



The Search for Nuclear Particles in the Pd-D Co-Deposition Experiment

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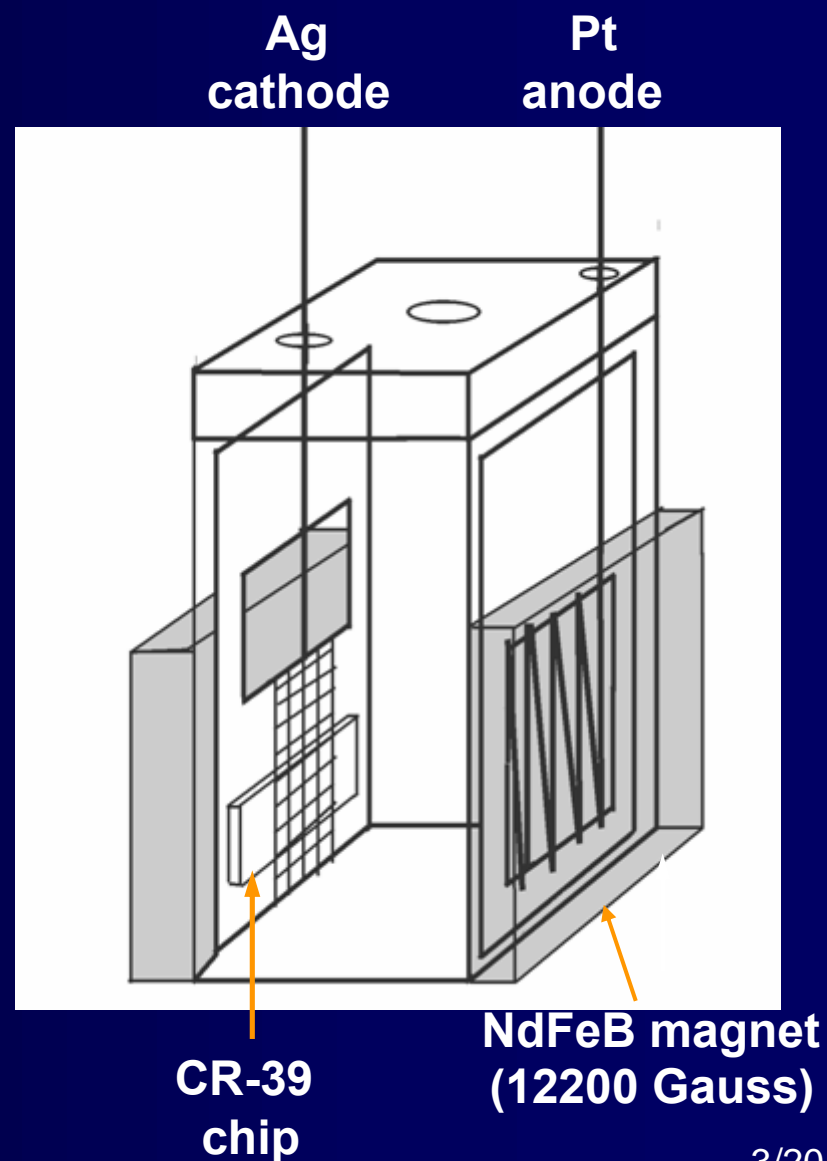
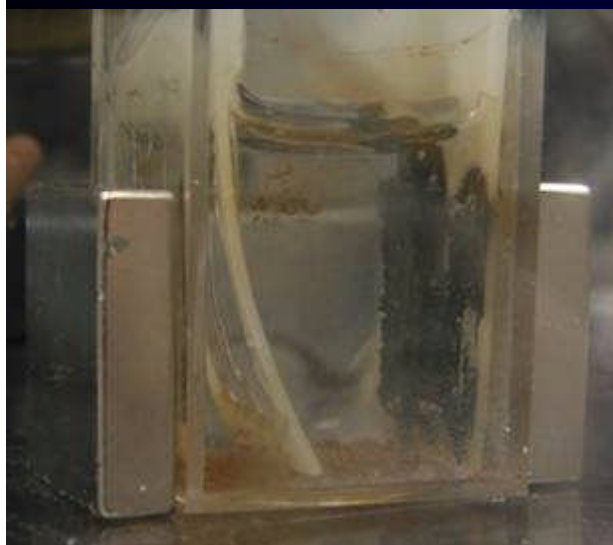


OUTLINE

- Experimental Design and Protocol
- Results: Electrochemistry, SSNTD (CR-39),
and Neutron Count Measurement
- Conclusions
- Future Work

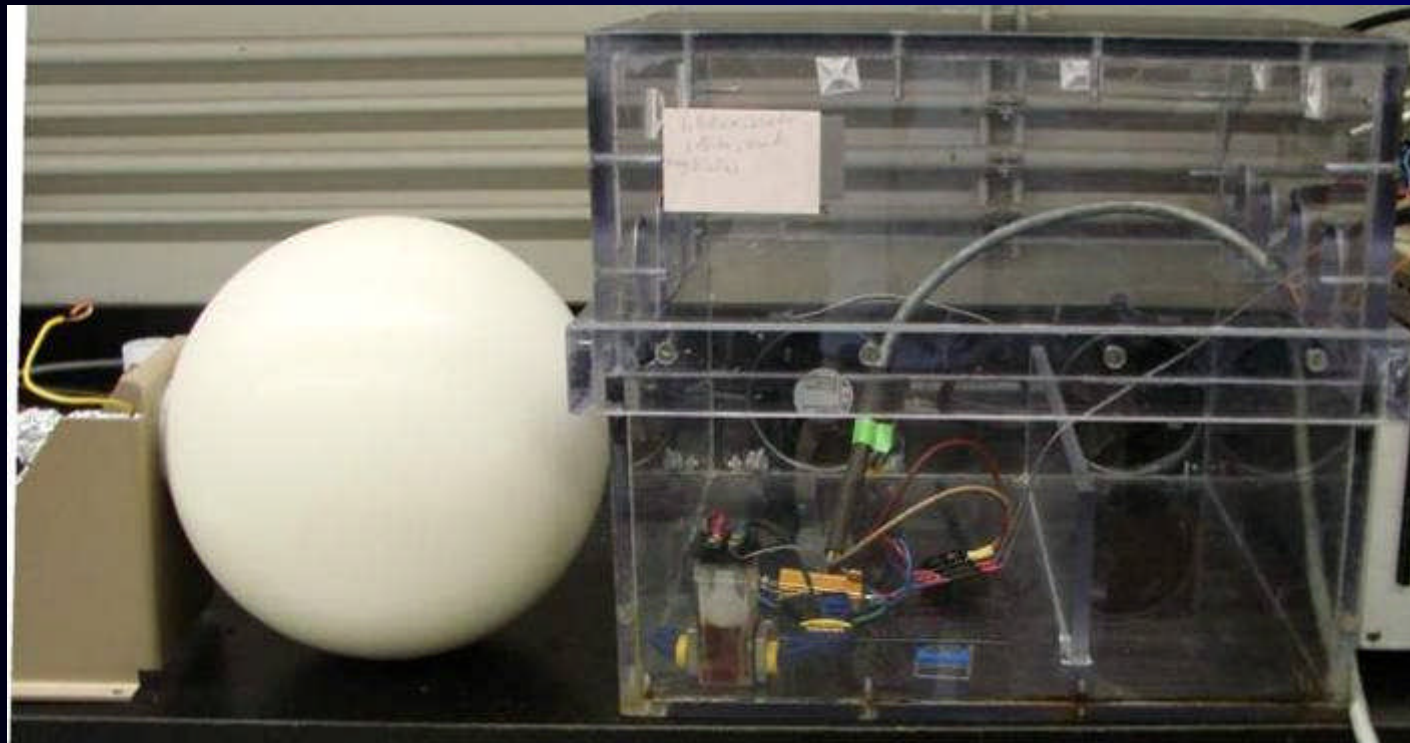
Experimental: Wet CR-39 Experiments

- All cells had magnets.
- 0.03 M PdCl₂ ; 0.3 M LiCl ; D₂O
- 0.2mA for 1 day, 0.5mA until solution cleared then 12 - 48 hours each of 1, 5, 10, 25, 50, and 100mA
- Experiments 3 - 6: cathode was ~16 cm of 0.5mm Ag wire wrapped against the CR-39
- Experiments 3 and 4 used TASL CR-39
- Experiments 5 - 12 used Fukuvi CR-39
- Etched in 6.5 N NaOH, for 6.5 hours, at 65°C

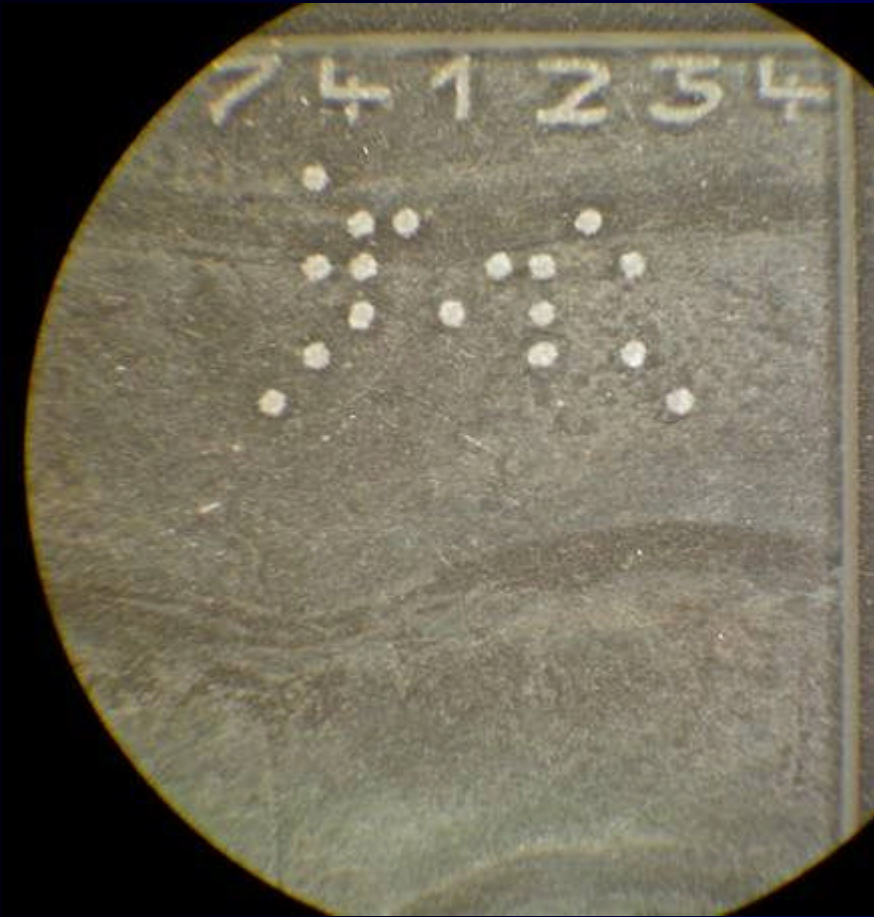


Experimental: Neutron Counter

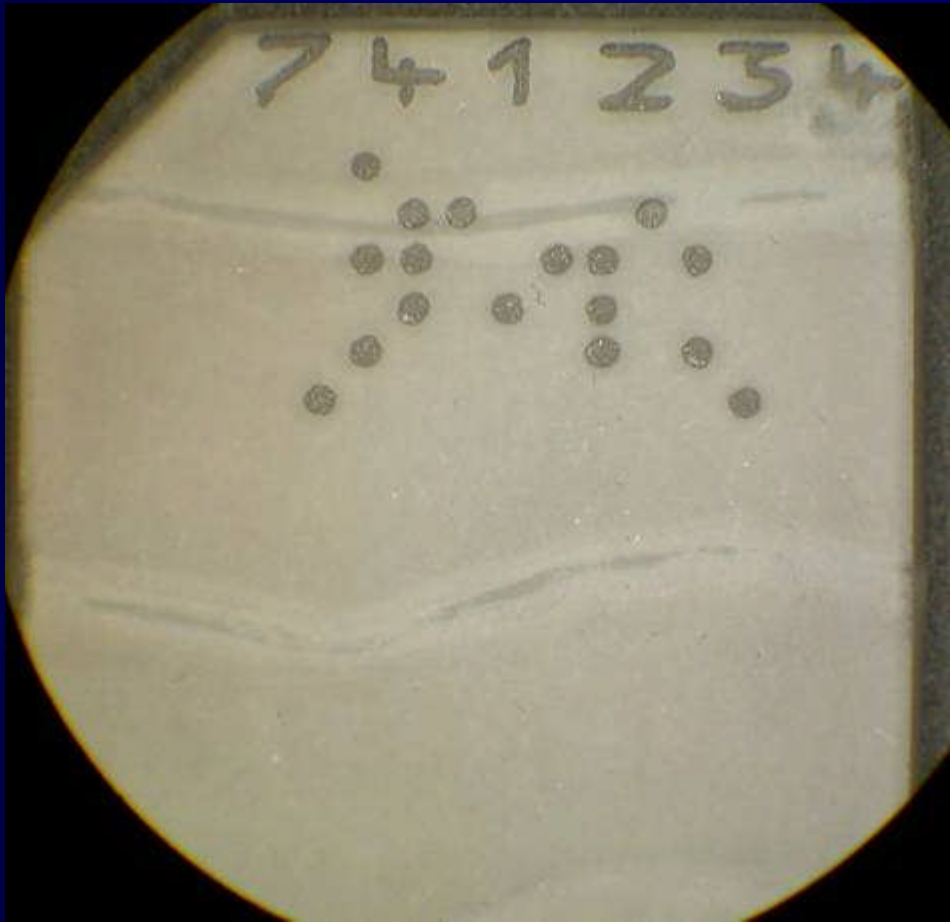
- BF_3 Ionizing neutron detector about 10 cm from operating cell.
- 12mm polycarbonate safety shield might thermalize neutrons and/or allow recoil back to CR-39



Results: BE008-4 CR-39 (TASL CR-39)

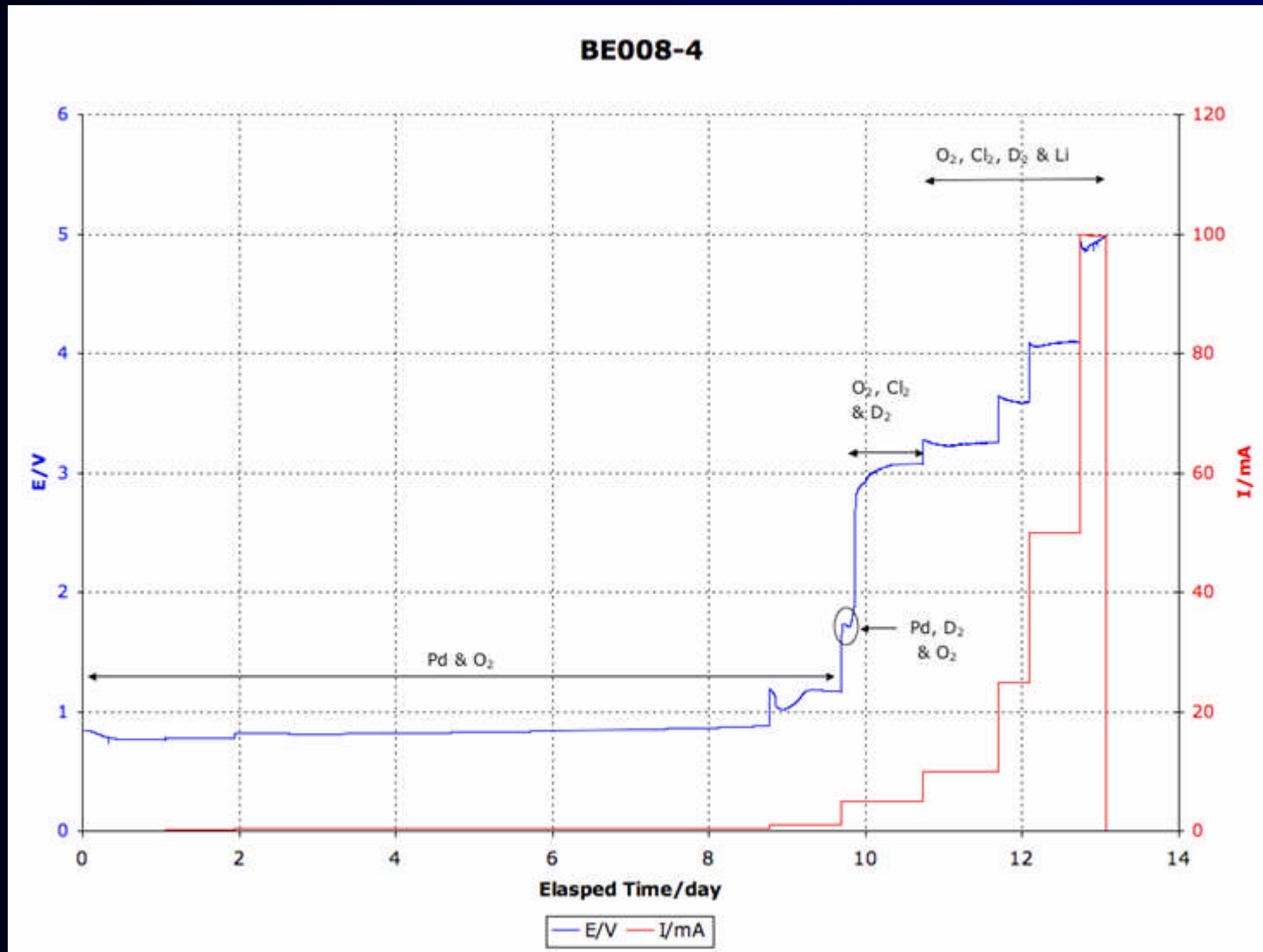


Before Etch

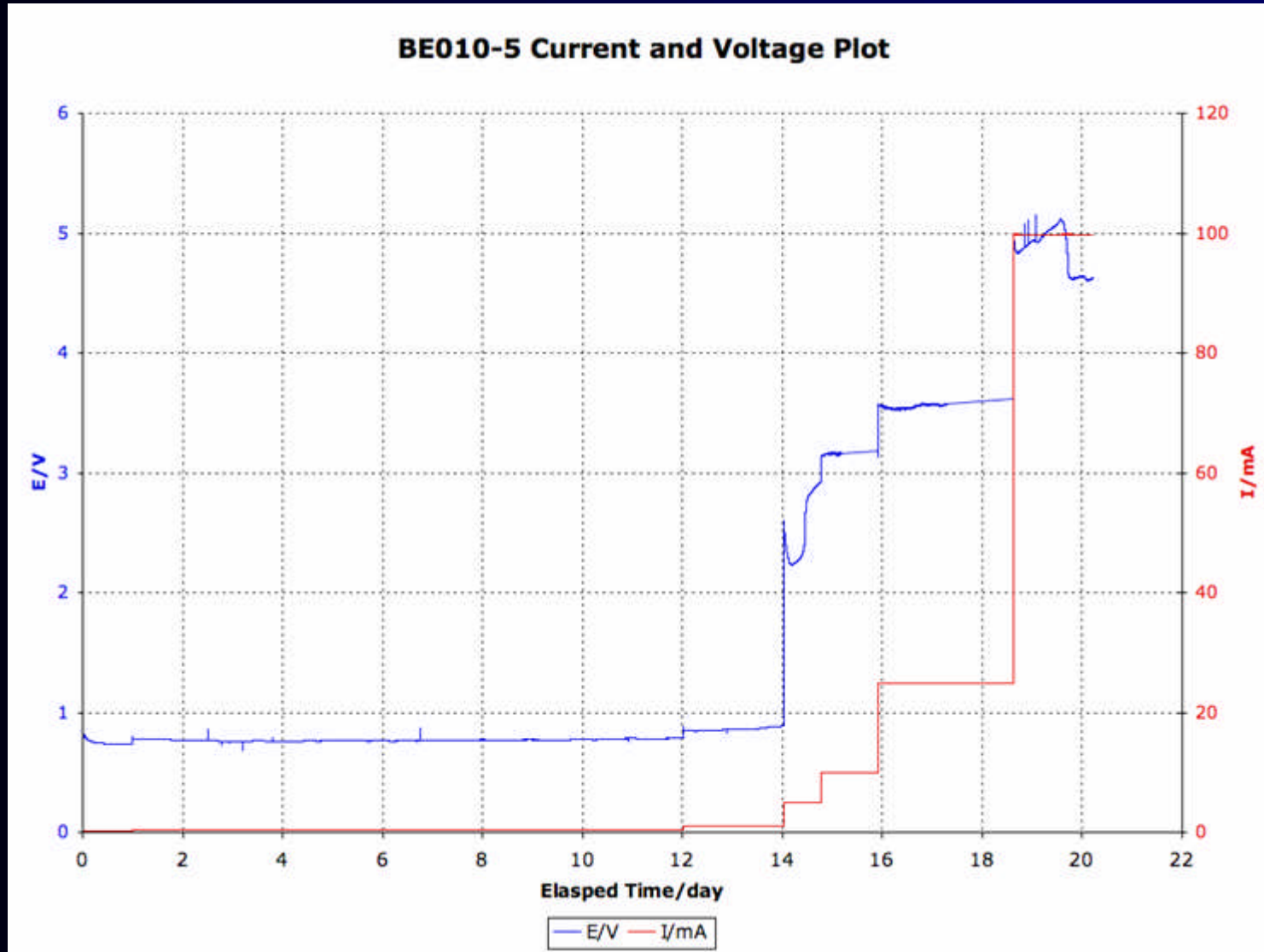


After Etch

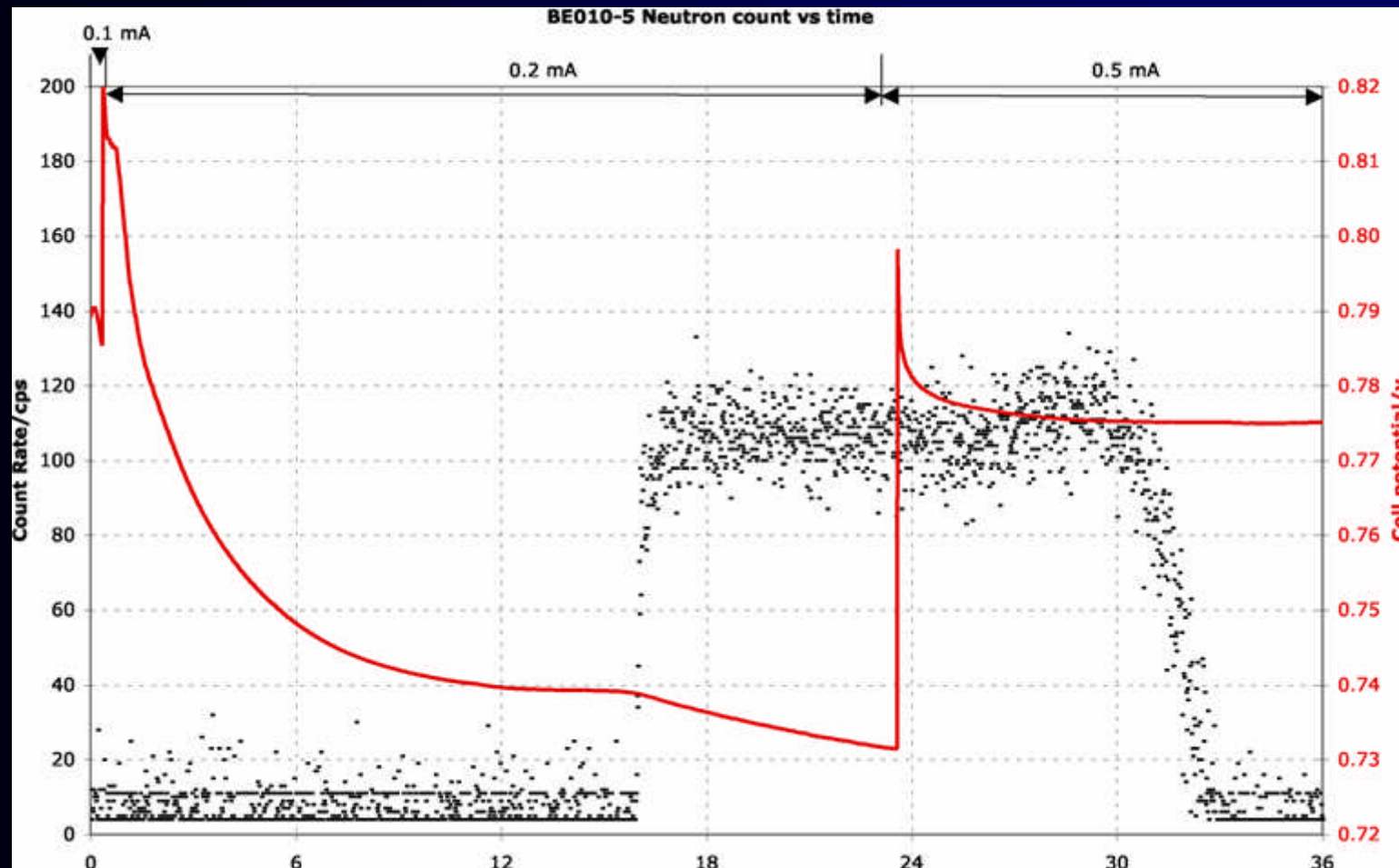
Results: Electrochemical BE008-4



Results: Electrochemical BE010-5

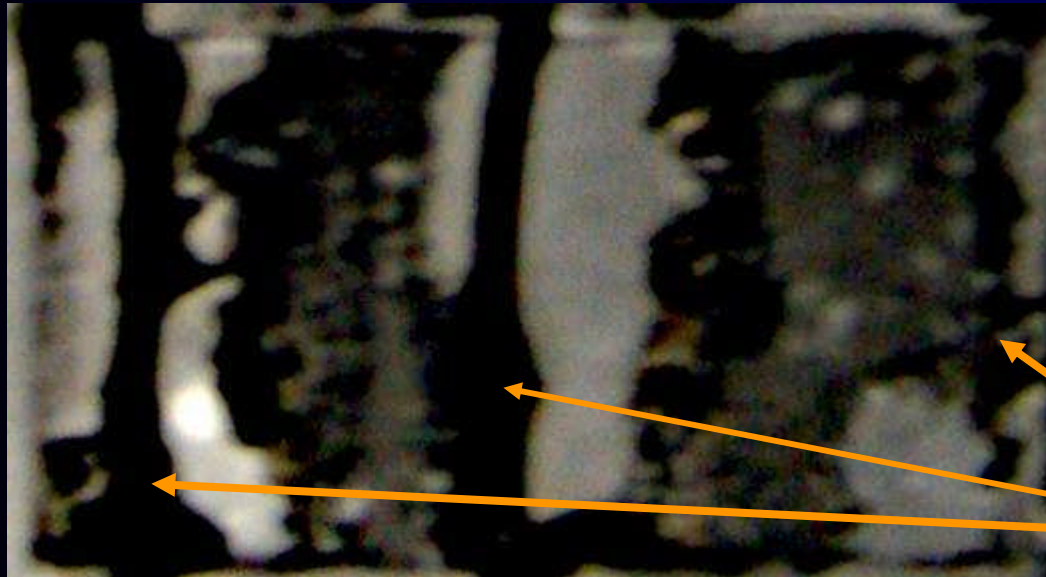


Results: BE010-5 CR-39 Neutrons



Note decline in cell potential after neutron burst commences - thermal effect?

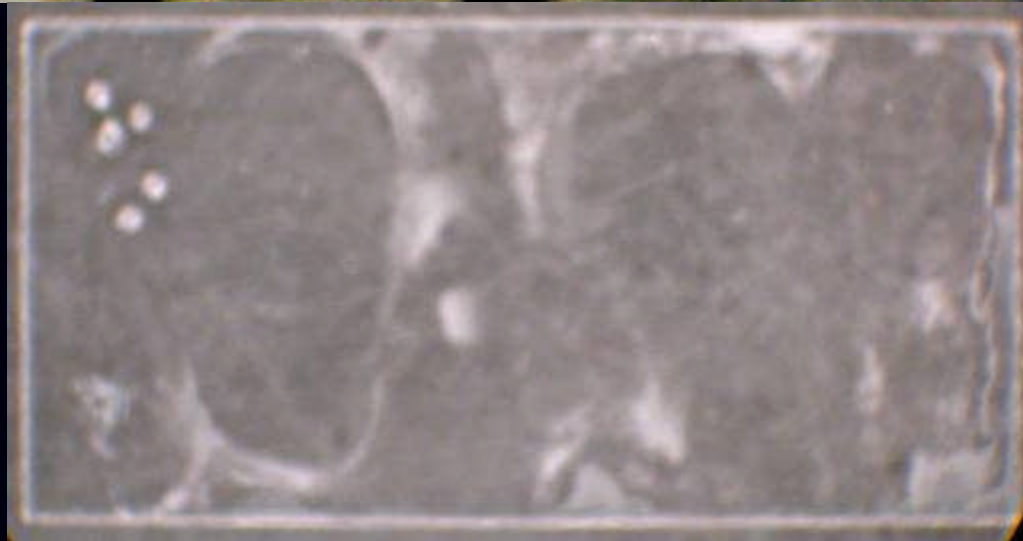
Results: BE010-5 CR-39



Pd "moss" between Ag wires on CR-39 after removal from cell

Chips exposed while covered with 60 μm polyethylene film

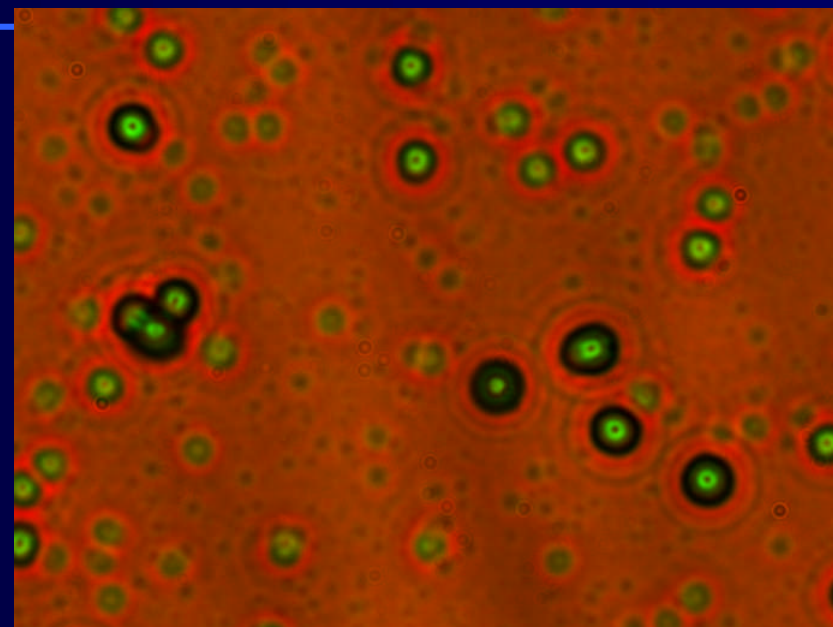
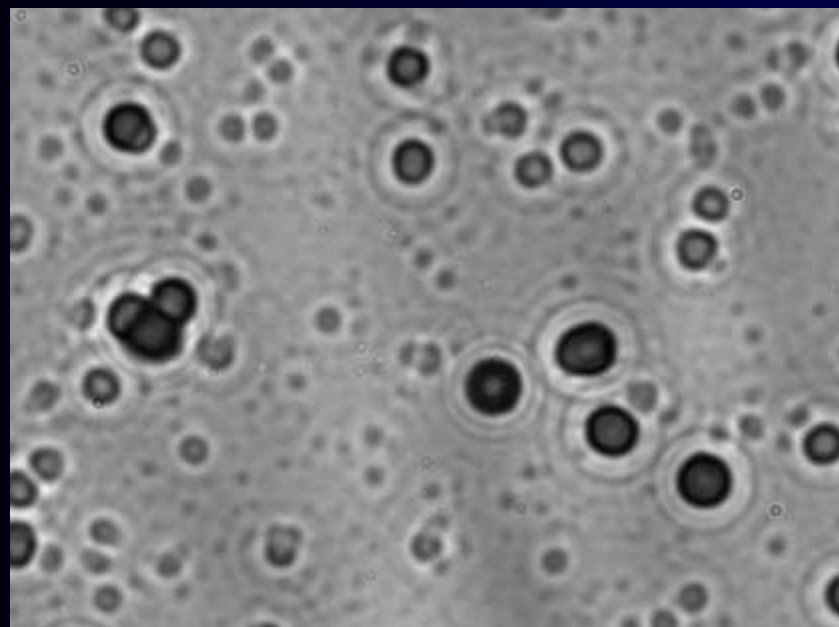
Ag Wires



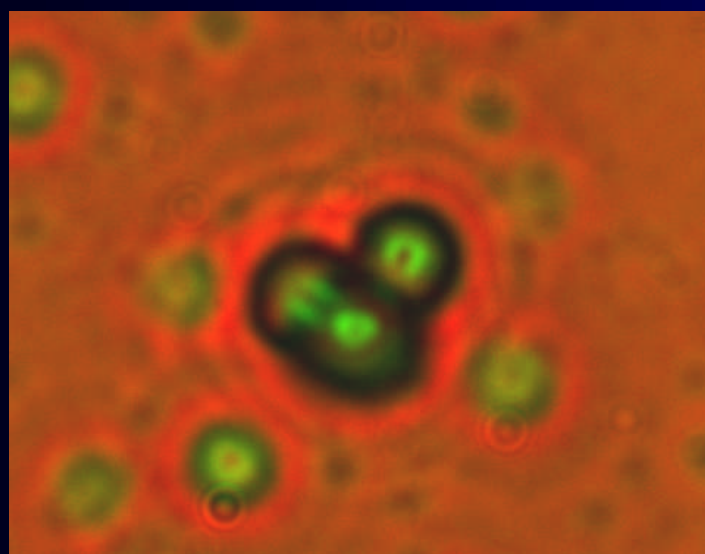
CR-39 after etching

Note outline of Ag wires

Results: BE010-5 CR-39 (Fukuvi CR-39)

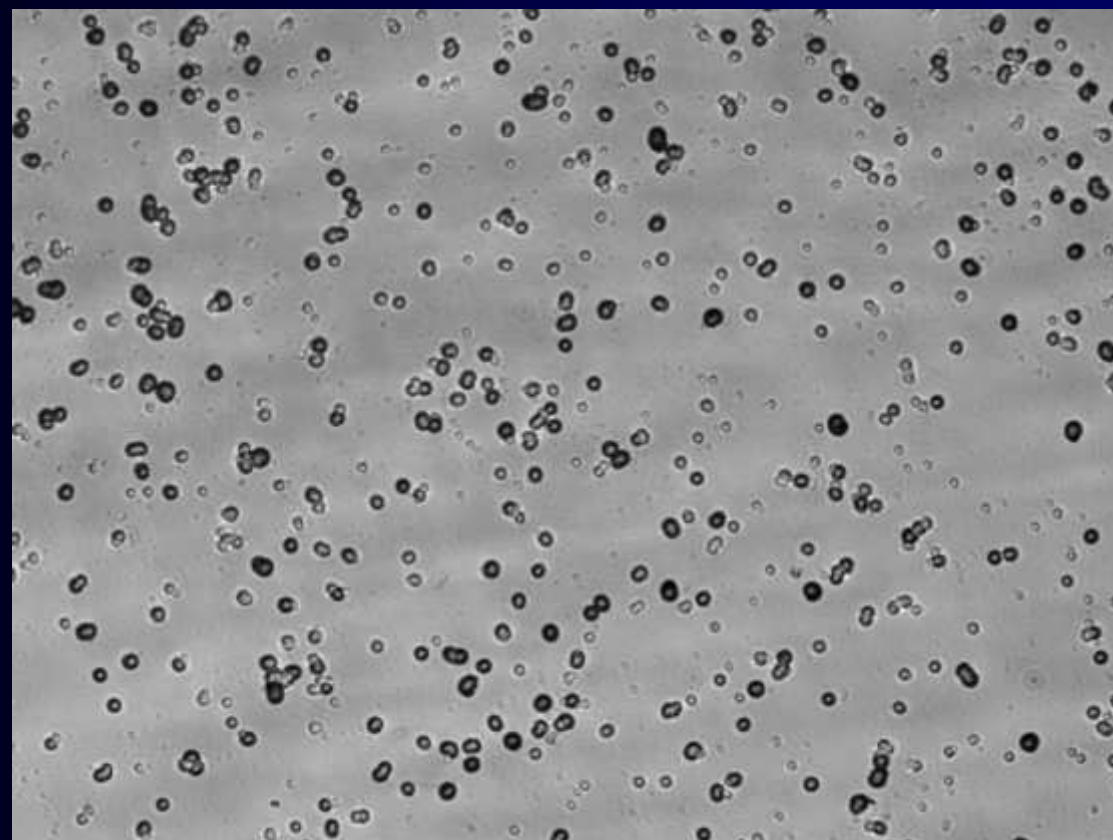


1000 x



Triple track

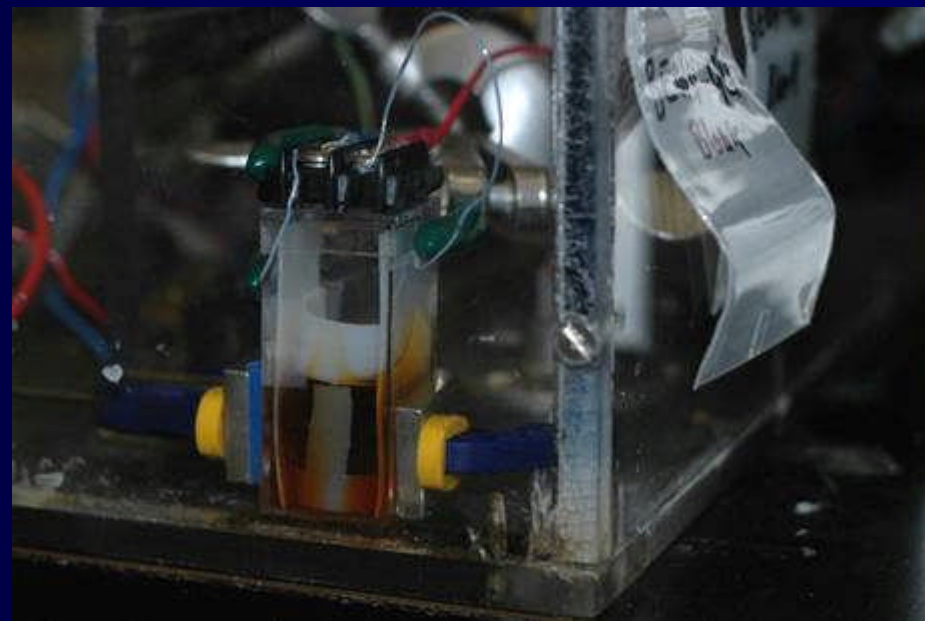
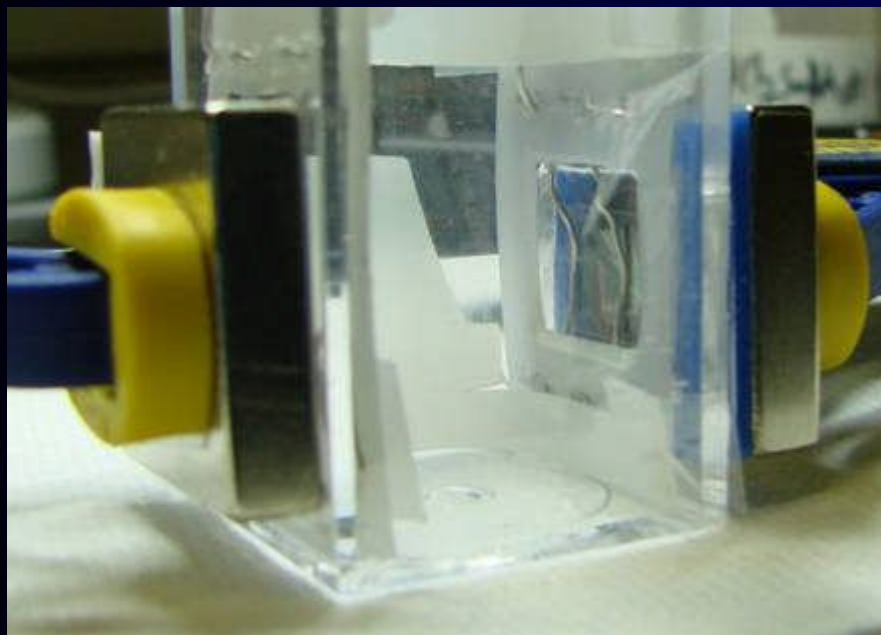
Results: BE010-6 CR-39 (Fukuvi CR-39)



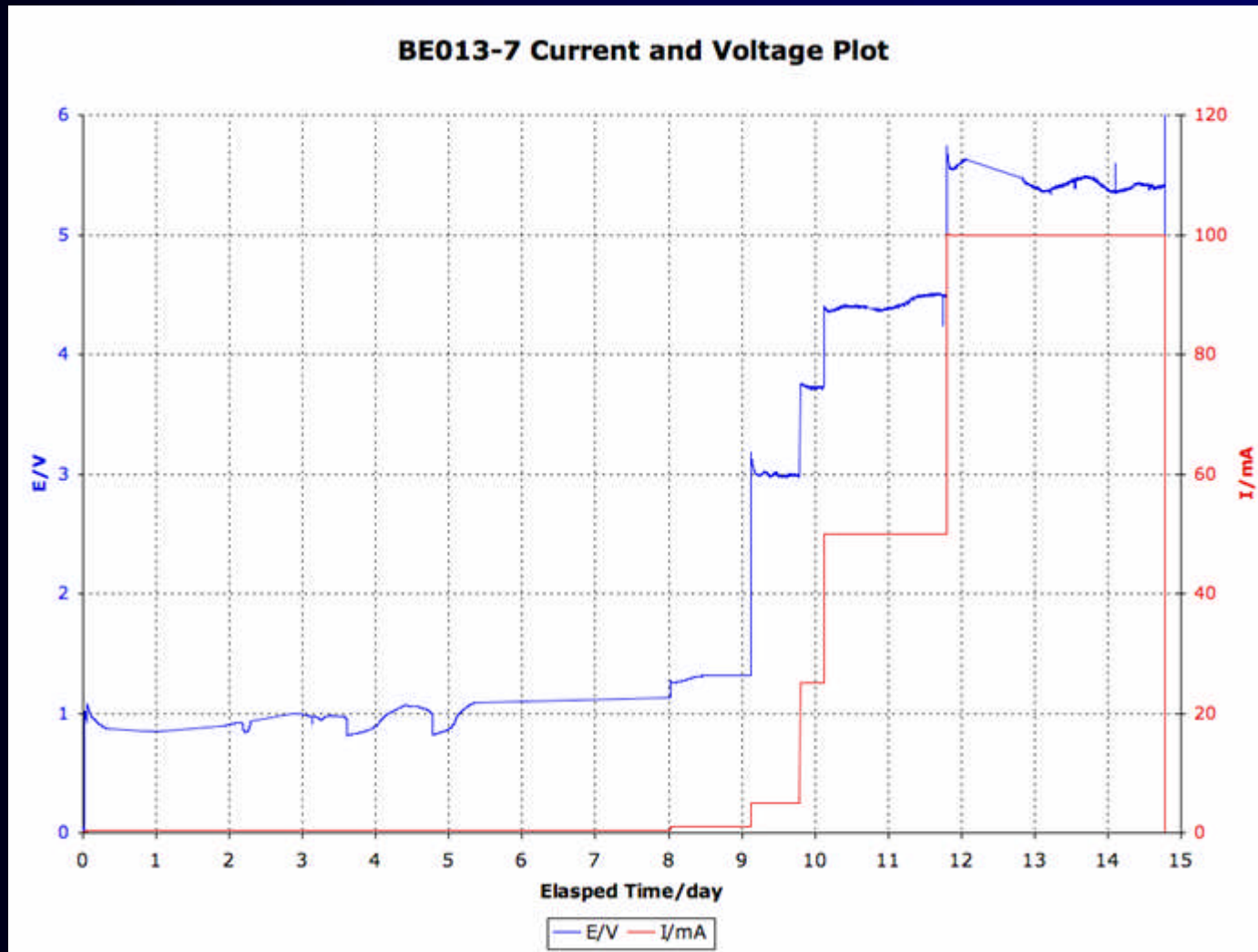
200x

Experimental: Dry CR-39

- All cells had magnets.
- 0.03 M PdCl₂ ; 0.3 M LiCl ; D₂O
- 0.2mA for 1 day, 0.5mA until solution cleared and then 12 - 48 hours each of 1, 5, 10, 25, 50, and 100mA
- Cathodes were ~16 cm of either 0.5mm Ag or 1mm Au wire pressed against the inside of the 6 μ m Mylar® window
- Fukuvi/Landauer CR-39 pressed against the outside of the 6 μ m Mylar® window
- Etched in 6.5 N NaOH, for 6.5 hours, at 65°C

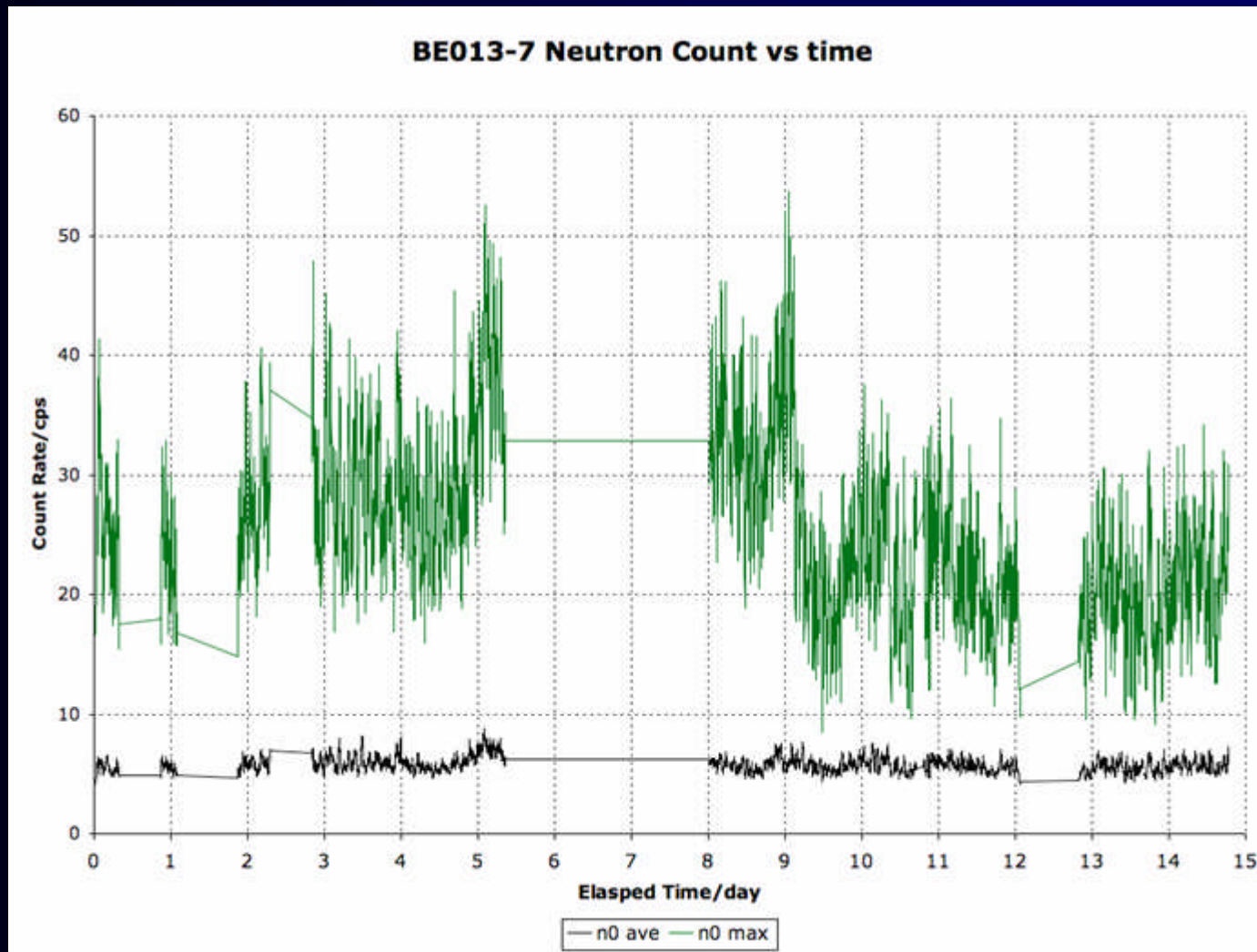


Results: BE013-7 Current and Voltage



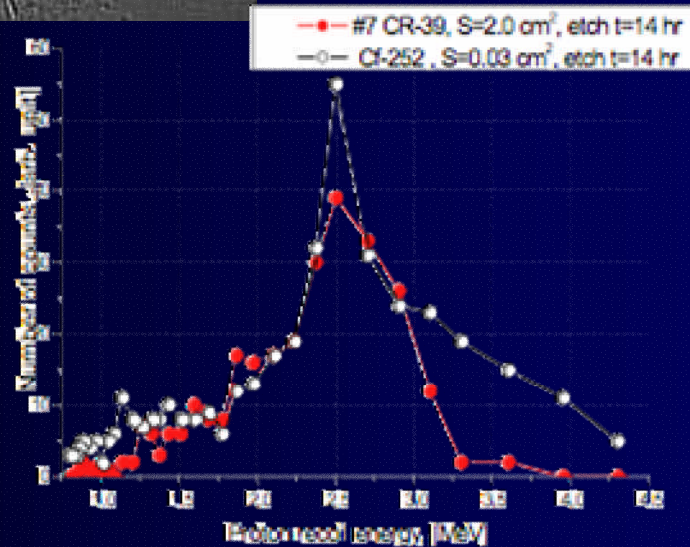
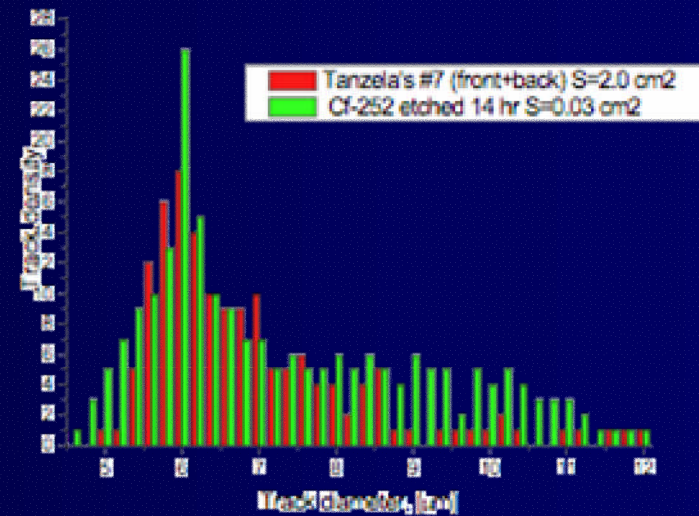
Reproducible current - voltage curve

Results: BE013-7 Neutrons

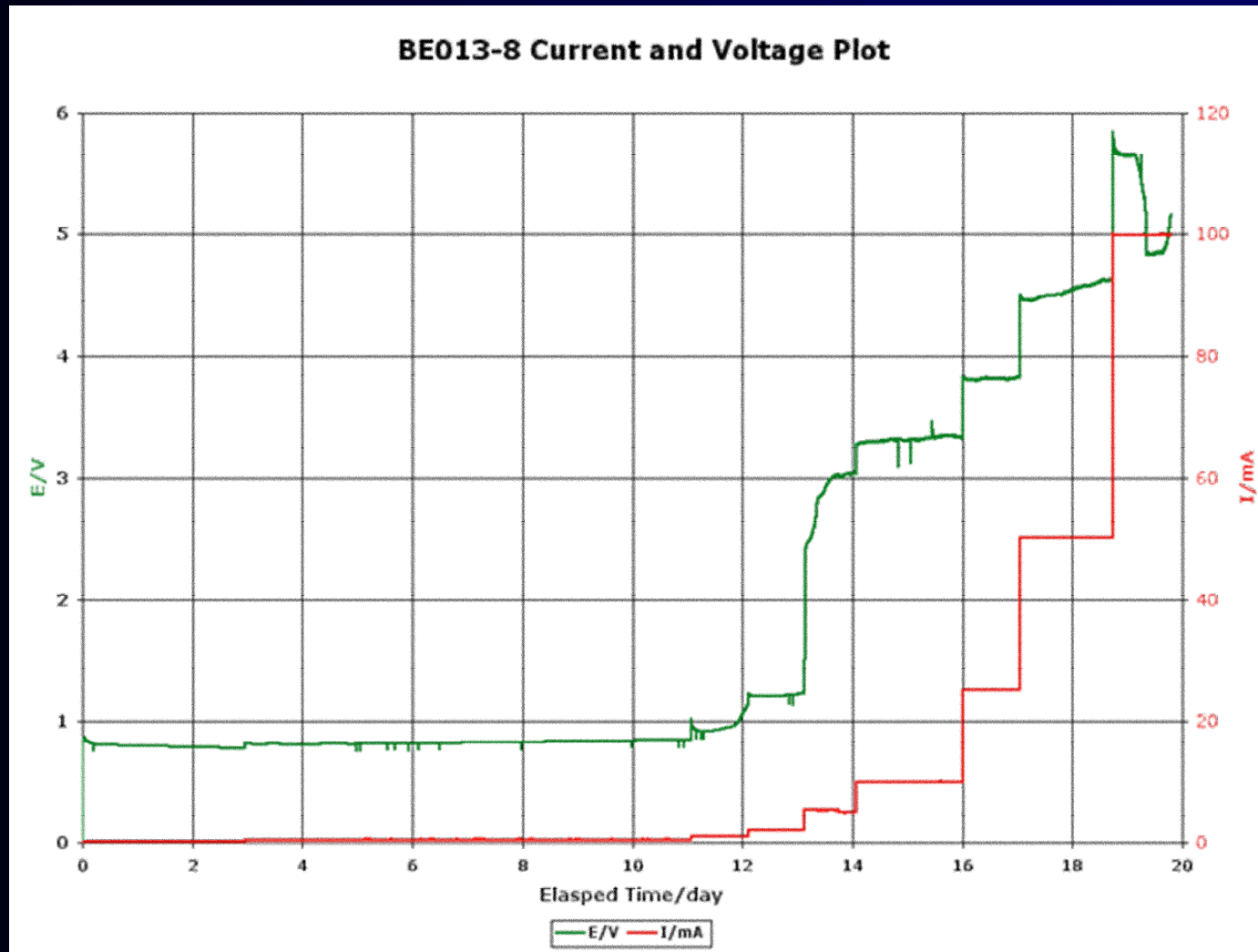


Serious data dropouts
Slight increase of neutron count above background

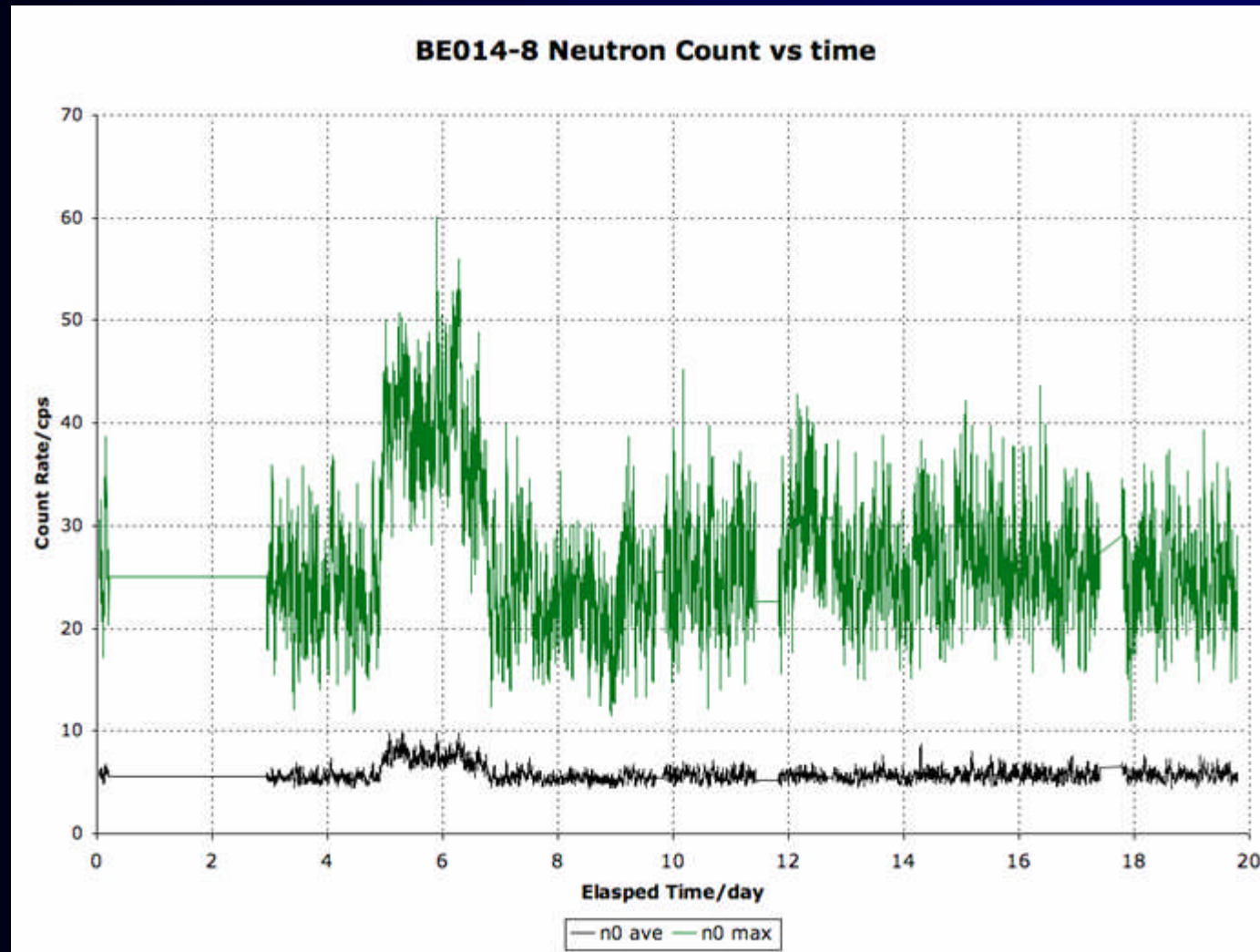
Results: BE013-7 CR-39 (Lipson Analysis)



Results: BE014-8 Current and Voltage



Results: BE014-8 Neutrons



Slight increase of neutron count above background for 48 hours
No obvious tracks above background seen in CR-39

Conclusions

- 12 Experiments run: 6 with “wet” and 6 with “dry” CR-39
- Neutron count above background suggested in at least 3 experiments
- The cells’ electrochemical behavior is reproducible in all 10 cells.
- Bare CR-39 is seriously attacked by the electrolyzing solution.
- Porous 60 μ m porous film does not totally prevent chemical attack.
- Depending on analysis (analyst?), CR-39 shows tracks due to protons from recoil of neutrons on polymer backbone, or alphas/protons from electrolyzing co-deposited PdDx.
- One experiment showed both a potential neutron “burst”, measured by one detector, and nuclear particle tracks in CR-39, analyzed by two analysts.
- During the potential neutron “burst”, the cell potential reacted in a manner consistent with electrolyte heating.



Future Work

- Measure solution tritium concentration
- Measure time-correlated alpha/beta energy spectra with 6 μ m Mylar® film.
- Measure time-correlated gamma energy spectra.
- Perform cathode thermometry or heat-loss calorimetry.
- Measure time-correlated neutron energy spectra(?)
- Develop in-house CR-39 photo-microscopy method.
- Try E-Field variant of PdD_x Co-deposition experiment.



Acknowledgements

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