Search for Charged Particle Tracks Using CR-39 Detectors to Replicate the SPAWAR Pd/D External Field Co-Deposition Protocol

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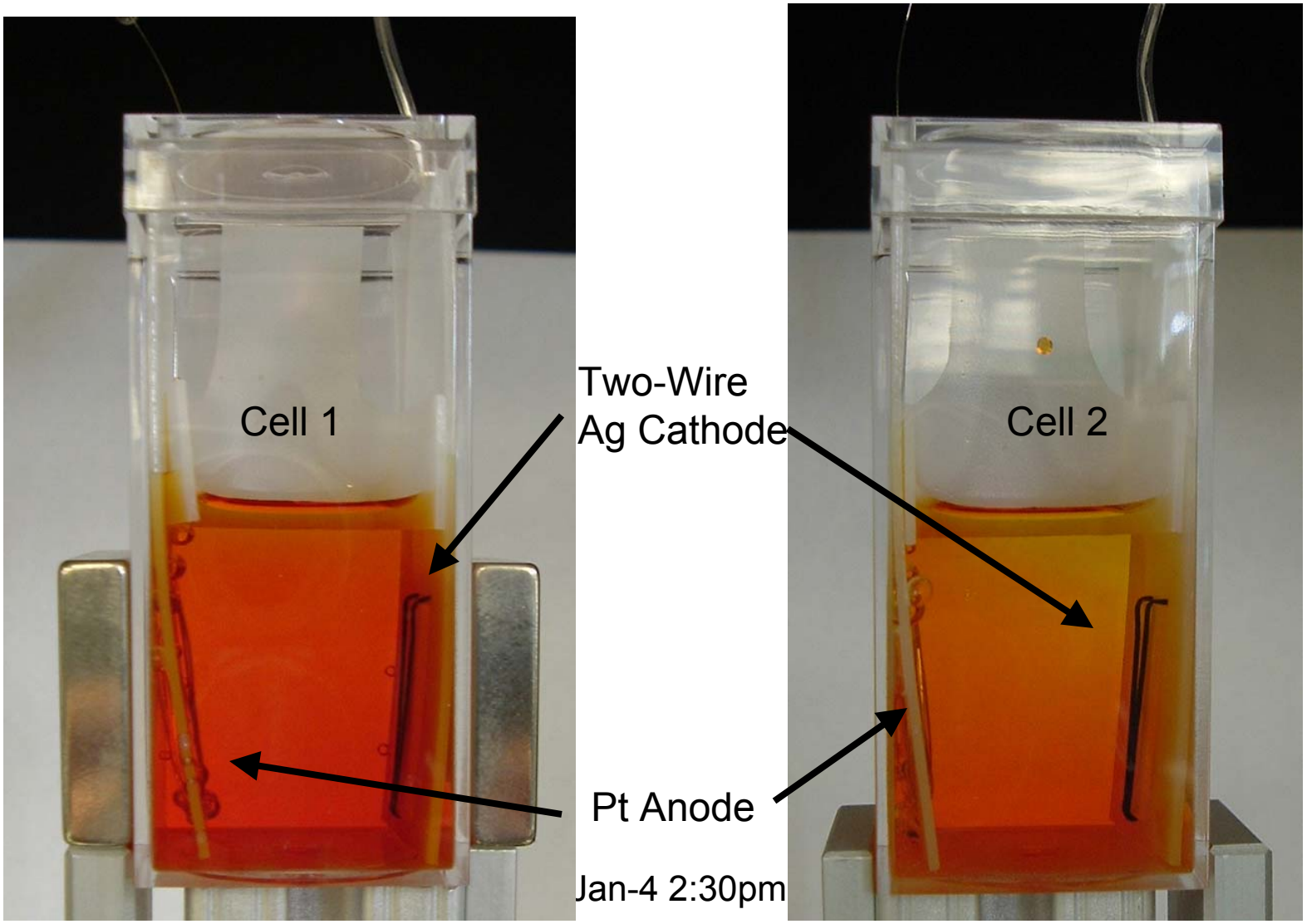
- Two cells (with & without magnets) – plastic **butyrate** rectangular cells, inch square
- Magnetic fields – approximately **2500 gauss** and **1 gauss** (+/- 40%) respectively at the cathodes
- Electrolyte – **0.03 M PdCl2 + 0.3 M LiCl in D2O**, 22ml per cell
- Anode – **Pt wire** 0.25 mm diameter and immersed length several cm
- Cathode – **Ag wire** of 0.25 mm diameter and immersed length several cm
- Detector – **CR-39** (1 cm x 2 cm **Landauer/Fukuvi**)
- **Additional CR-39 detectors** (from **TASL**) were added outside the cells during the last 24 hours of electrolysis (at 100mA). Neutron detectors from **Landauer** (designed for dosimetry badges) were also added during the last days of the "loading" electrolysis phase.
- Before etch, electrolyzed CR-39 showed SMALL amounts of apparent Pd deposition on the CR-39 plastic track detector. CR-39 was rinsed to remove electrolyte but NOT wiped to remove the deposition. All CR-39 except the neutron detectors have been **etched 3 hours at about 68 deg C in 6.5 molar NaOH**.

Cells with CR-39 under AG cathode wires before adding electrolyte

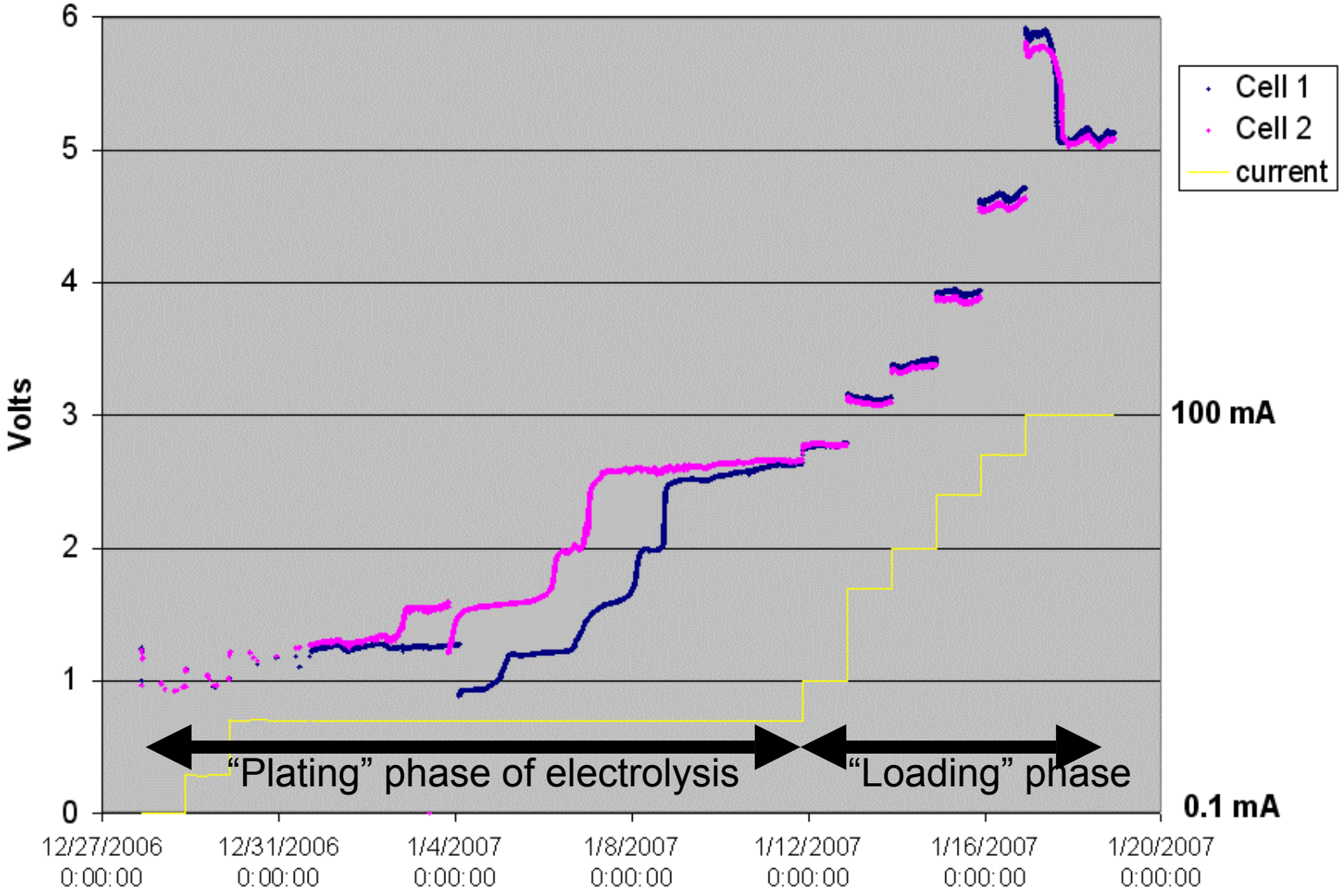
Cell 1

Cell 2

Half way through “plating” phase of electrolysis

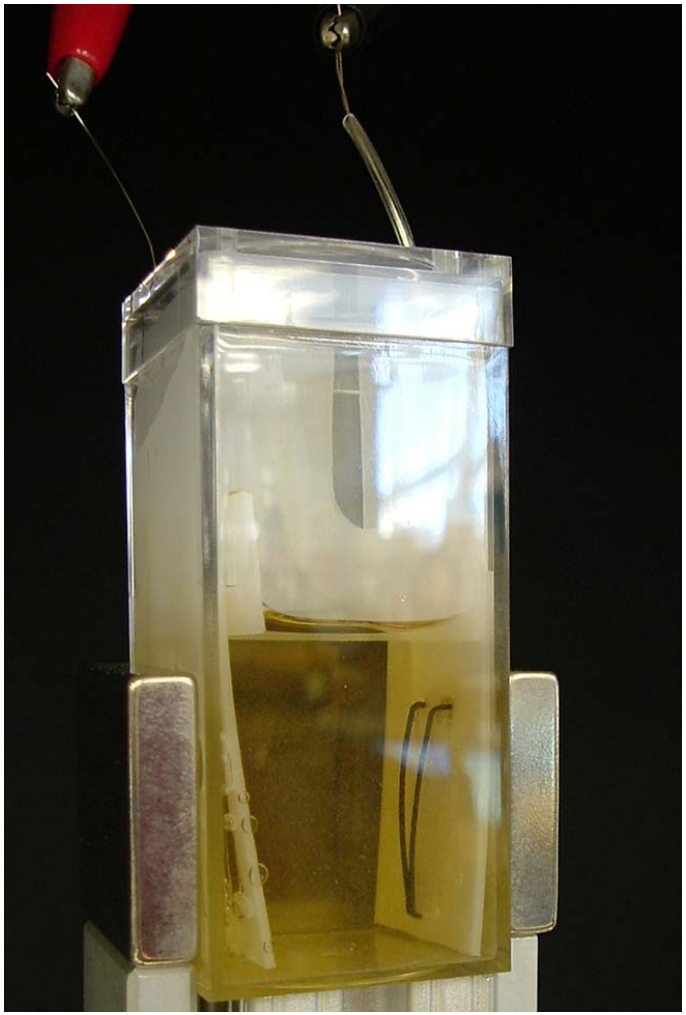


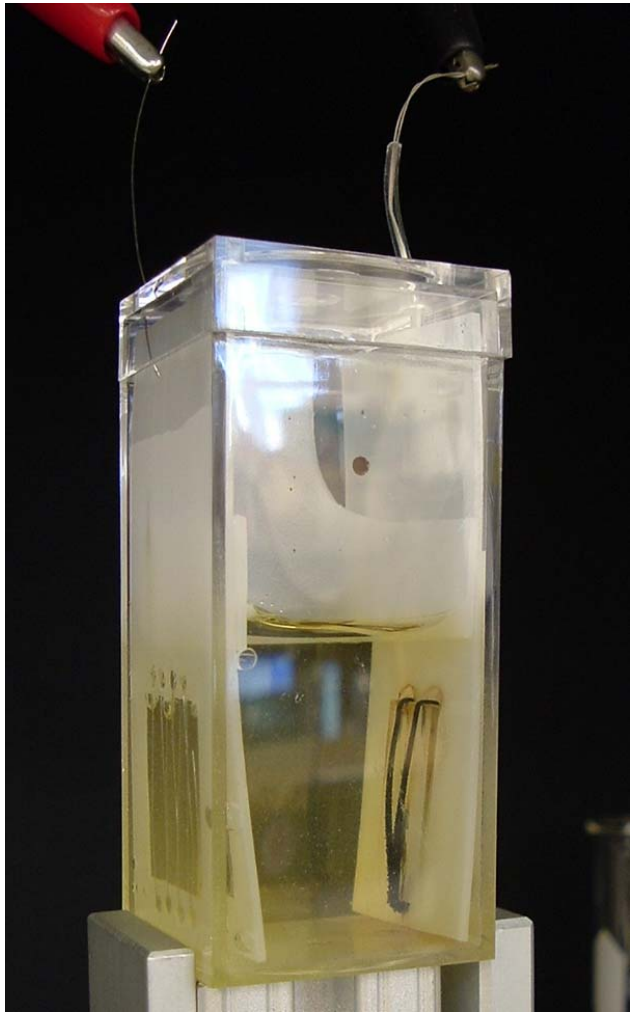
Applied currents, and measured voltages across each cell during electrolysis



“Plating” almost done

Cell 1





Cell 2

“Plating” done

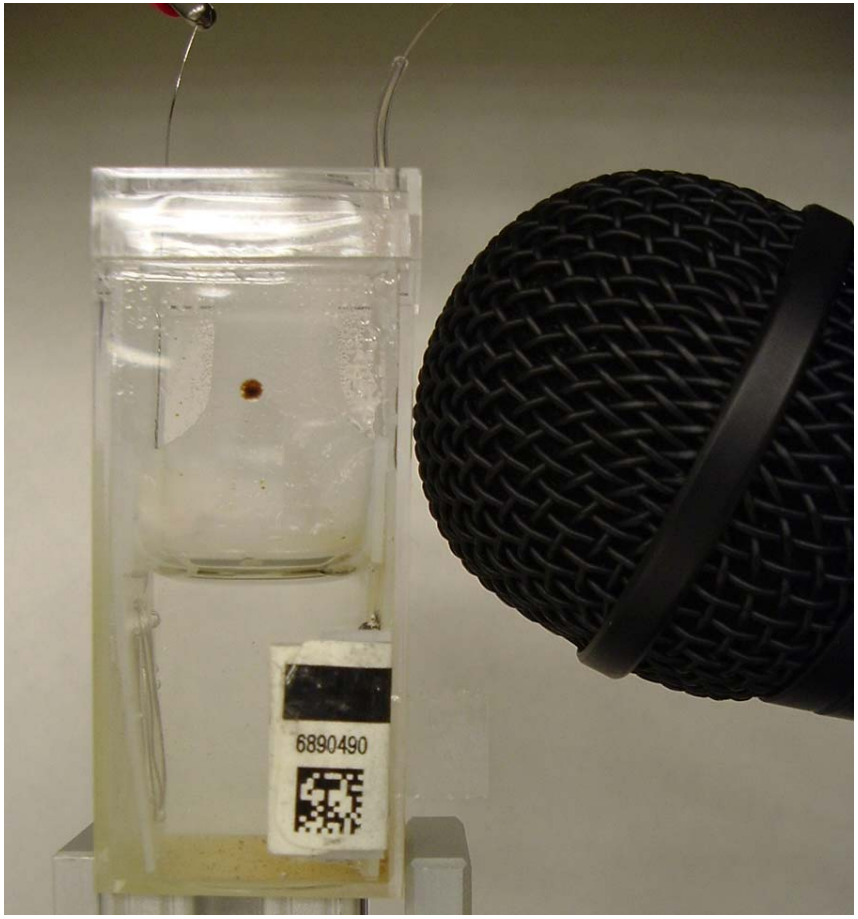
Cell 1

Cell 2

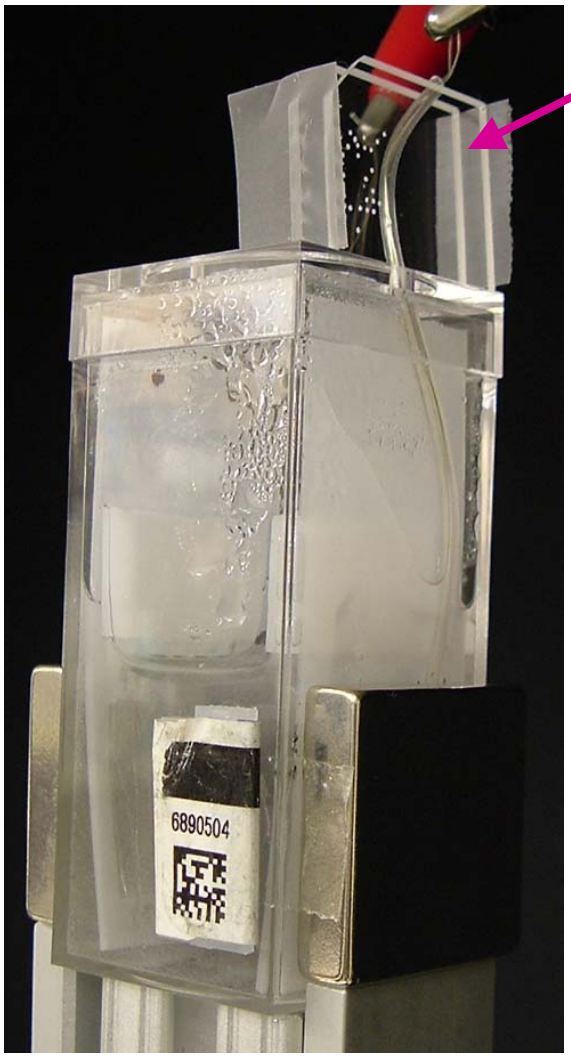
Jan-11 9:20am

Sounds recorded from Cell 2

Cell 2



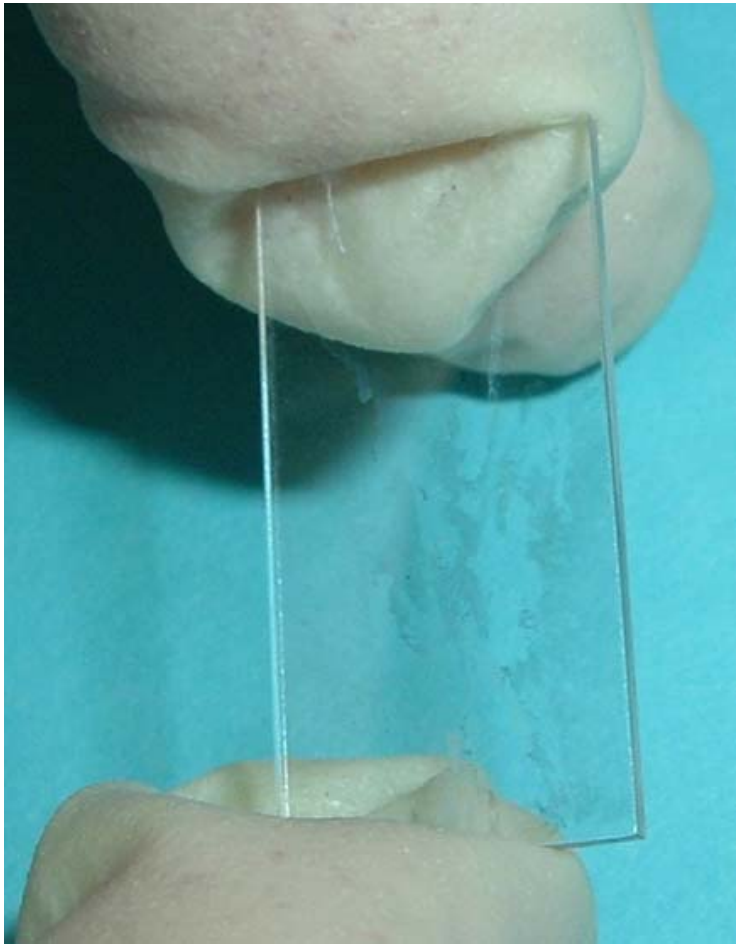
External CR-39 detectors added surrounding path of exit gas above cathodes



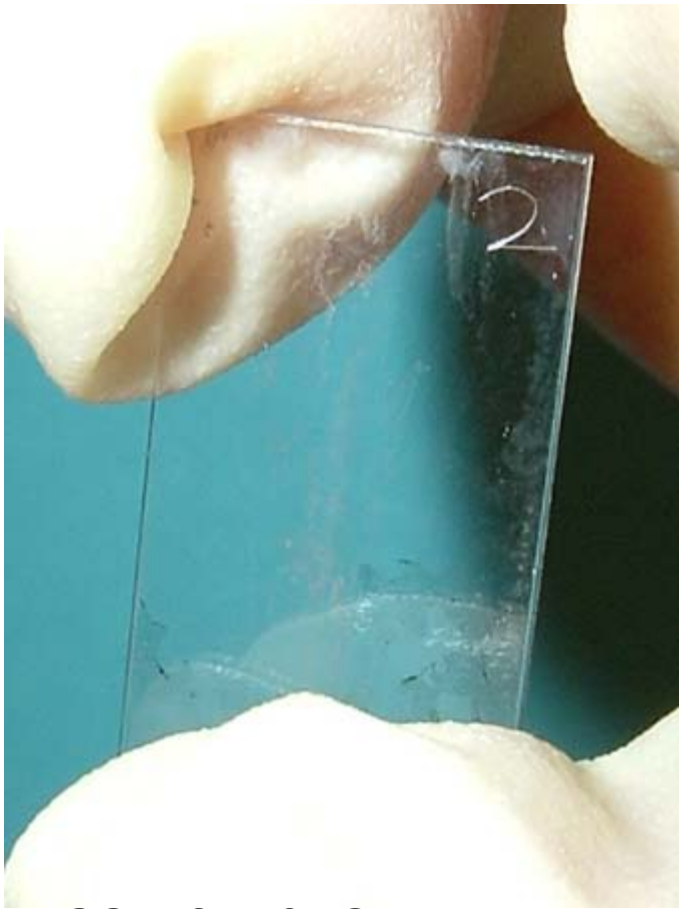
Cell1 Cell2

Jan-17 9:30pm

Electrolyzed CR-39 before etching

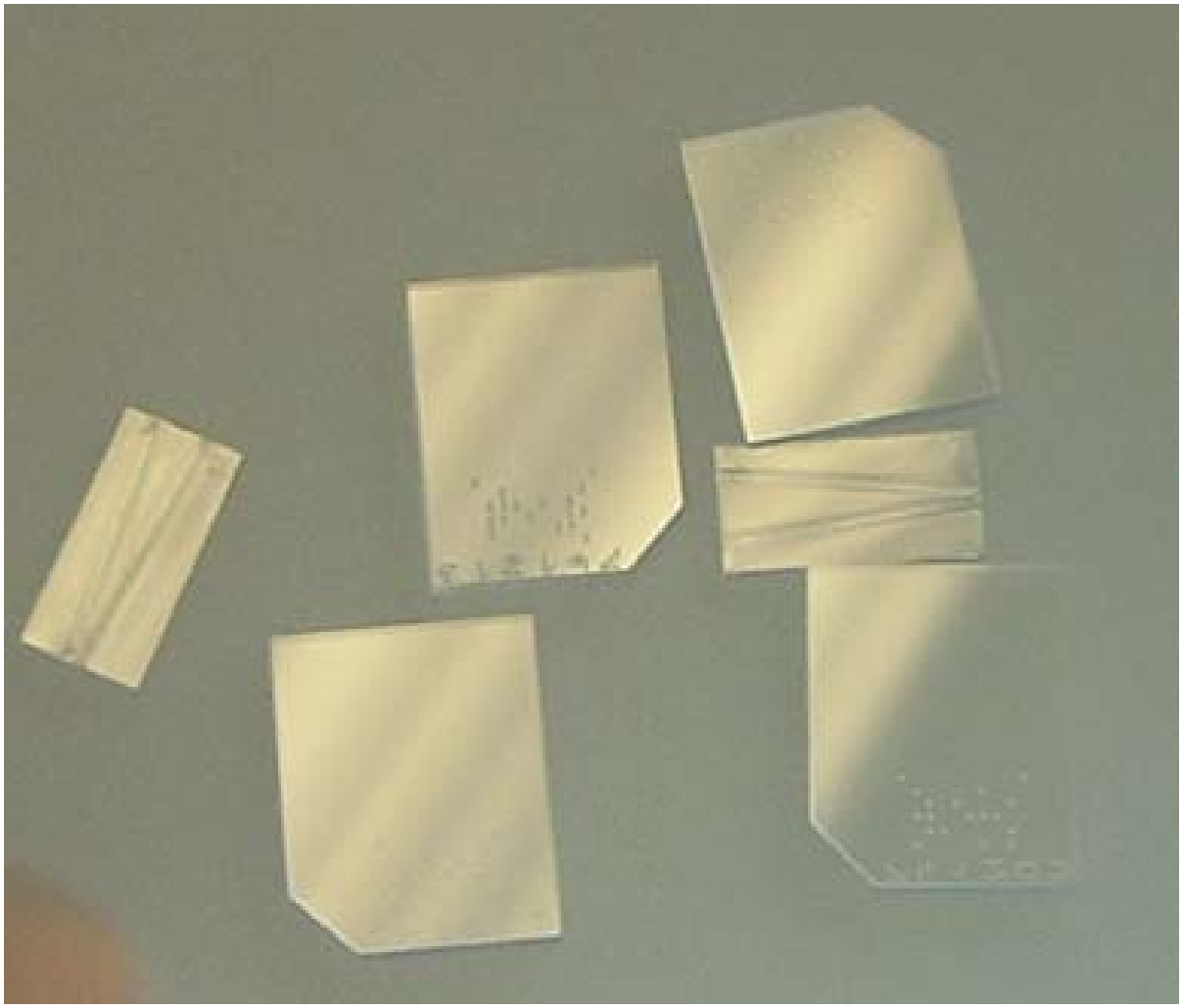


From Cell 1

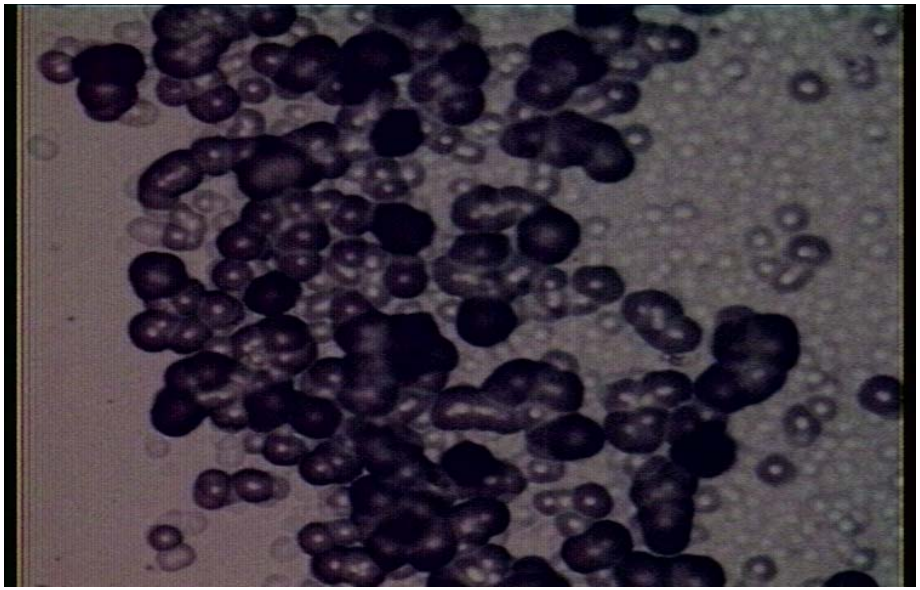


From Cell 2

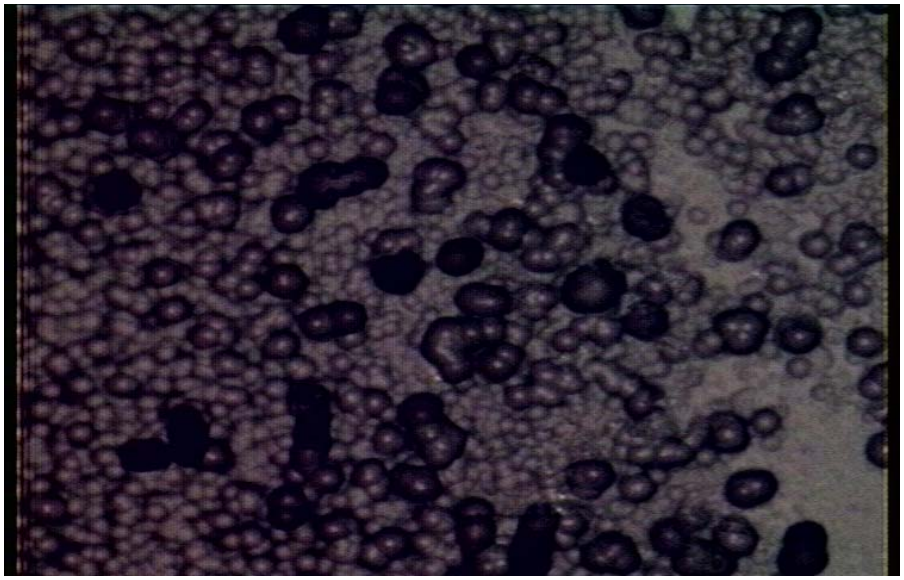
CR-39 chips after etching 3 hours in 6.5 Normal NaOH at 68 deg C



Etchpits



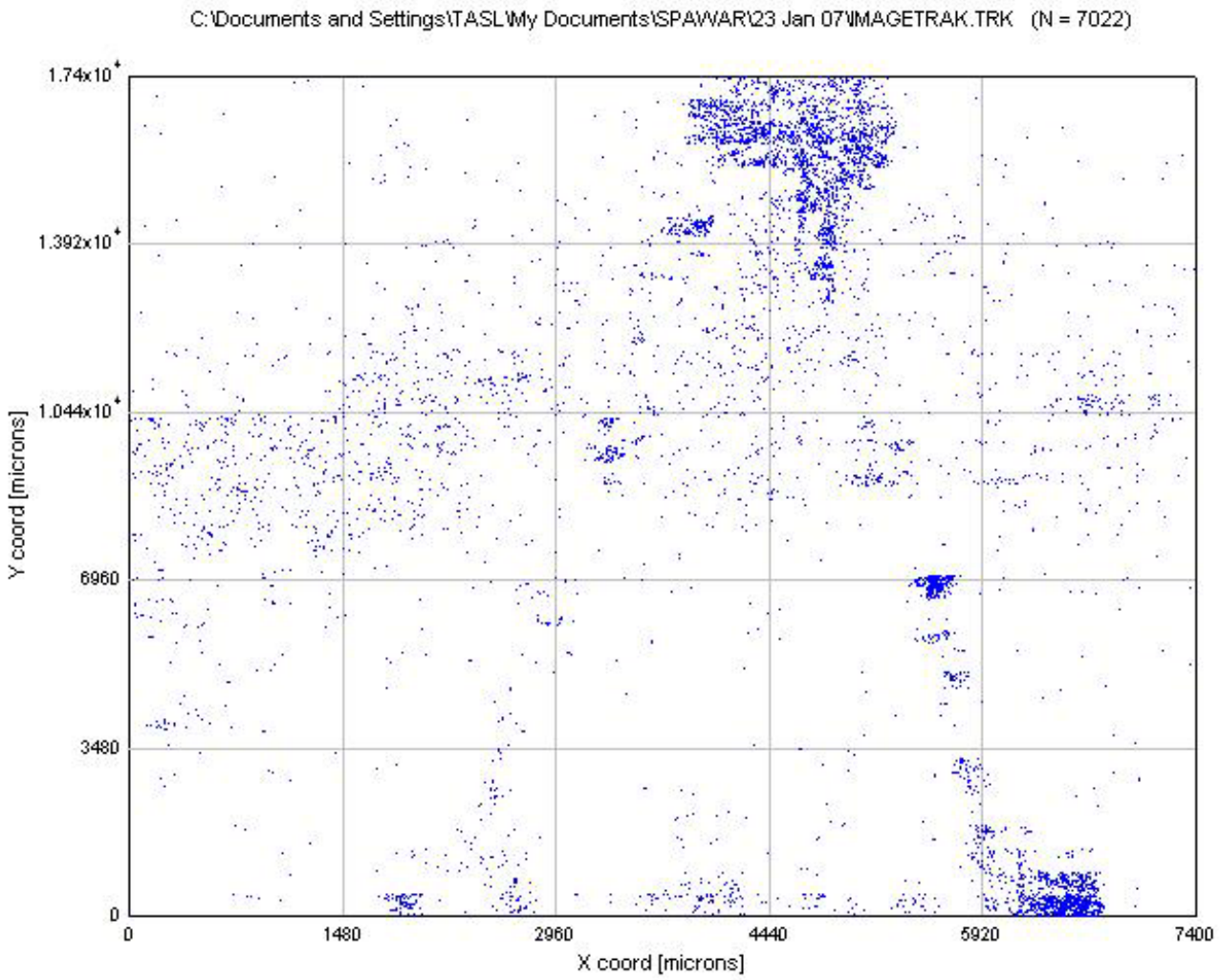
Cathode side of Cell 1
BbottomGrWh.jpg



Cathode side of Cell 2
CbottomGrWh.jpg

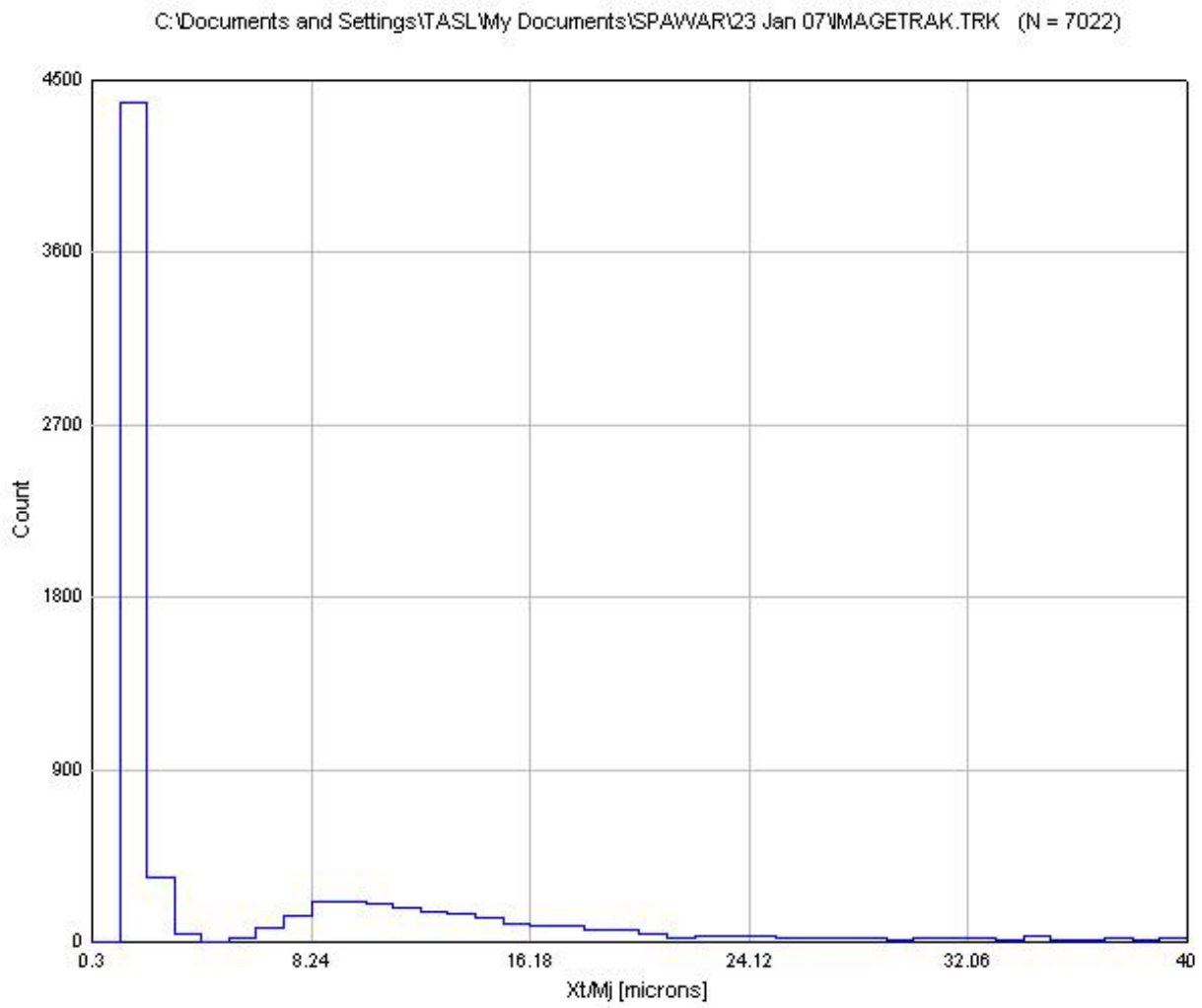
Each image is 205 +/- 20 microns wide by 160 +/- 16 microns high. Images taken with white light on the “uvscope”.

Scan of front side of CR-39 from Cell 2 (This side was in contact with Ag cathode)



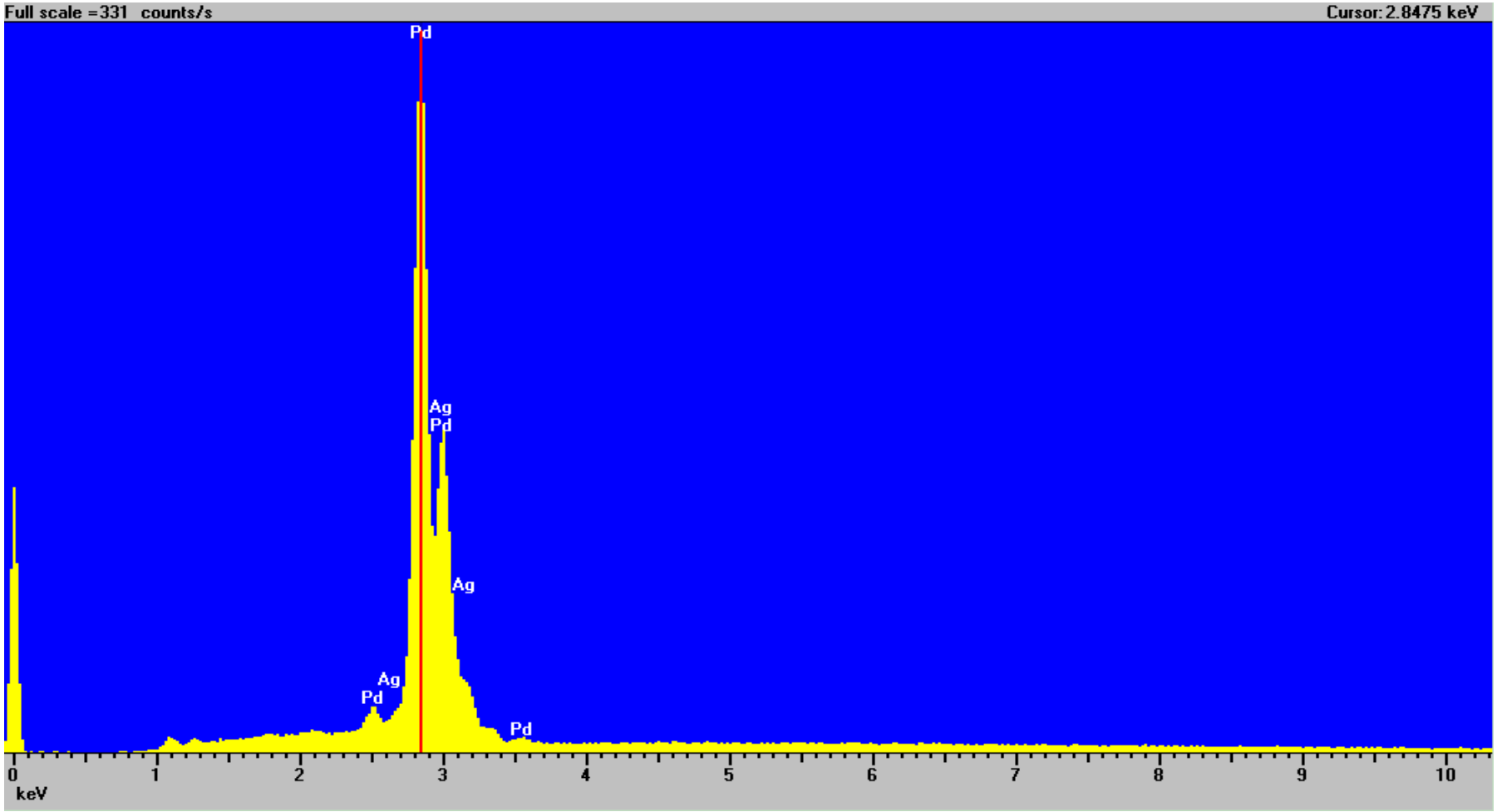
Each blue dot represents the (X, Y) coordinate of an etchpit in microns

Scan of front side of CR-39 from Cell 2 (This side was in contact with Ag cathode)



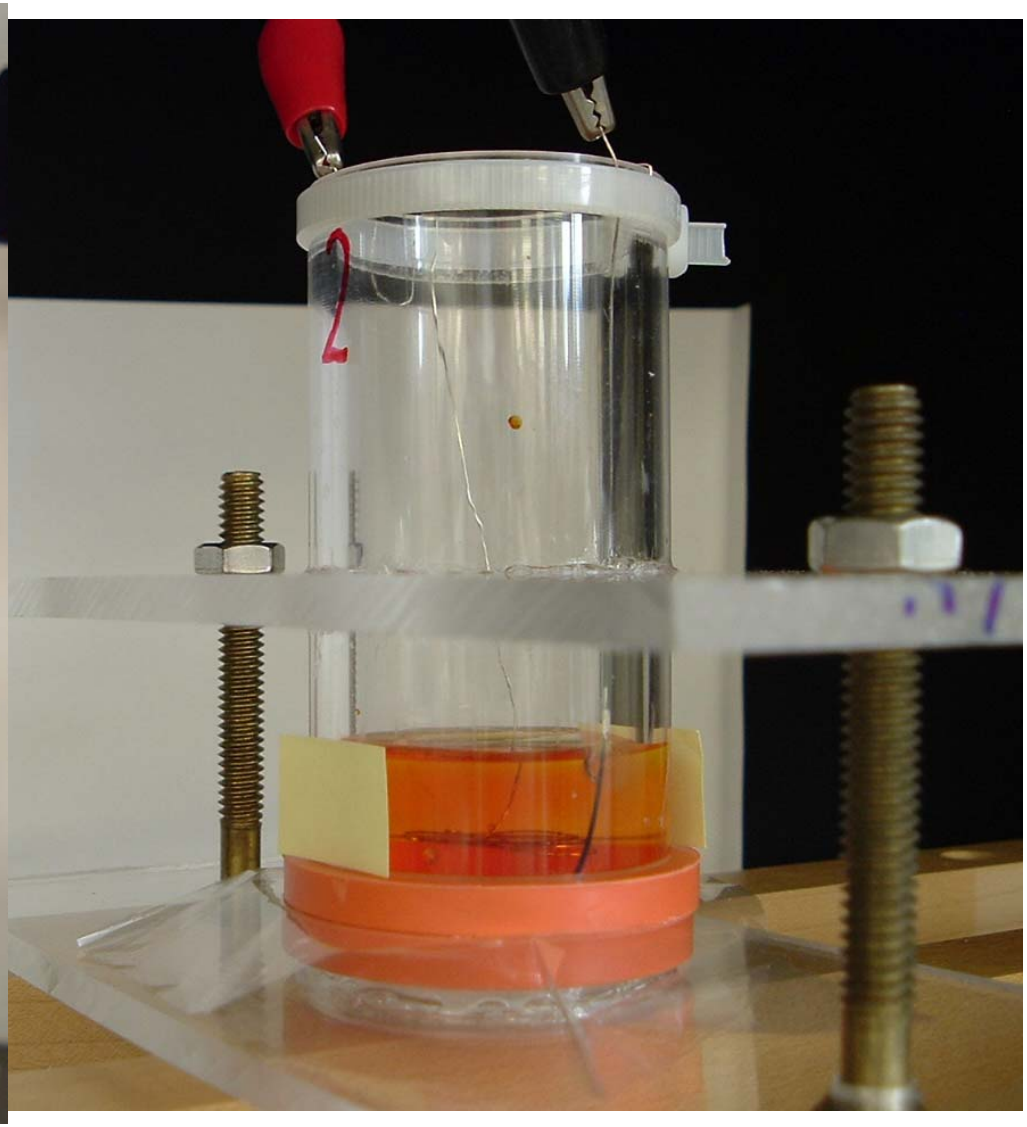
Size distribution of etch pits in microns.

Electron microprobe spectrum of Pd covered Ag electrode (Cell 2)

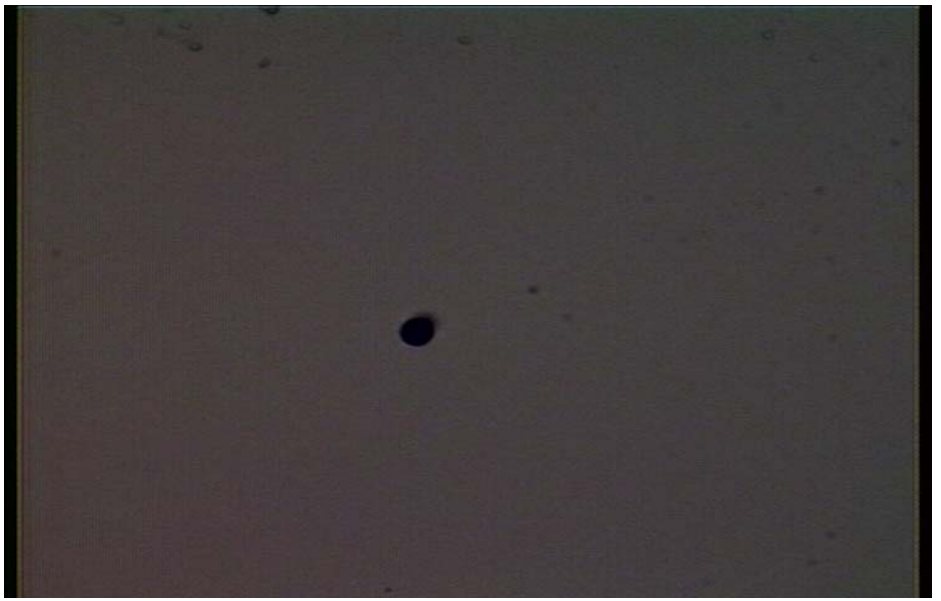


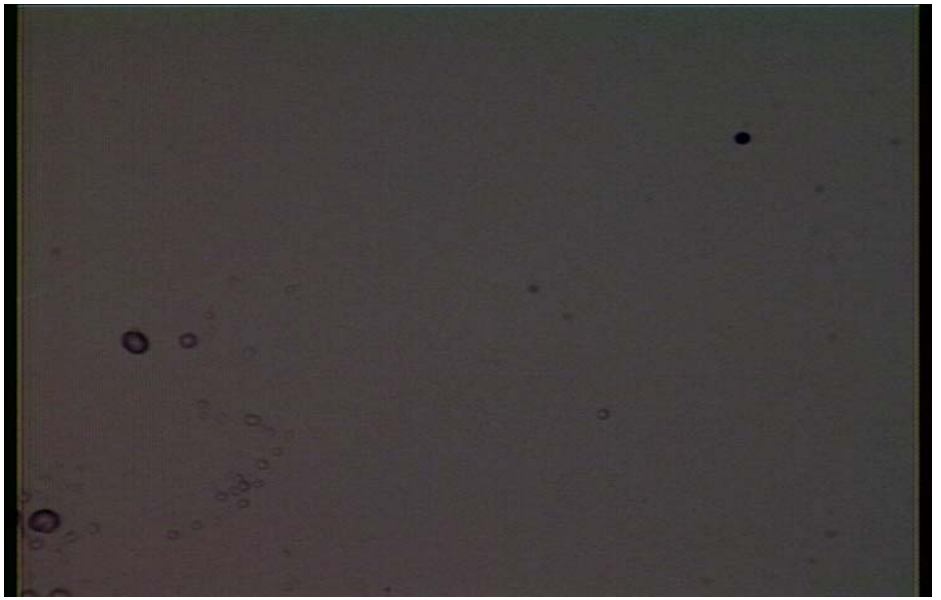
PD_ONAG.PNG

Protecting CR-39 from chemical damage



Protected CR-39 (initial images)





Above: Am-241 exposed area. Right: two images of tracks in initial survey.

Acknowledgements

I am deeply grateful to my colleagues, especially Pam Boss and her SPAWAR team for detailed information and support in replicating their co-deposition protocol. Thanks to Larry Forsley and Gary Phillips for scanning my CR-39 samples using their automated microscope.

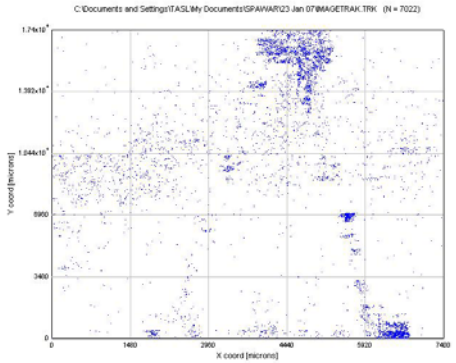
Thanks to Steve Krivit and New Energy Institute for their support with this project.

I also wish to acknowledge John Dash of Portland State University for opening his lab to me in 2005, and for being a living example of research and education to aspire to.

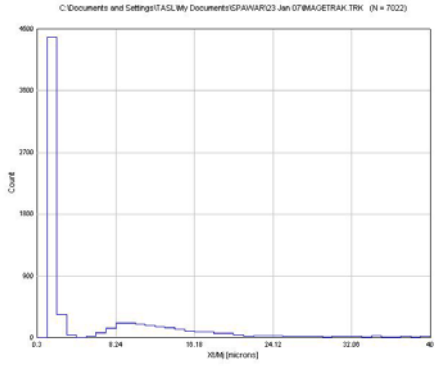
Summary of next 6 slides: scan data from CR-39 (Only CR-39 from inside Cell 2 has been scanned as of this writing)

(Enlarged images are on the following pages)

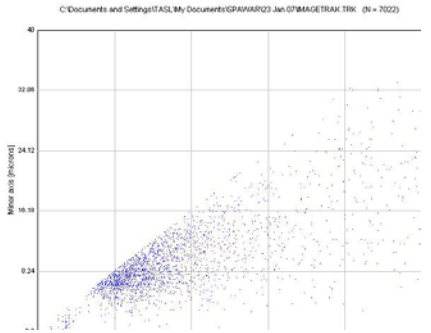
Cathode side



Locations of etch pits

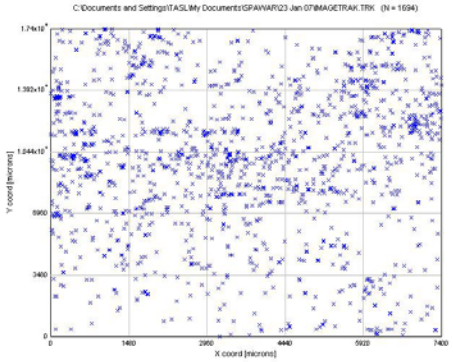


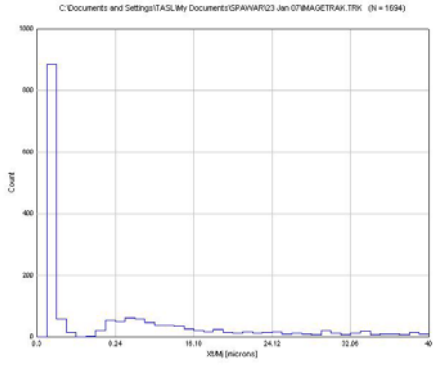
Size distribution of etch pits

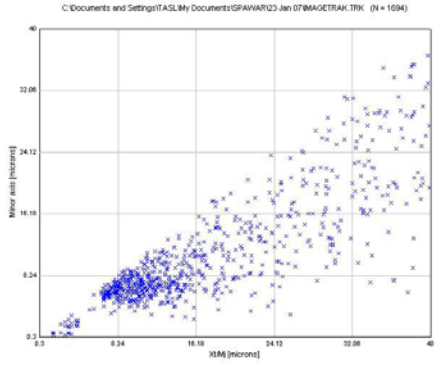


Sizes and shapes of etch pits

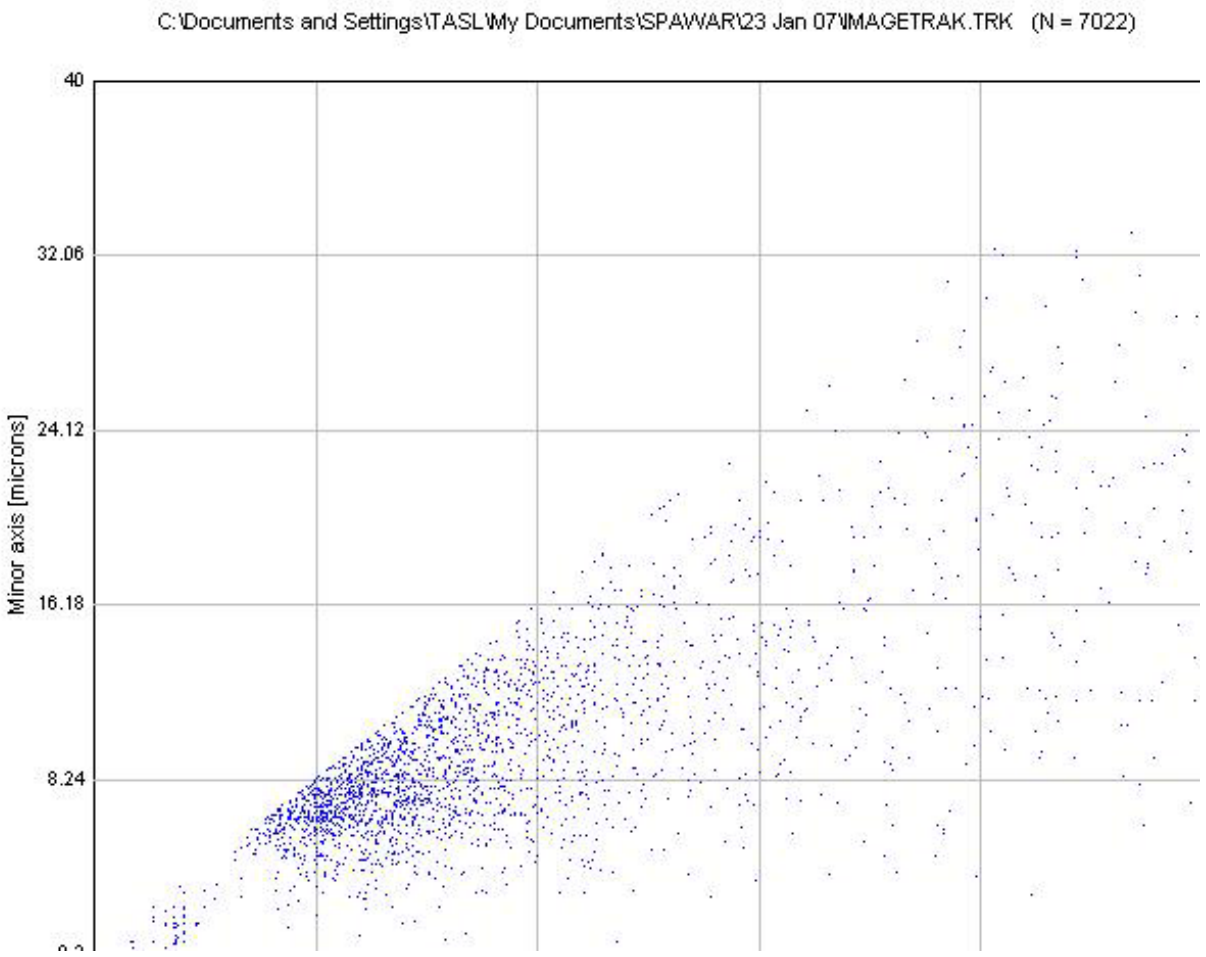
Reverse side







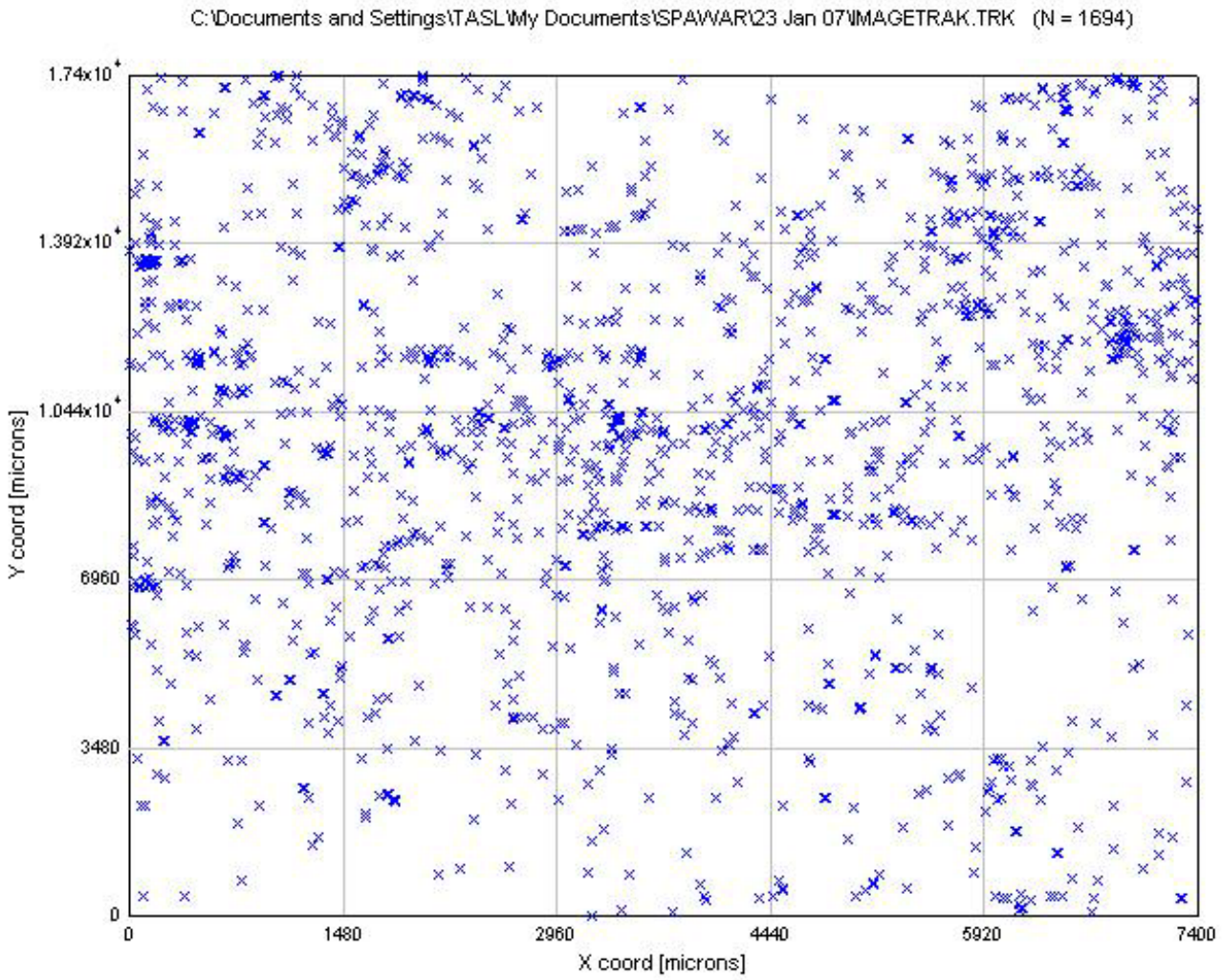
Scan of front side of CR-39 from Cell 2 (This side was in contact with Ag cathode)



Note: bottom right of plot image was lost

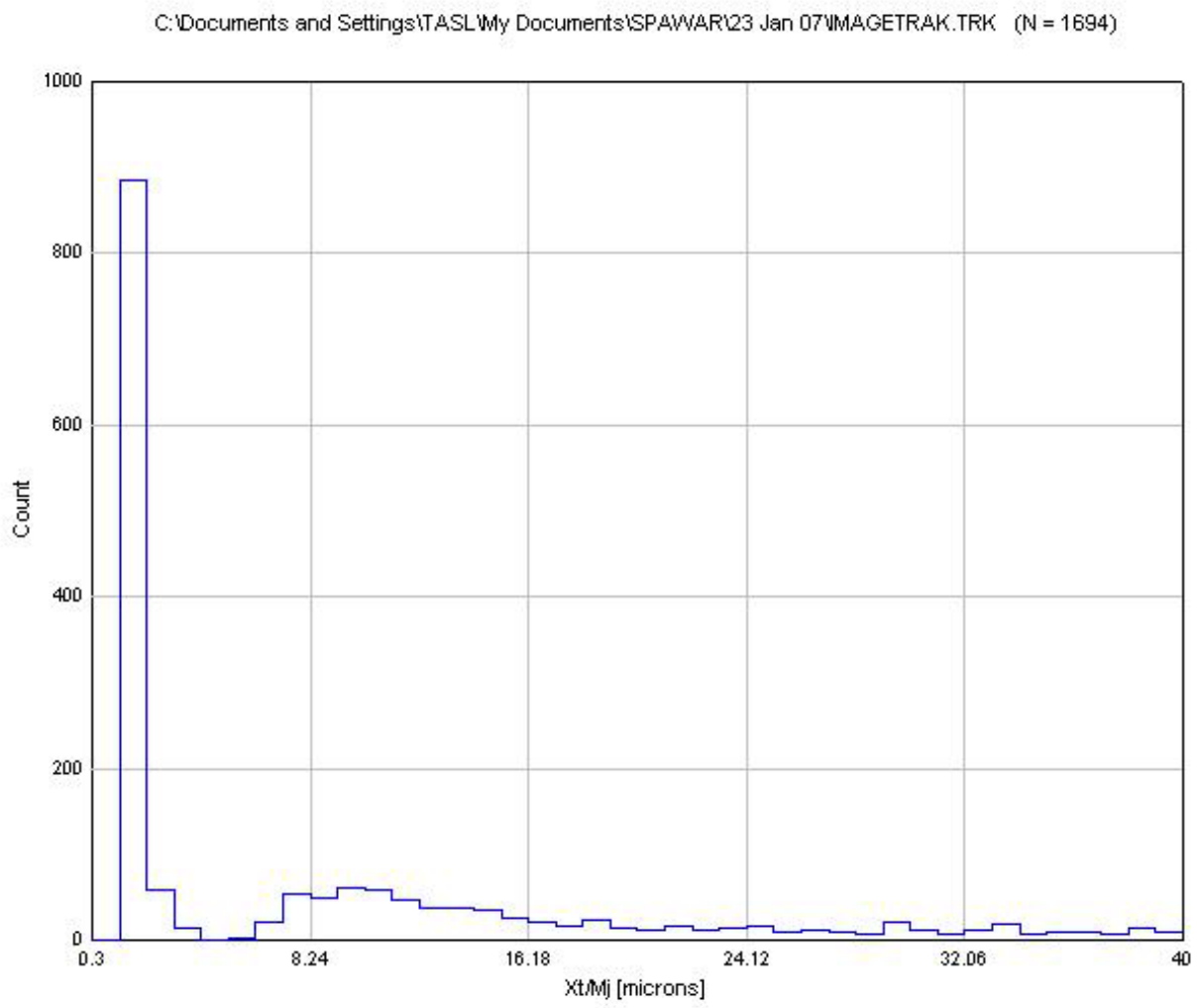
Size and shape distribution of etchpits.

Scan of back side of CR-39 from Cell 2 (Side not in contact with Ag cathode)



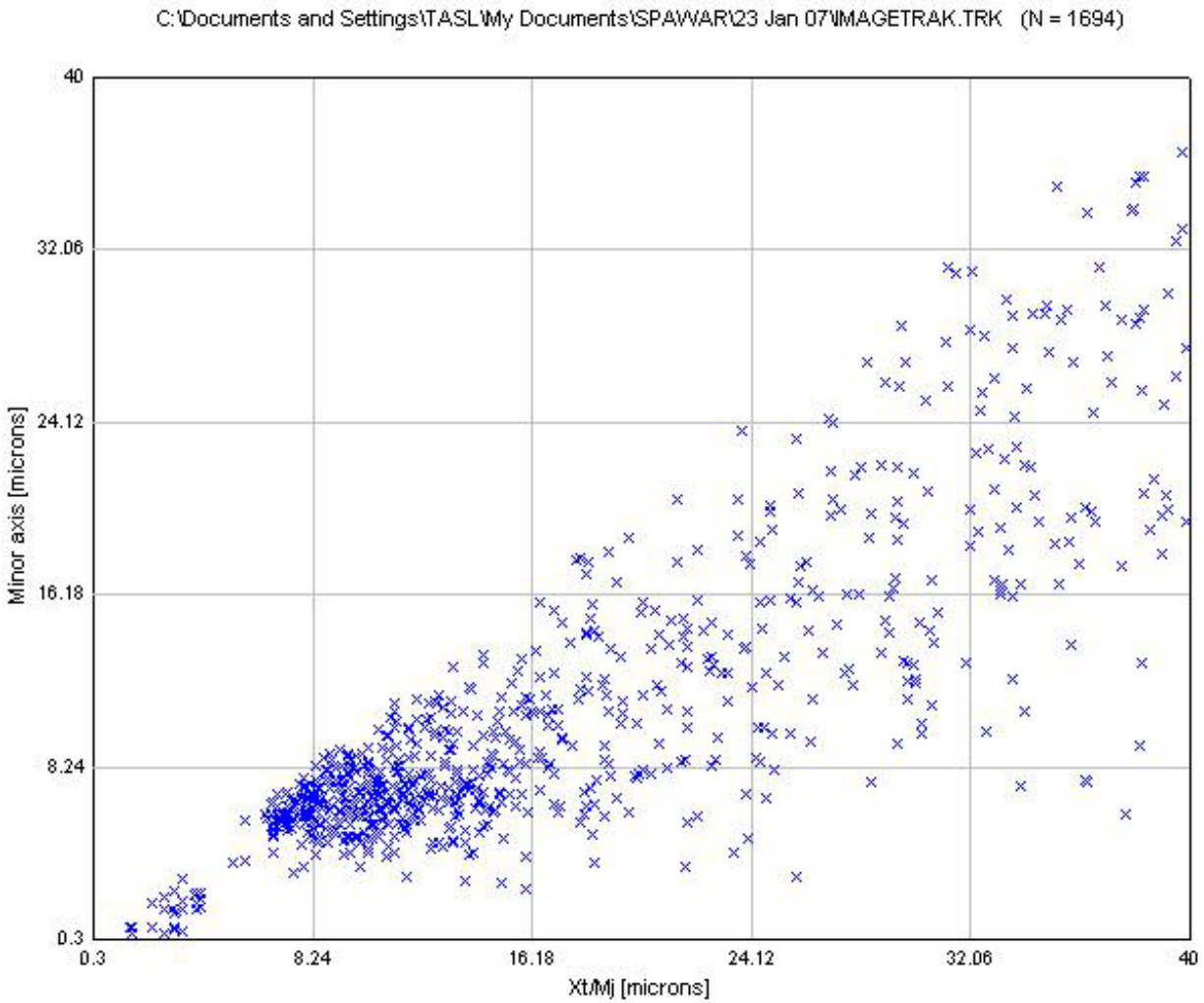
Each blue X represents the (X, Y) coordinate of an etchpit in microns

Scan of back side of CR-39 from Cell 2 (Side not in contact with Ag cathode)



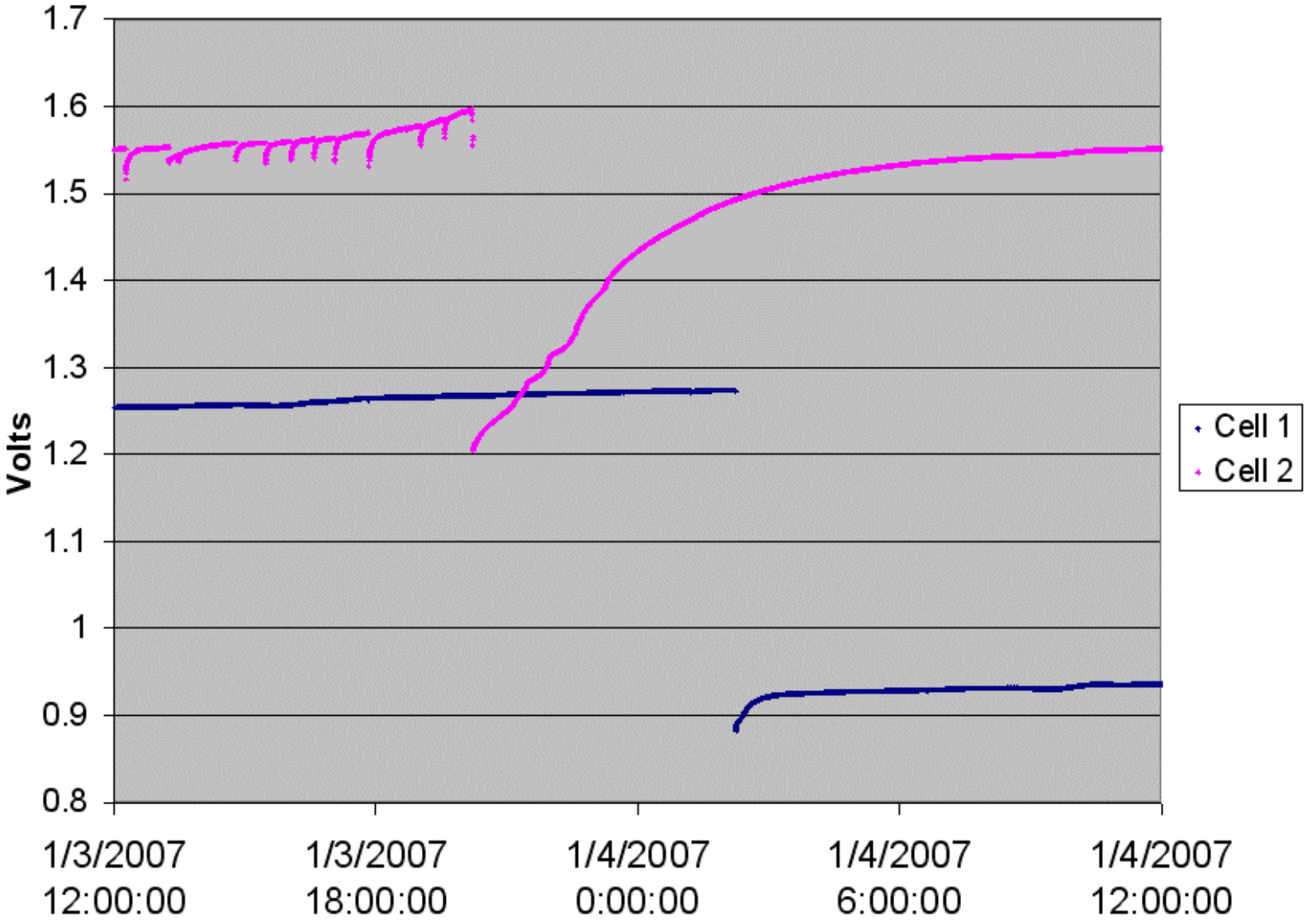
Size distribution of etch pits in microns.

Scan of back side of CR-39 from Cell 2 (Side not in contact with Ag cathode)



Size and shape distribution of etchpits.

The graph below shows the electrolysis voltages, recorded at 6 second intervals, showing sudden drops in potential across each of the two cells. Current was steady at 500 +/- 4 microamps during this entire time.



Parameters measured for each etchpit

Units are microns except for PHI

One etchpit

X	Y	PHI	RANGE	DIP	MAJ	MIN	XT	ZT	M2
246.2	2701.3	325.9	0.0	0.0	23.03	18.43	23.03	9.22*	9.22
214.0	2834.6	249.6	0.0	0.0	13.23	13.23	16.35	15.56*	2.86
319.4	2950.6	40.8	0.0	0.0	9.60	6.10	8.33*	2.86*	1.24*
272.3	3545.8	210.4	0.0	0.0	8.52	6.57	7.69*	5.03*	1.14*
493.8	3391.3	270.0	0.0	0.0	0.82	0.82	1.61	0.63*	0.40
211.6	3902.4	215.5	0.0	0.0	15.11	7.09	13.32*	1.42*	1.42*
206.4	3932.8	313.9	0.0	0.0	16.72	16.72	16.72	15.49*	6.39*
474.1	4138.9	331.3	0.0	0.0	11.19	9.24	11.19*	7.99*	1.73*
187.9	3925.4	205.3	0.0	0.0	25.09	11.70	25.09*	1.85*	0.57*
...									

Etchpit location

Track Orient-ation

Major & minor axes

Endpoint depth

Endpoint diameter

(Not sure how much we can trust these two parameters)