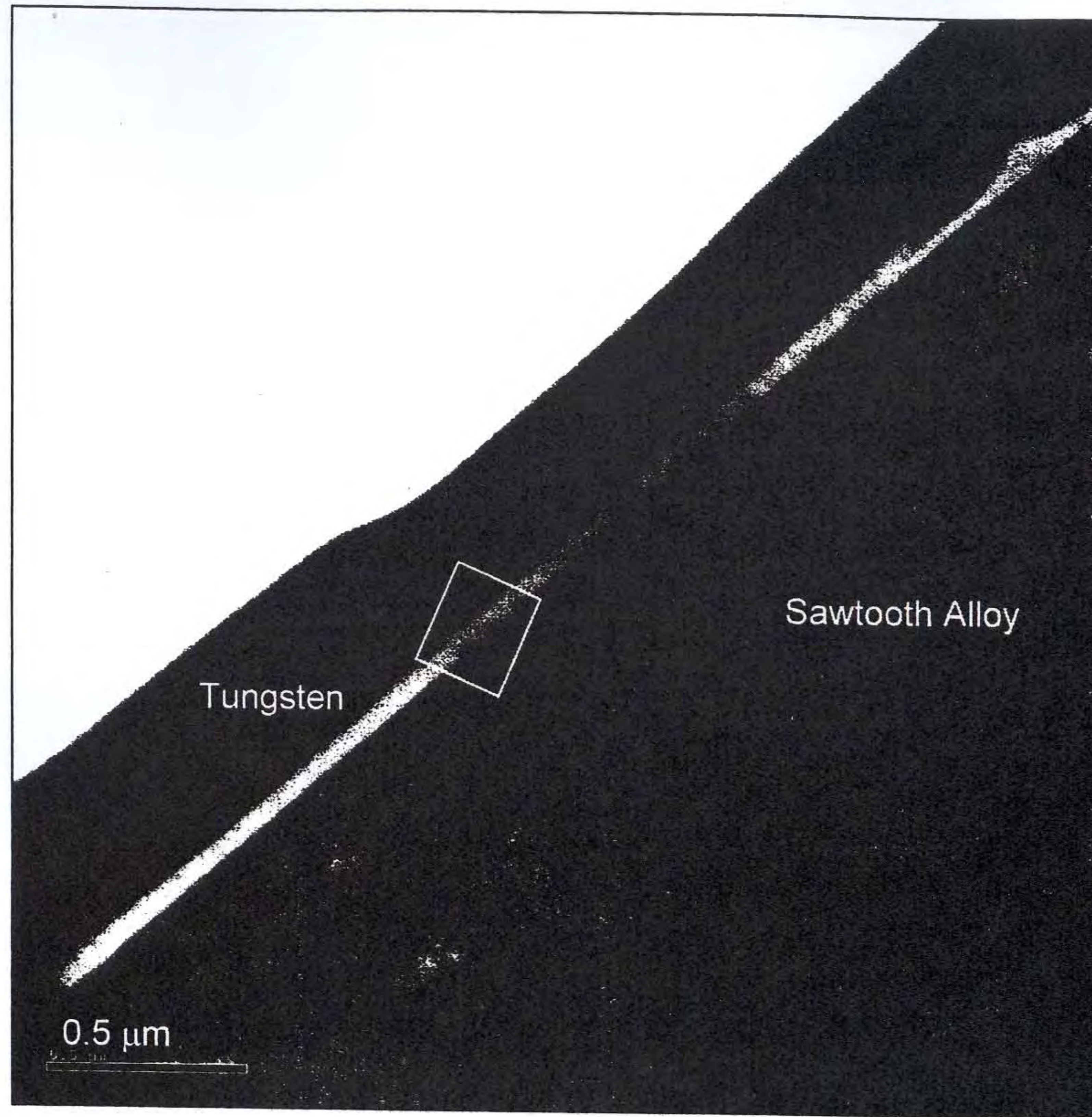
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calcium and sulfur associated with the surface layer is indicated by the peaks labeled in Spectrum A. No Ca is shown in the adjacent area B, from the base alloy. This Ca-rich surface layer is consistent with the Auger electron spectroscopy and x-ray photoelectron spectroscopy results obtained from the surface of the same sawtooth, and is associated with the chemical processing treatment applied by BTN. Please note that the remaining peaks on the spectrum result from the alloy itself, or, in the case of W and Ga, from the focused ion beam milling procedure.

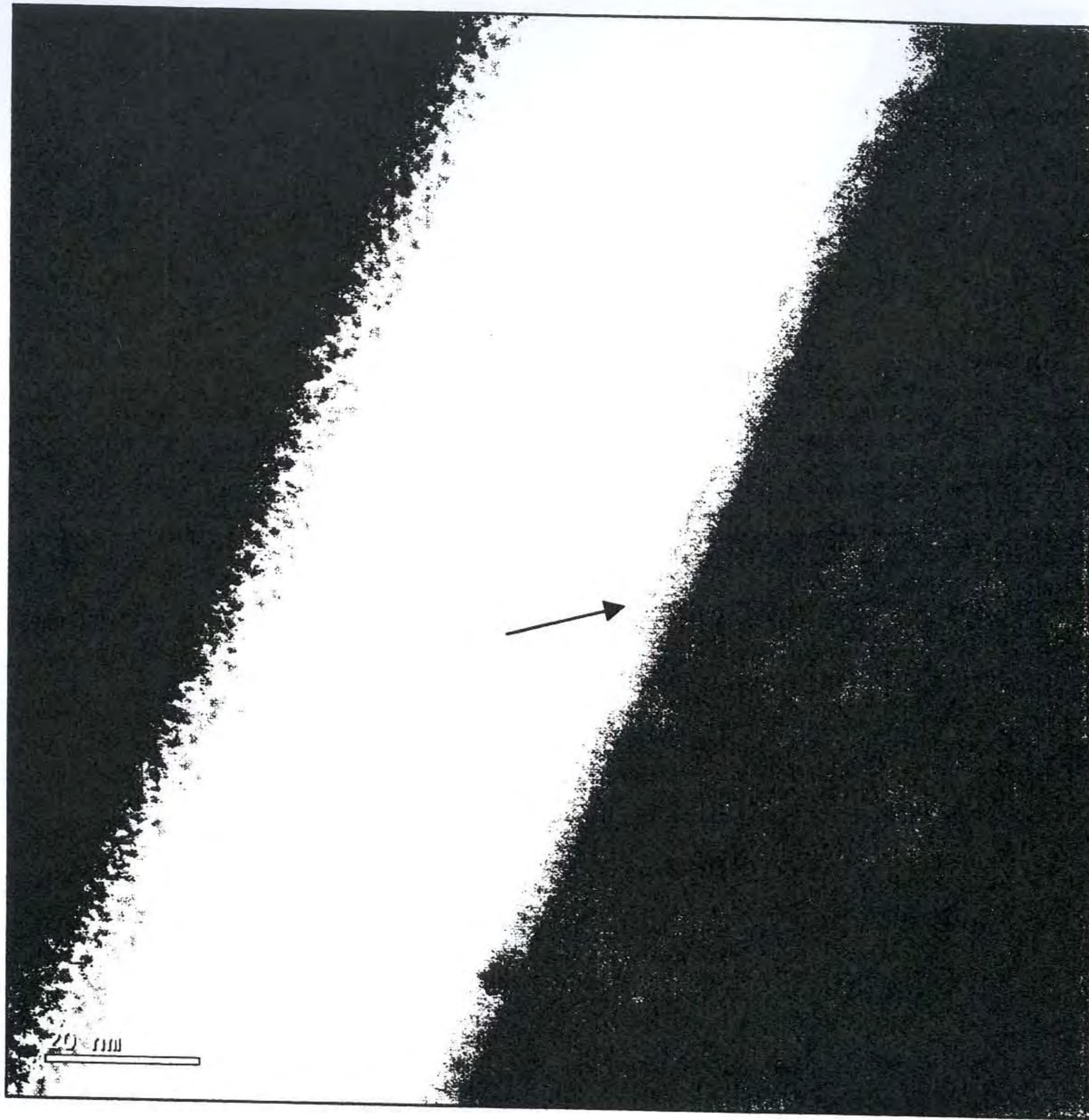
Sincerely yours,

A handwritten signature in black ink, appearing to read "L. Allard". The signature is fluid and cursive, with a long horizontal stroke at the end.

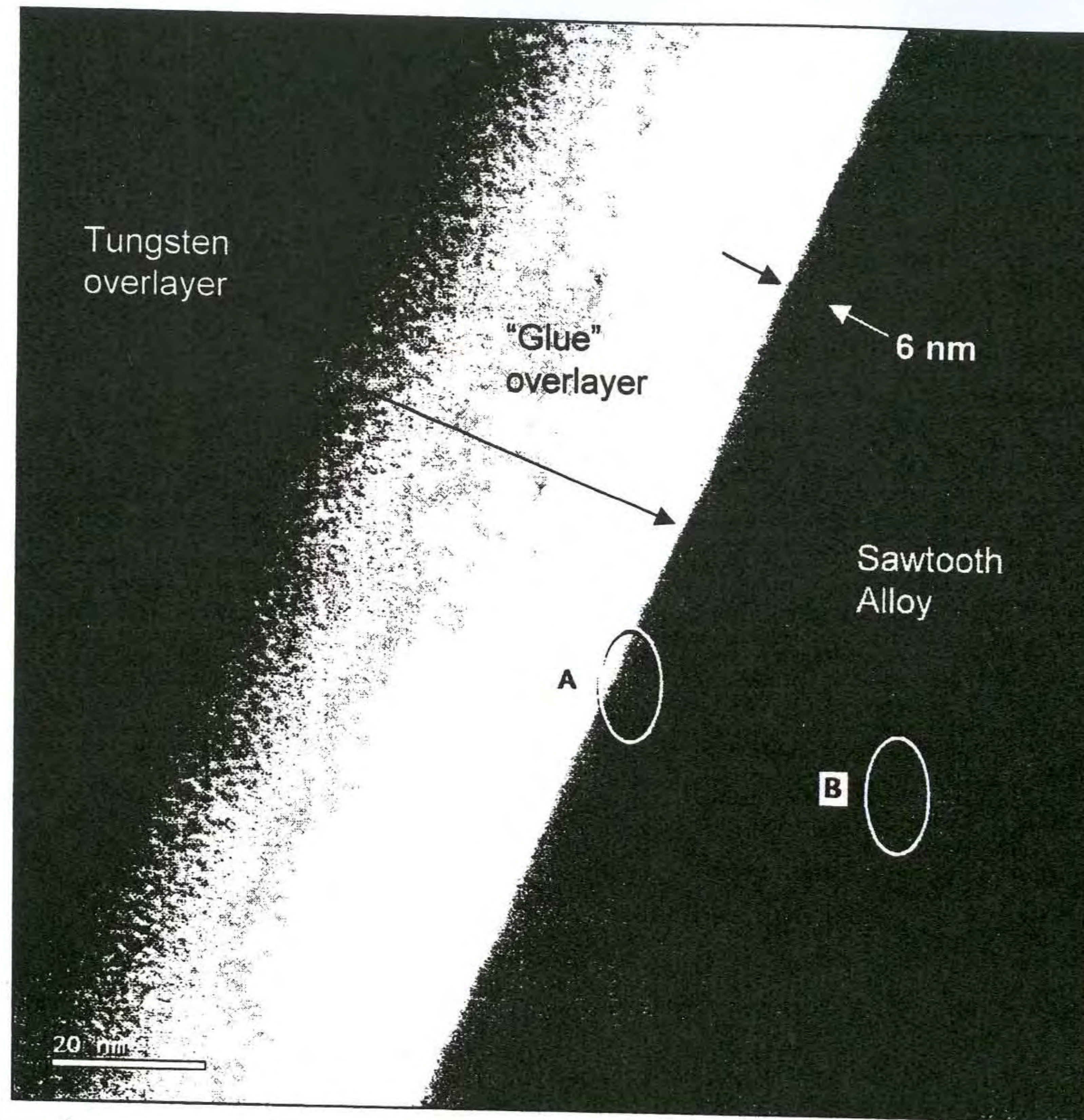
Lawrence F. Allard, PhD
Distinguished Member of the Research Staff
Task Leader, Materials Analysis Group
High Temperature Materials Laboratory
Metals and Ceramics Division
Oak Ridge National Laboratory
Oak Ridge, TN 37831



TEM image of focused-ion-beam milled sawtooth. Box shows area of higher magnification image.

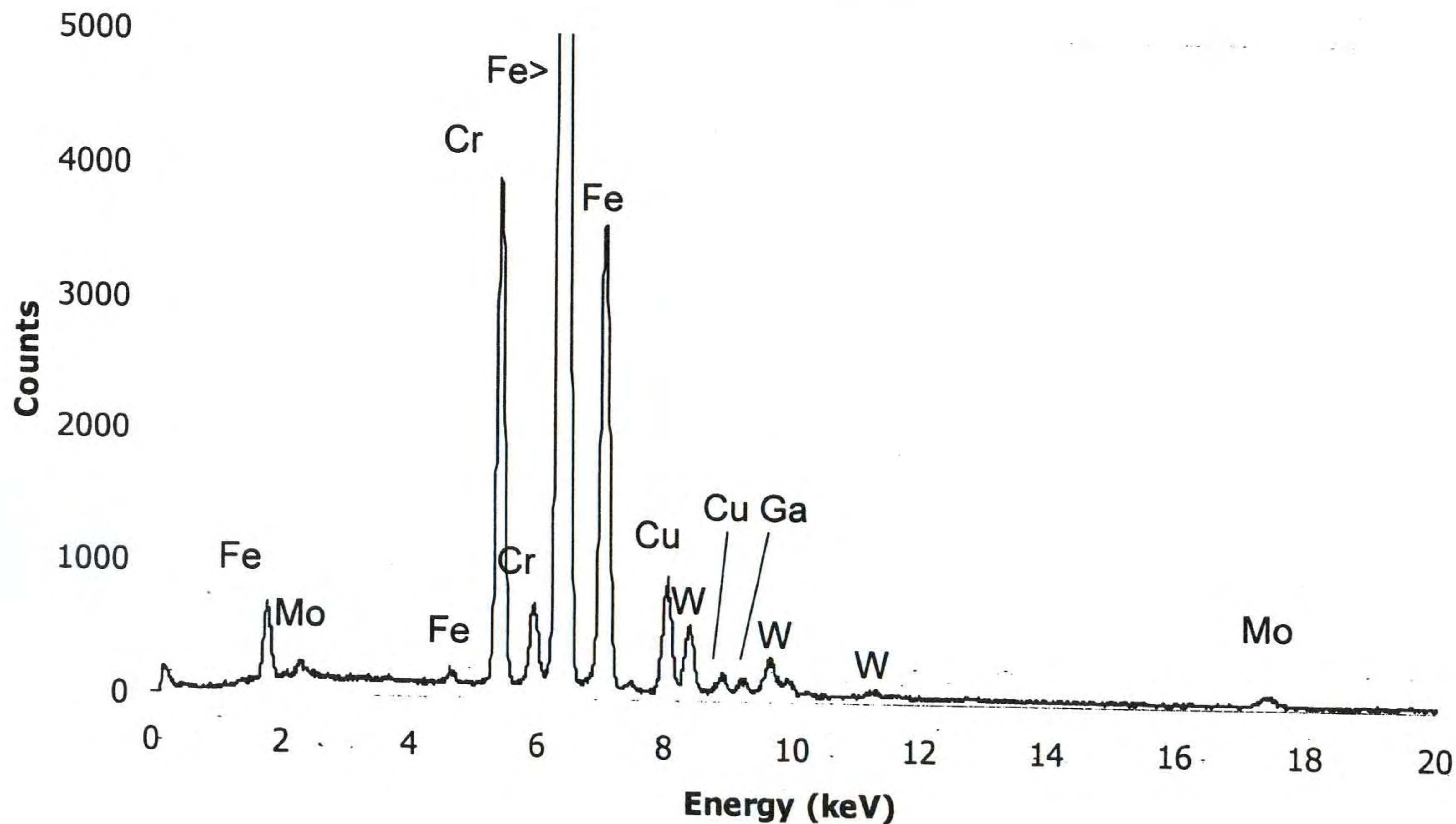


A higher exposure shows the discrete layer on the alloy surface more distinctly.

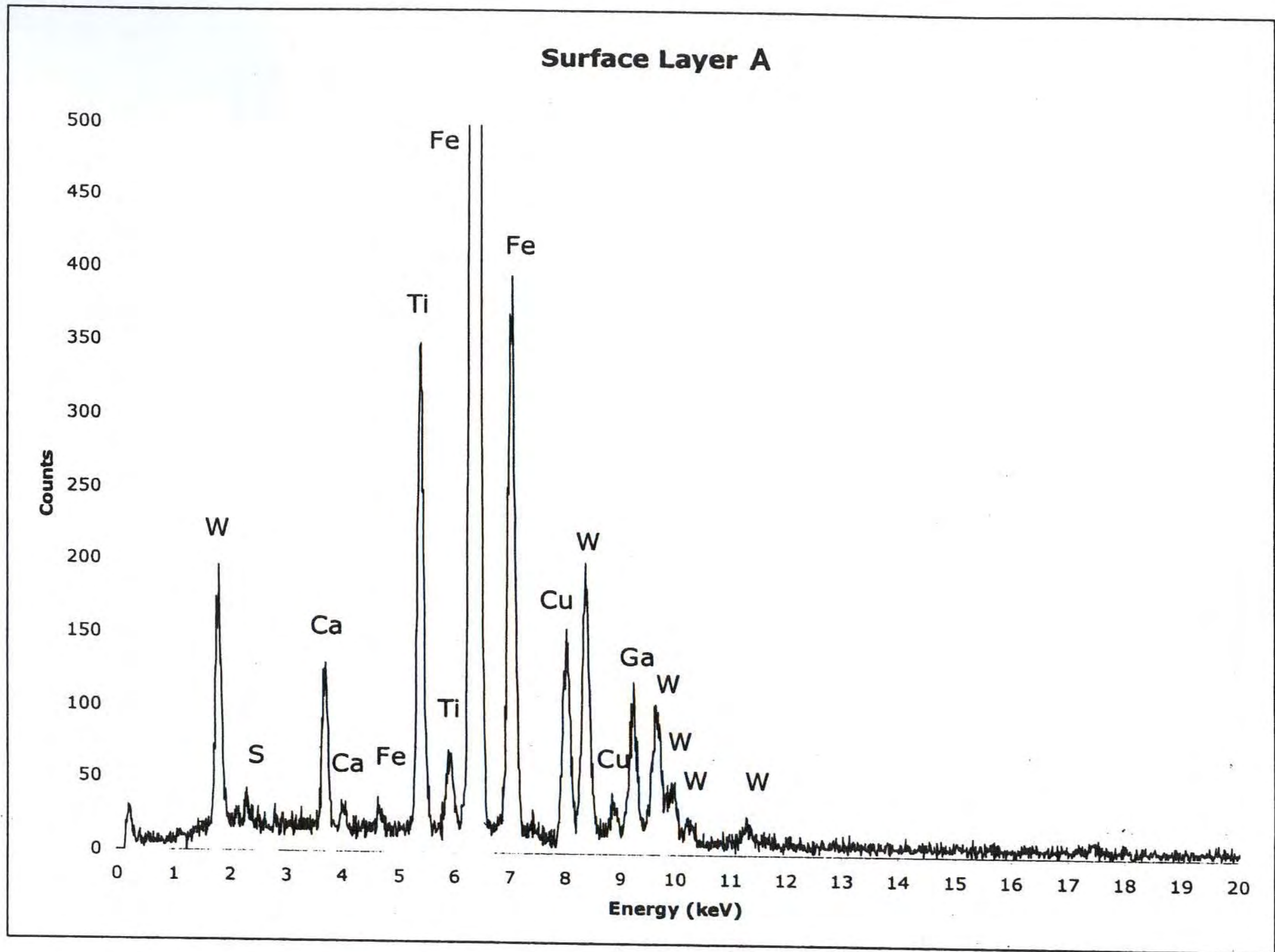


Inset area from previous figure, showing cross section at surface of sawtooth. A discrete surface layer 6nm thick is evident. Energy-dispersive x-ray spectra were collected from areas labeled A and B.

Sawtooth Alloy B



EDS spectrum from sawtooth alloy, area B. Note presence of Mo peak at 17.4keV, and corresponding Mo peak (which overlaps S) at 2.31keV. No significant Ca or S present in alloy.



EDS spectrum from 6nm surface layer on sagittal sawtooth. Note presence of Ca and S in layer.