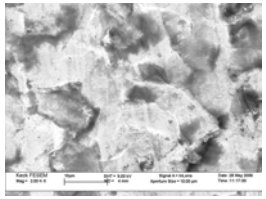
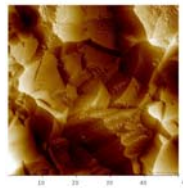
Surface Roughness vs. Grain Size Analysis on Nb Samples

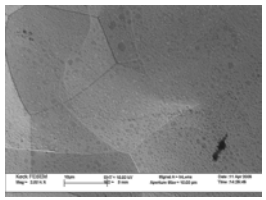
J. Kaufman, H. Padamsee, Cornell University



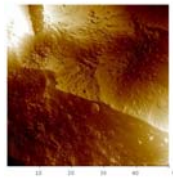
Smaller Grain



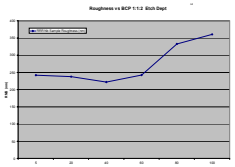
We have measured the surface roughness produced by a 100um BCP 1:1:2 etch for polycrystalline niobium samples of various grain sizes. Our goal is to study the change in surface roughness with grain size. Field Emission Scanning Electron Microscopy (FESEM) and Atomic Force Microscopy (AFM) were used to document samples and grain sizes. An Alpha-Step stylus profilometer and the Atomic Force Microscope were used to measure roughness.

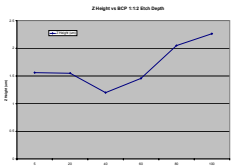


Larger Grain



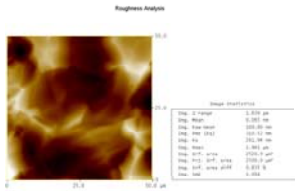
Initially the effects of BCP 1:1:2 etch depth on niobium roughness and step height between grains was studied. Roughness increases significantly between 50 and 100 um. We decided to use the standard 100um etch for the study.



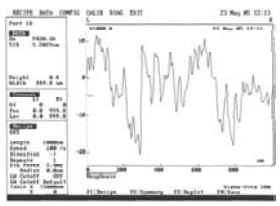


Roughness measurements using the AFM indicated that on a micro scale (nm), surface roughness was quite similar between the smaller grain samples and the larger grain samples.

The main difference the AFM roughness measurements indicated is that the step height (Z range) between grains tended to be greater with the larger grain samples



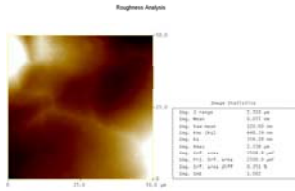
Rms (Rq) Average = 436.77 nm



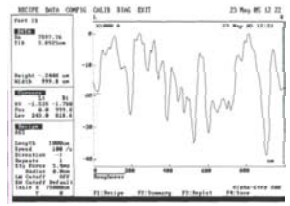
Profilometer Roughness Measurements:

1. RA= 4726.4A
2. RA= 7326.3A
3. RA= 5430.3A

Average RA = 5827.7A



Rms (Rq) Average = 444.04 nm



Profilometer Roughness Measurements:

1. RA = 8884.3A
2. RA = 7597.7A
3. RA = 7100.2A

Average RA = 7860.7A

Using the profilometer, macro scale (um) roughness measurements were obtained. These measurements indicated that larger grain samples were more rough than smaller grain samples.Using this and the AFM data it has been determined that larger grain samples are inherently more rough due to the increased differences in height (Z range) at their boundaries that the larger grains exhibit as compared to the smaller grains.