

Visit Report: Cal Tech

Date: 10/19/2020

Engineer: Zach Mehl

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Summary

Visit duration Monday October 19, 2020 – Wednesday October 21, 2020

Work performed

- Carried out 12 month preventative maintenance schedule:
 - Reviewed current operation of system
 - Fermi edge showing healthy xray window
 - Survey and unscanned data showing instrument in good alignment, only small tweaks will be necessary
 - Replaced water circulator particle filter and ion exchange filter
 - Topped off water level, tested flow rate and checked for leaks – ALL OK
 - Checked all interlocks
 - Checked all electronics cooling fans
 - Replaced xray anode
 - Visually inspected lens screens
 - Checked all valve operation and reviewed state of vacuum system
 - Checked crystal heater
 - Reviewed state of 9600 xray controller
 - All voltages OK – 2kv balanced, VF, VQ calibrated
 - Recorded all voltages
 - Checked all spot sizes and power output
 - Aligned crystal monochromator for maximum counts and best alignment
 - Calibrated v1 curves for maximum lens throughput
 - Calibrated detector width
 - Captured and loaded new signature file for use
 - Recorded all spectrometer voltages
 - Took instrument performance data to ensure count rate and resolution within specification
 - Recorded computer configuration values

Follow up

Inventory used

Performance Data

Survey

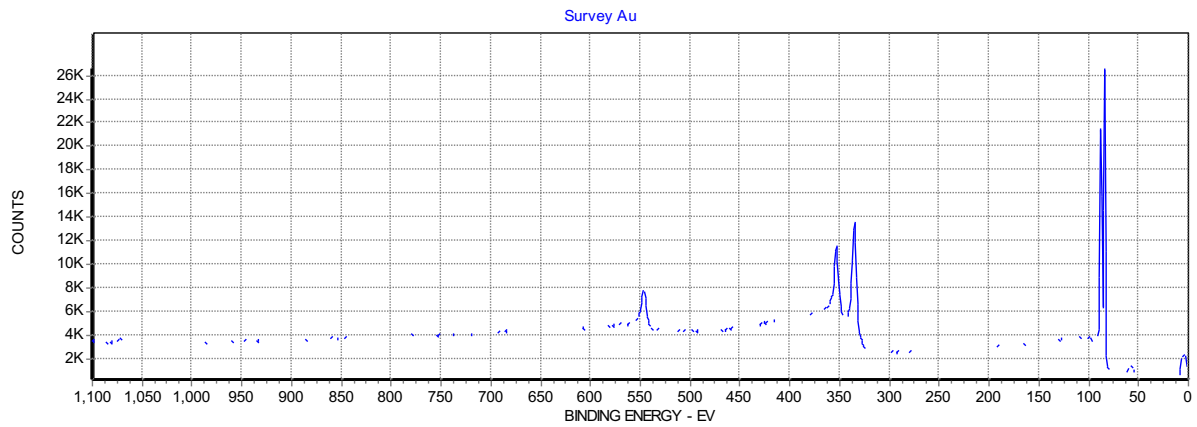


Figure 1: Survey on Au calibration sample after sputtering showing very little surface contamination.

Gold Purity: 94 %

Detector Performance

Signature

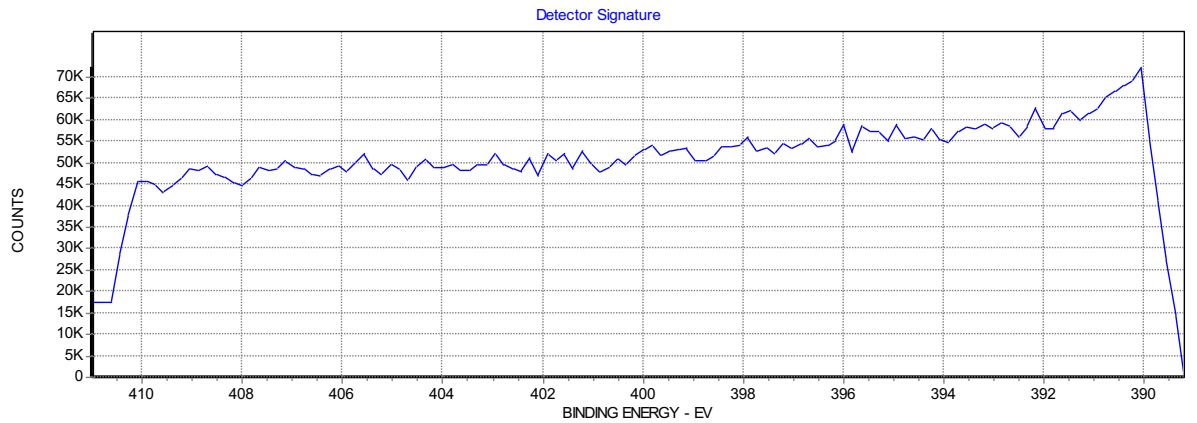


Figure 2: Detector signature after 2 minutes of acquisition. 800 micron spot, Res 4.

Dark Signal

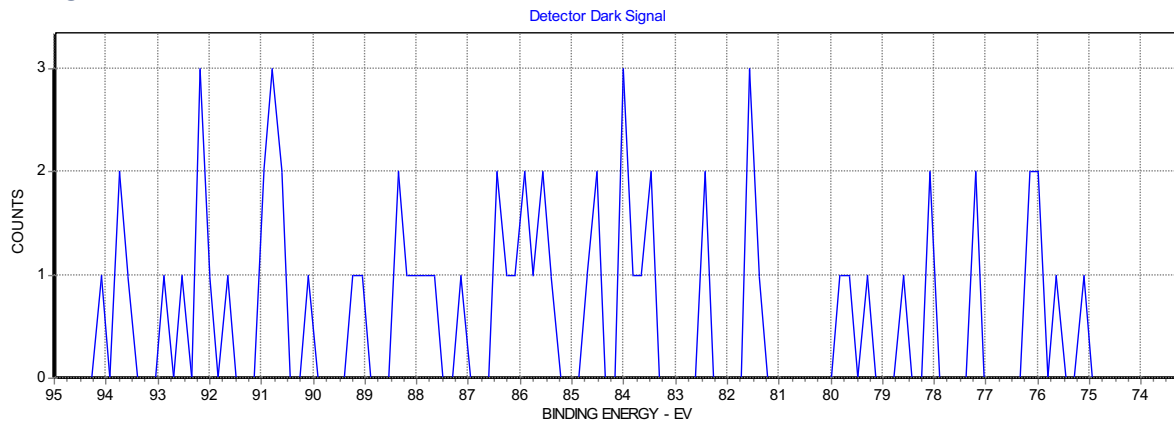


Figure 3: Detector dark signal. Acquisition for 60 seconds in Res4 with all x-rays off.

Signal to Background

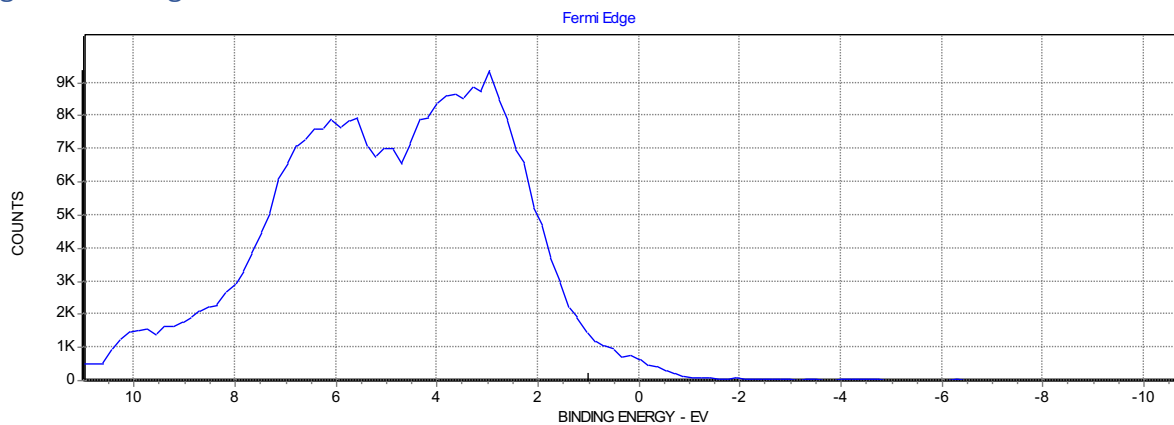


Figure 4: Gold fermi edge level, for testing health of x-ray window. Taken for 60 seconds, Res4, 600 micron spot.

Signal to Background ratio calculation:

	Actual Measurement
Peak Valence Band Counts	9300
Average Background Counts	28.8
Ratio Peak/Background	322.9166667

Gold Performance

The following data is taken in unscanned mode to test the performance of the system. The measurement is taken with a center binding energy of 84 eV to accommodate for the Gold 4f7/2 and 4f5/2 peaks. Each spectra is from 60 seconds of capture time. Peak fitting is then used to find the counts area under the peak and the full width half maximum (FWHM).

Note: Count rate and resolution is highly dependent on gold purity on the surface. Refer to the survey for the actual gold purity during the visit.

Region 1: 800 Micron Spot, Resolution 4

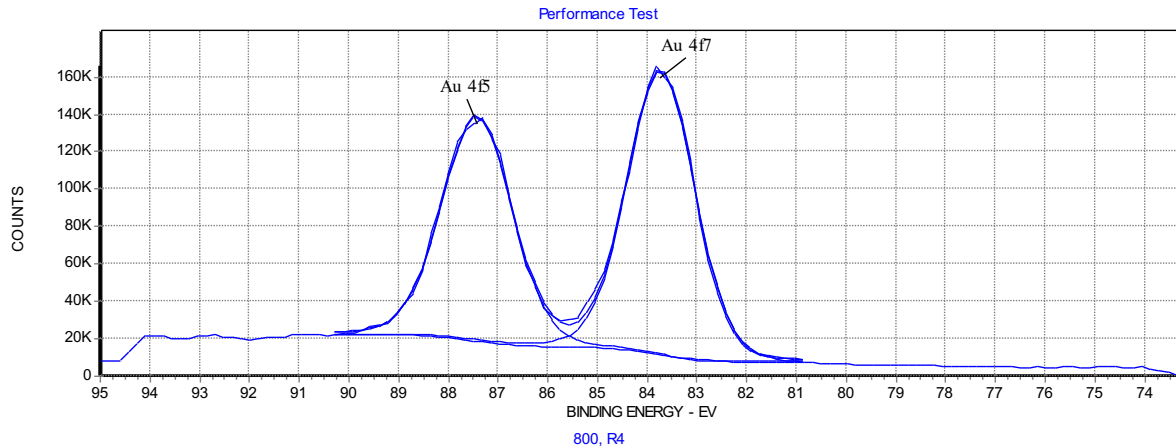


Figure 5: Gold performance test. Taken using 800 micron spot, resolution 4, 60 seconds of unscanned acquisition.

Peak ID	Adj'ed Be	Area	FWHM	% Gauss
Au 4f7	83.73	1532768	1.596	87.408
Au 4f5	87.428	1259270	1.659	86.828

Region 2: 600 Micron Spot, Resolution 3

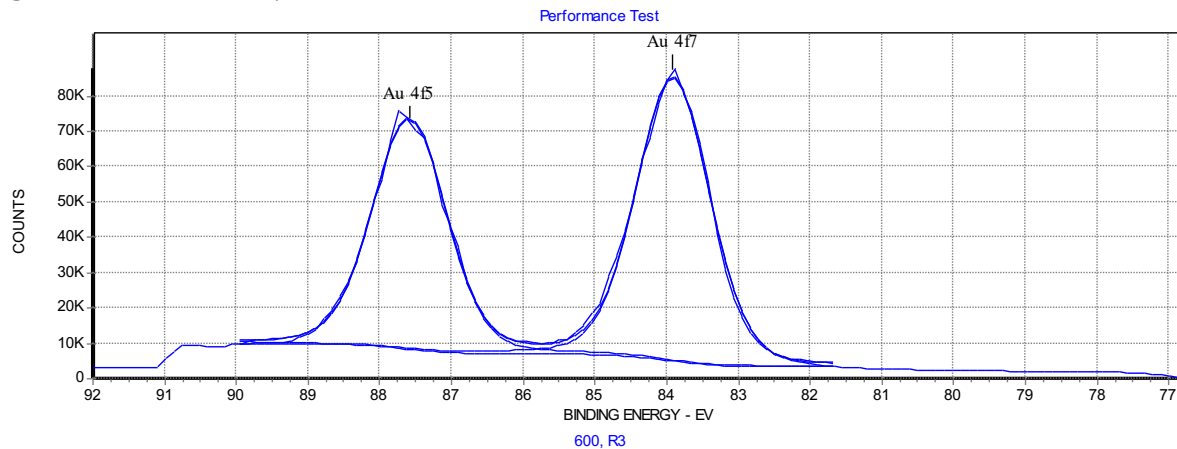


Figure 6: Gold performance test. Taken using 600 micron spot, resolution 3, 60 seconds of unscanned acquisition.

Peak ID	Adj'ed Be	Area	FWHM	% Gauss
Au 4f7	83.916	930371	1.206	81.349
Au 4f5	87.591	757324	1.193	79.097

Region 3: 300 Micron Spot, Resolution 2

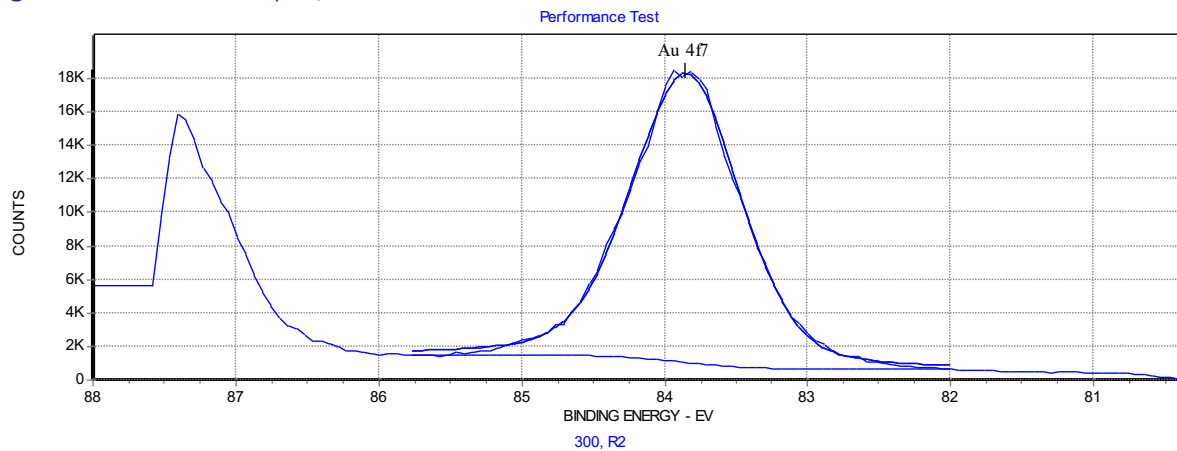


Figure 7: Gold performance test. Taken using 300 micron spot, resolution 2, 60 seconds of unscanned acquisition.

Peak ID	Adj'ed Be	Area	FWHM	% Gauss
Au 4f7	83.855	299315	0.891	71.928

Region 4: 150 Micron Spot, Resolution 1

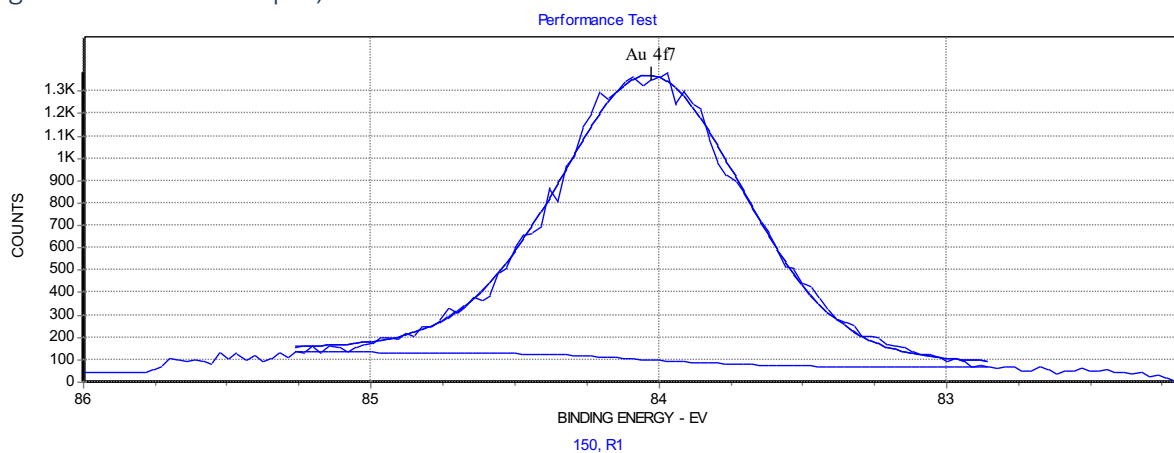


Figure 8: Gold performance test. Taken using 150 micron spot, resolution 1, 60 seconds of unscanned acquisition.

Peak ID	Adj'ed Be	Area	FWHM	% Gauss
Au 4f7	84.029	36692	0.764	78.664

Appendix – Electronics Documentation

9600 X-Ray Controller

**Service Physics Model 9603 X-Ray System
PARAMETER TABLES**

COMPANY	Cal Tech	
CUSTOMER	Bruce	
DATE	10/19/2020	COMMENT:
TEST ENGINEER	Zach Mehl	

Gun Info

S/N	8830-3065
Date Installed	Dec-19
Notes	

SPOT SIZES

	100	200	400	800	L1	L2	L3
I Out	1.58	5	9.98	20	4.99	9.98	20
I Fil	1.25	1.26	1.26	1.27	1.26	1.27	1.27
V 2KV	2.3	2.3	2.3	2.3	2.3	2.3	2.3
I 2KV	6.57	7.33	7.9	8.5	7.33	7.9	8.5
VQ	0	0	0	0	0.25	0.3	0.39
VF	8.34	8.34	8.34	8.43	8.29	8.33	8.4

Spectrometer Power Supply

8701 Spectrometer Power Supply Parameters		
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COMPANY	Cal Tech
CUSTOMER	Bruce
DATE	10/19/2020
TEST ENGINEER	Zach Mehl

PARAMETER	PE 25eV	PE 50eV	PE 100eV	PE 150eV
B.E.	84	84	84	84
Vo	1386	1359	1304	1249
BOOK	1368.7	1340.3	1282.9	1226
DELTA	-17.3	-18.7	-21.1	-23.0
SPHERE +	1374	1334	1253	1172
BOOK	1356.2	1315.5	1233.6	1152.4
ADJ VALUE	1356.7	1315.3	1231.9	1149
SPHERE -	1399	1384	1354	1324
BOOK	1381.1	1365	1332.1	1299.4
BOOK SPHERE	24.9	49.5	98.5	147
CALC SPHERE	25	50	101	152
I Mag				
BOOK	53	75	106	130
V trim	1392	1370	1327	1284
BOOK	1374.4	1352	1306.7	1261.1
ADJ VALUE	1374.7	1351.3	1305.9	1261
V1	733	783	834	885
BOOK	750	825	900	1000
VQ	1401.5	1390	1368	1346
BOOK	1382.9	1370	1343.3	1316.5
ADJ VALUE	1384.2	1371.3	1346.9	1323
V2	1449	1486	1560	1634
BOOK	1431.7	1469.7	1543.4	1615.3
ADJ VALUE	1431.7	1467.3	1538.9	1611