

Notes on Scanning Electron Microscope Analysis of 25-Cell W-Band Structure Iris Diffusion Bond Joint

Introduction

E. Colby 8/14/98

The sample selected for microscopy was 5R50 (Jean Francis's cataloging system), iris joint BI4,5 (Dennis Palmer's substructure nomenclature). The sample had been potted in plastic, and had undergone metallographic preparation comprising lapping to very fine finish followed by an acid etch. Material had been removed from the sample such that the exposed surface examined microscopically had been deep inside the diffusion bond joint. Clean metal surfaces were available for microscopy. Electrical grounding was provided initially with commercially produced carbon-suspension sticky pads, but was found too poor to prevent charge buildup. Grounding was then accomplished with aluminum foil strips affixed to the copper samples by small pieces of adhesive tape.

Images and Spectra

Seven electronic images and three secondary electron emission spectra were acquired. Images and spectra are electronically archived in two locations:

Sem.slac.stanford.edu:\sem\data\w-band

On the NT network V:\arbd\w-band\SEM_Analyses\980813

A summary of the images is provided in the table below. Spectra are secondary electron emission spectra obtained from very small subregions of the attached images, as described briefly below.

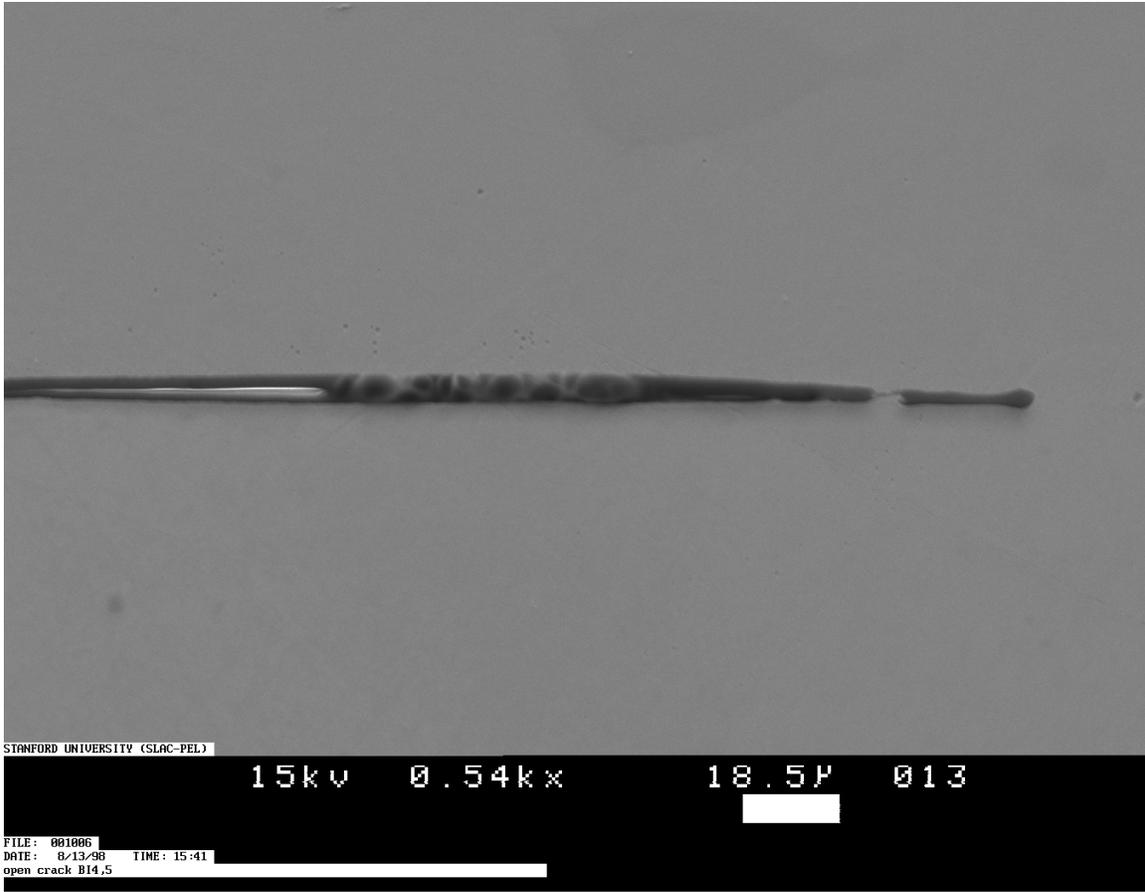
<u>File Name</u>	<u>Description</u>
001006B.gif	Largest crack in bond joint at 540X, fluorescent insulator is source of spectrum
001006.gif	Pit adjacent bond crack at 1630X, spectrum from site inside crack
001007.gif	Surface porosity on surface away from crack at 3000X
001008.gif	Pit along "good" bond joint segment at 8800X
001009.gif	Overview of "good" bond region at 500X
001010.gif	Grain boundary/bond joint intersection with two pits at 2000X
001011.gif	Double pit in "good" bond region at 2670X with spectrum of pit contents

Image 001009.gif provides a useful overview of all the sample sites.

Discussion

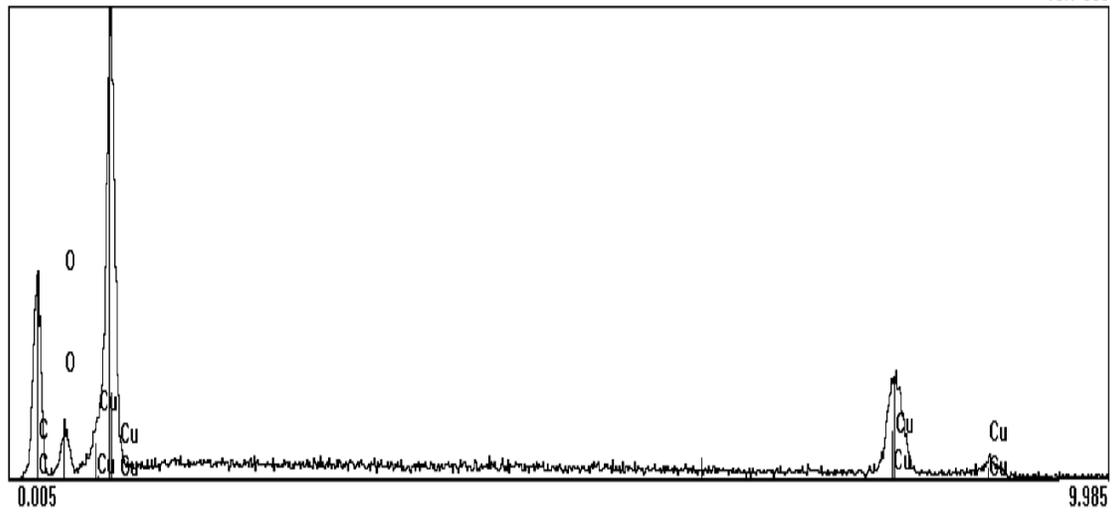
The pits appearing in image 001007 could well arise during the acid etch step. Since similar lapping and etch treatment is used prior to diffusion bonding it is reasonable to expect the diffusion bond surfaces so prepared to be pitted, giving rise the voids seen in images 001006, 001008, 001009, and 001011. The size of the surface pits and the bond crack pits are comparable, $\sim 1 \mu$. Relative dislocation of the copper grains is also evident from the shadows cast in image 001010. Such changes in surface flatness could account for the smaller crack seen in 001006.

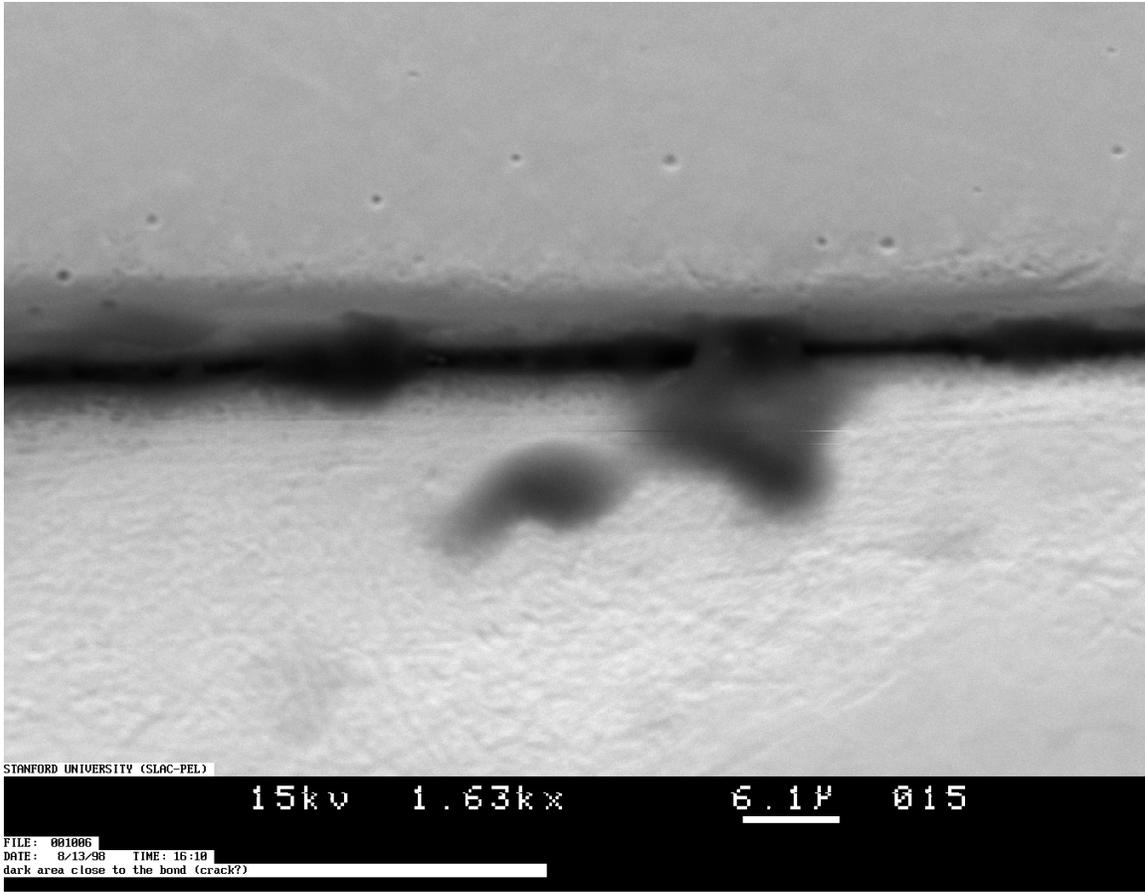
The sample was quite free of surface particles of the type seen in the prior SEM analysis of the W-band structure, completed on July 23, 1998.



Spectrum: Untitled1 Range:20keV

Vert=658

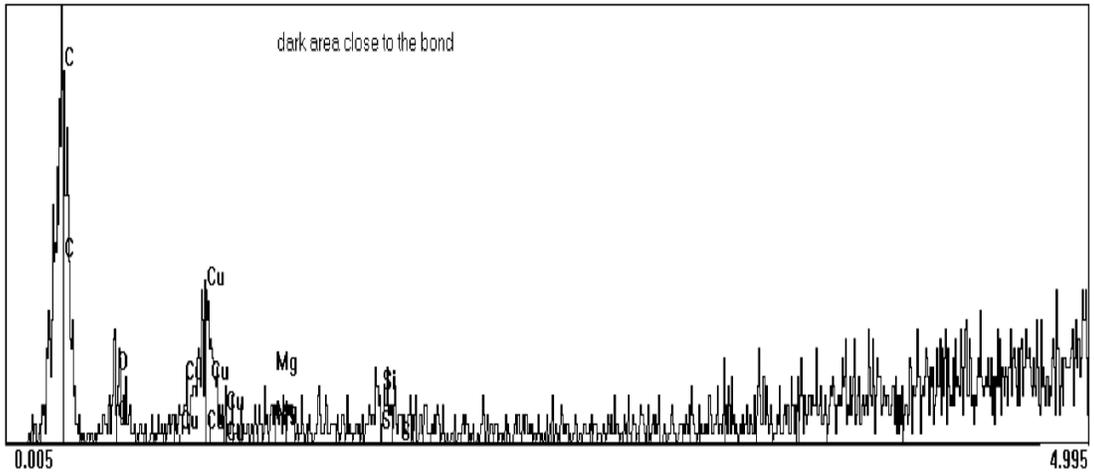


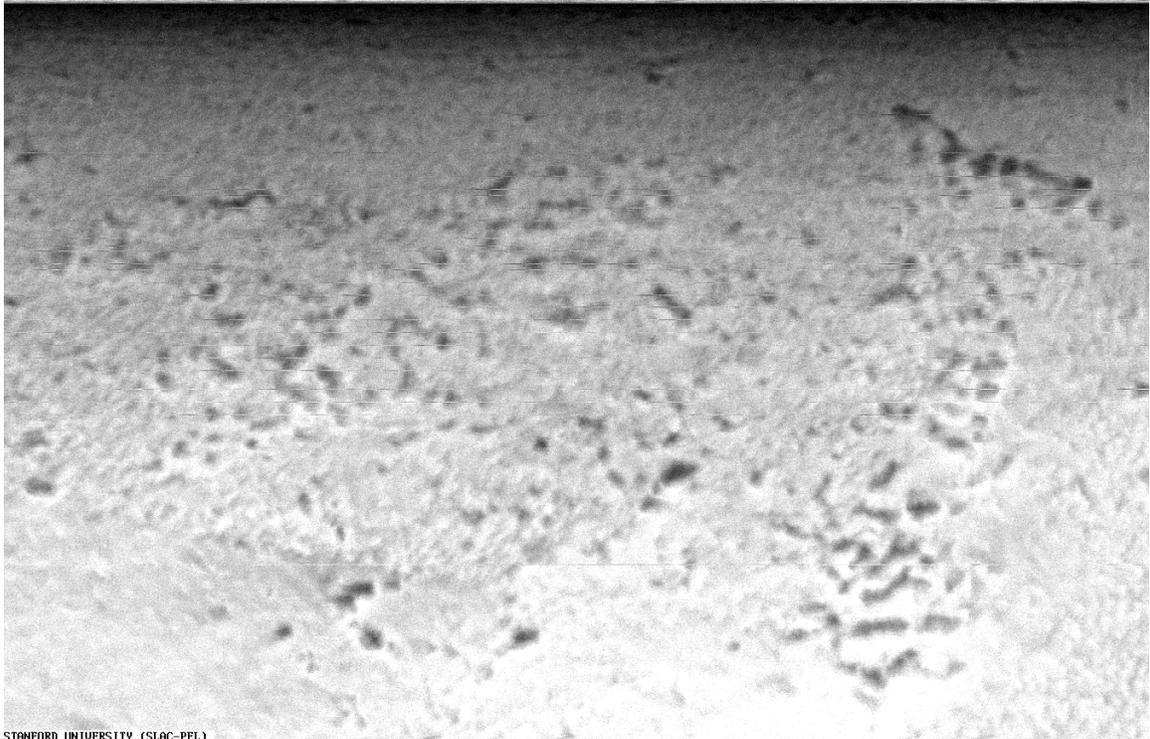


Spectrum: Untitled1

Range:20keV

Vert=46

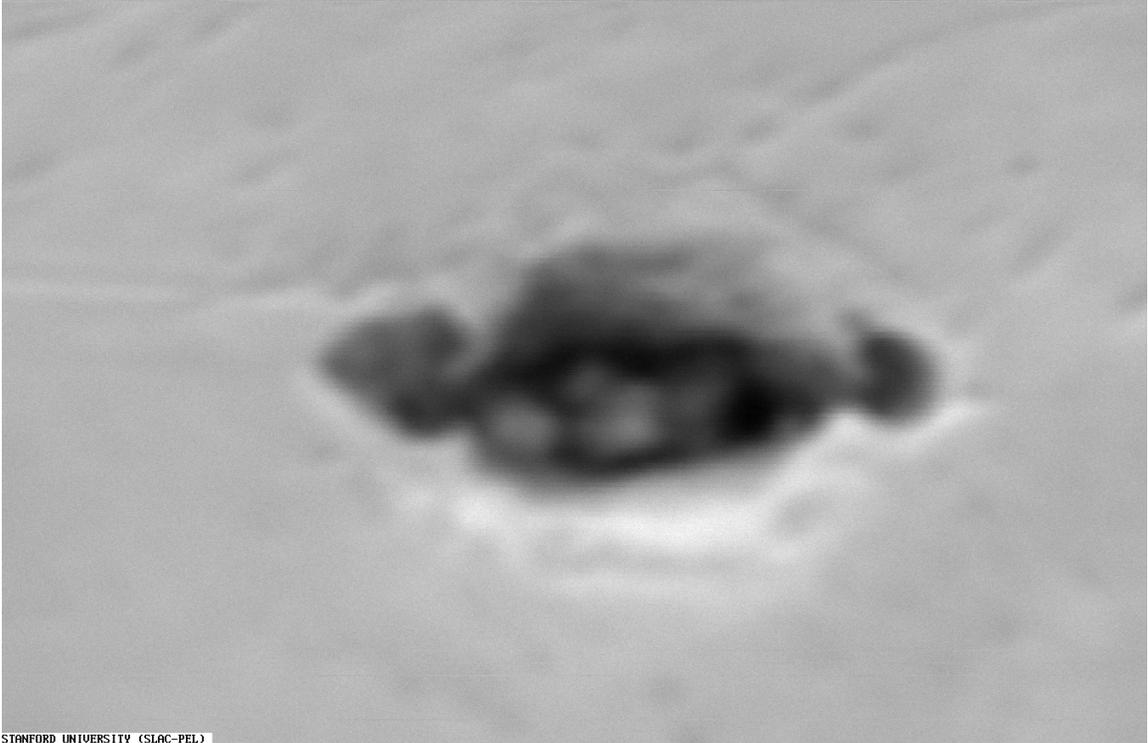




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15kV 3.0kx 3.30µ 016

FILE: 001007
DATE: 8/13/98 TIME: 16:35
copper porosity away from bond



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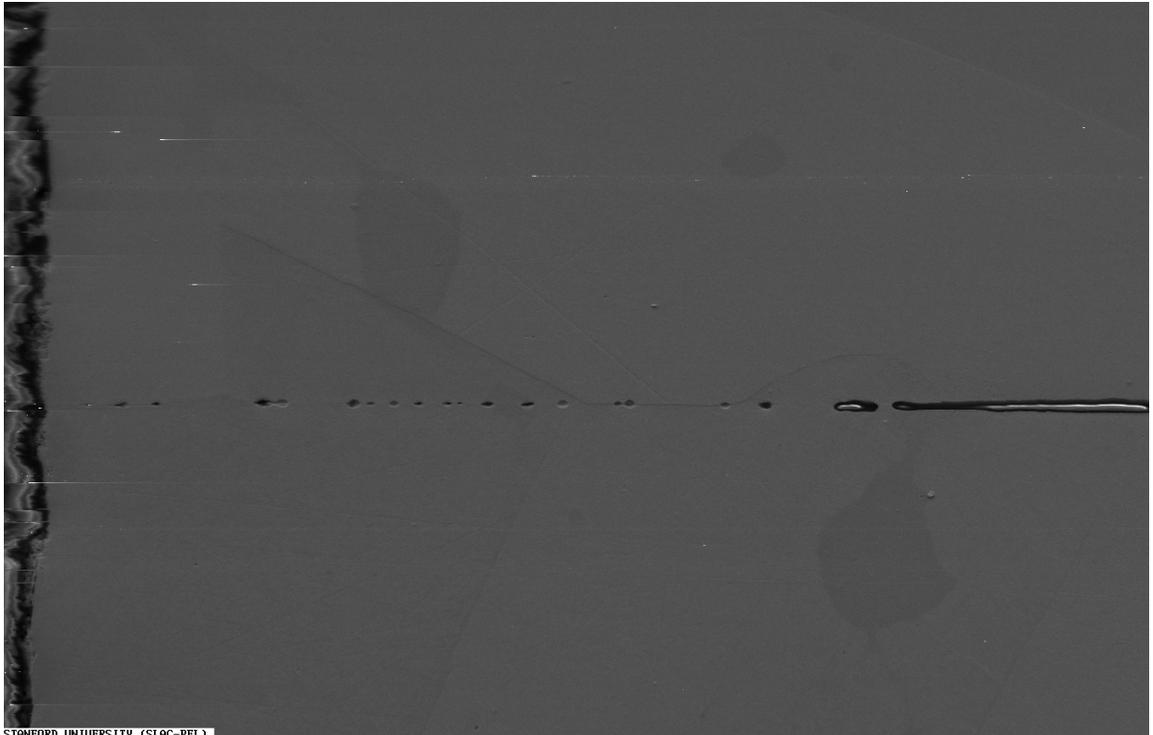
15kV

8.8kx

1.15μ

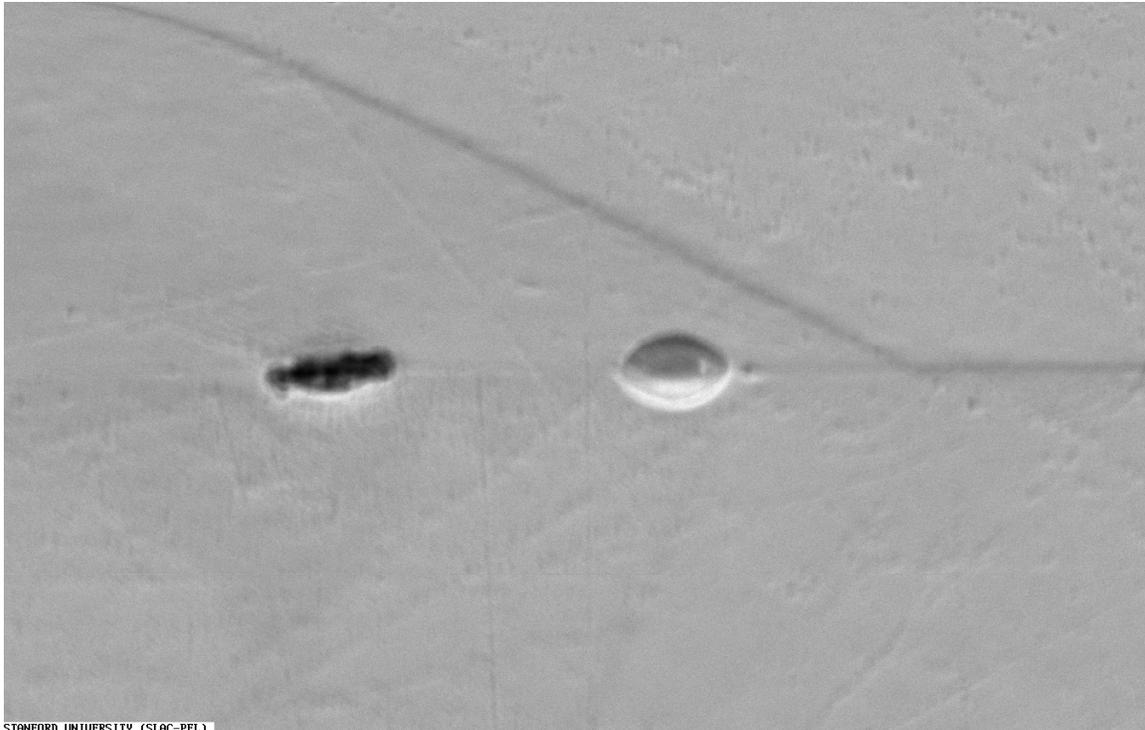
017

FILE: 001000
DATE: 8/13/98 TIME: 16:50
good region, hole in bond



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FILE: 001009
DATE: 8/14/98 TIME: 9:04
distance view of good bond



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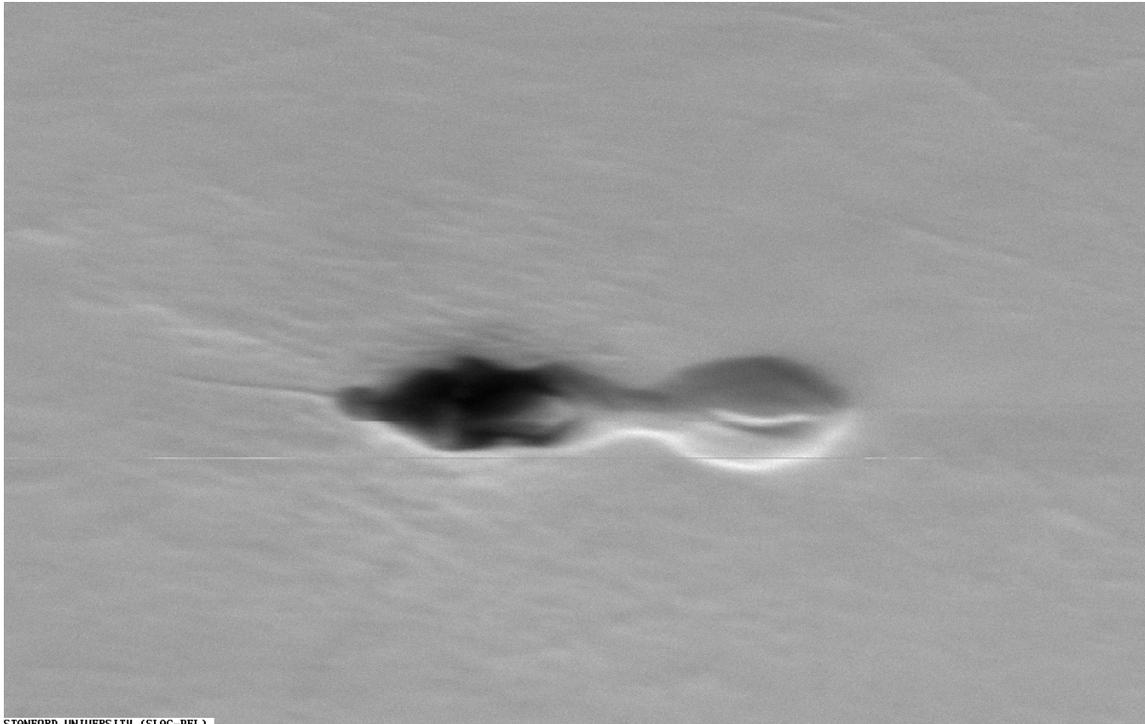
15kV

2.0kx

5.00μ

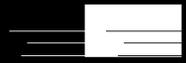
019

FILE: 001010
DATE: 8/14/98 TIME: 9:18
grain tip view at bond



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15kV 2.67kx 3.7μ 020



FILE: 001011
DATE: 8/14/98 TIME: 9:33
island at bottom of bond pit