MCP #116 Life Test Report

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LAPP MCP Godparent Review

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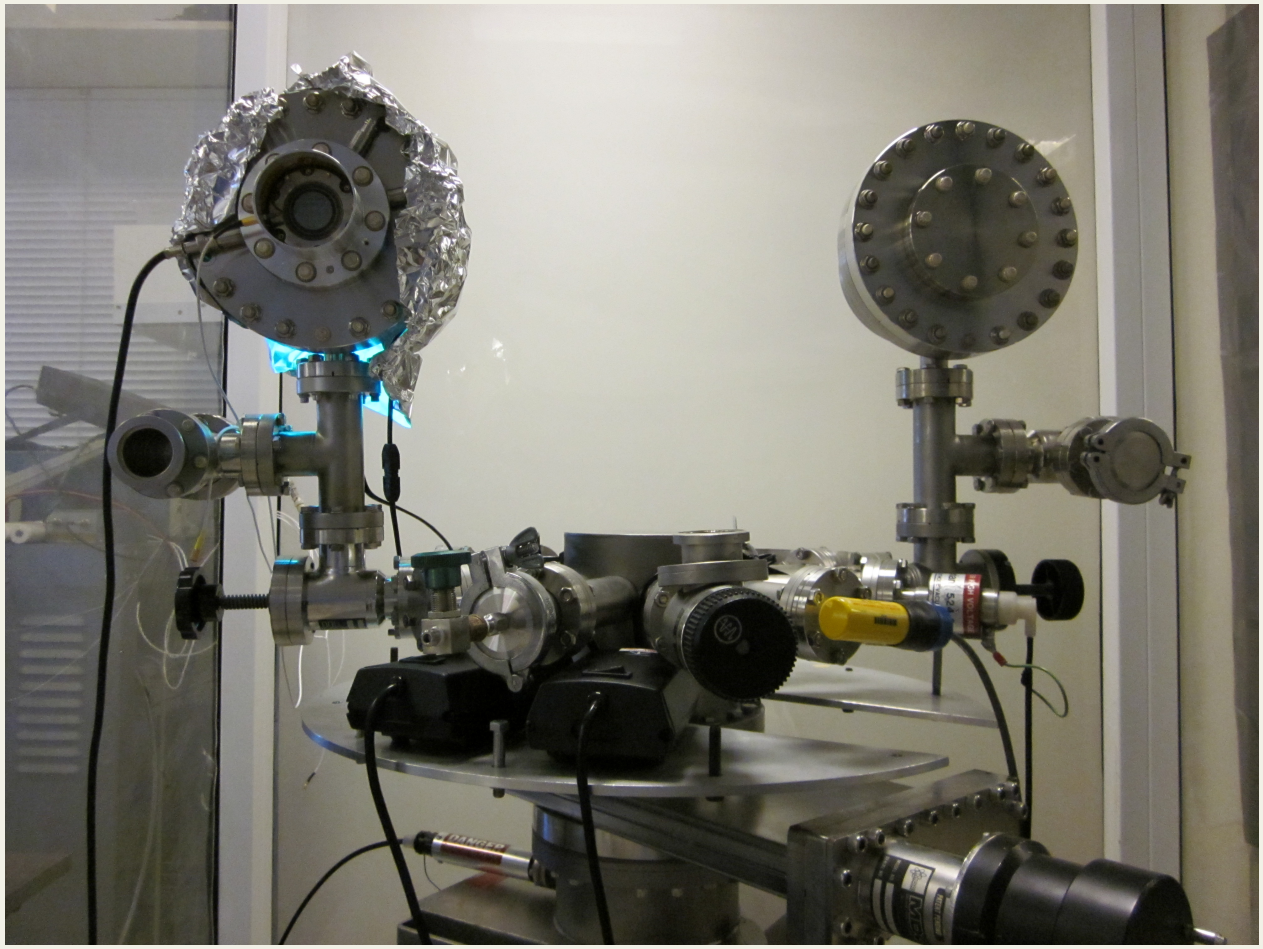
MCP #116

- INCOM 33mm diameter substrate
  - 20 µm pores, 60:1 l/d, 8° bias angle, 60% OAR
- 2000 Å NiCr electroding, *under* ALD
- Argonne ALD activation:
  - 55 Å Al_2O_3 passivation layer
  - 800 Å "Chem-2" resistive layer
  - 55 Å Al_2O_3 SEE layer
  - Not annealed
- Vacuum resistance R = 31 MΩ

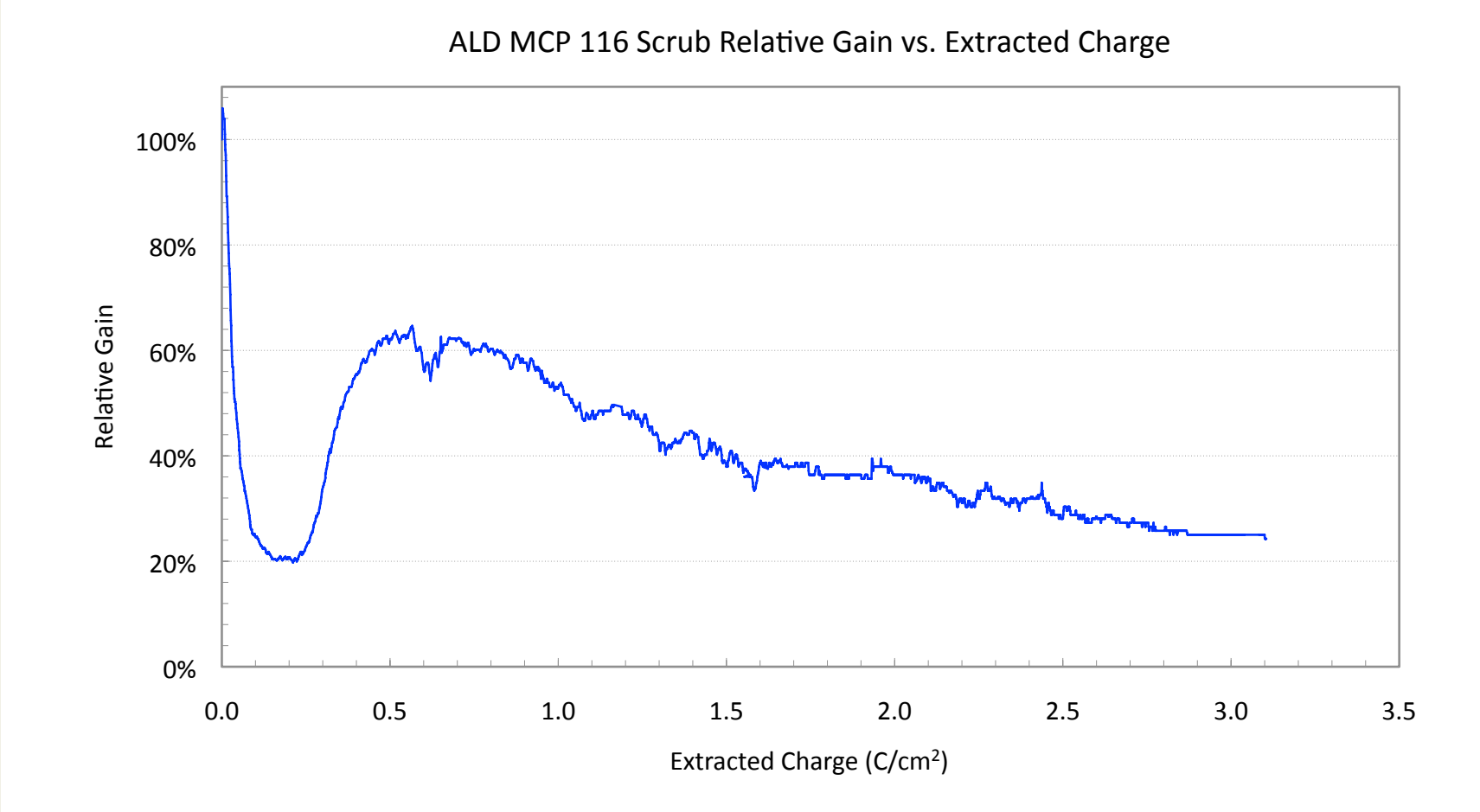
MCP #116 Life Test

- Single plate in thermoplastic based phosphor screen detector on life test system
  - Sapphire window, quartz diffuser, 2x bare penray lamps, Al foil shroud
- Pre-scrub imaging vs. voltage
- Baked at 145°C for 48 hours
- Post-bake imaging and "gain" vs. voltage
- Start scrub 9/10/10. End scrub 4/6/11. **208 days**
- Operated at about 1 µA photocurrent (~ 2% of strip current)
- Numerous intermediate gain versus voltage tests
- Imaging performed along with G vs. V, until phosphor damaged
- **Final extracted charge 3.11 C/cm^2**
- Post- Initial Scrub:
  - Expose to N_2, then rescrub
  - Expose to argon, then rescrub

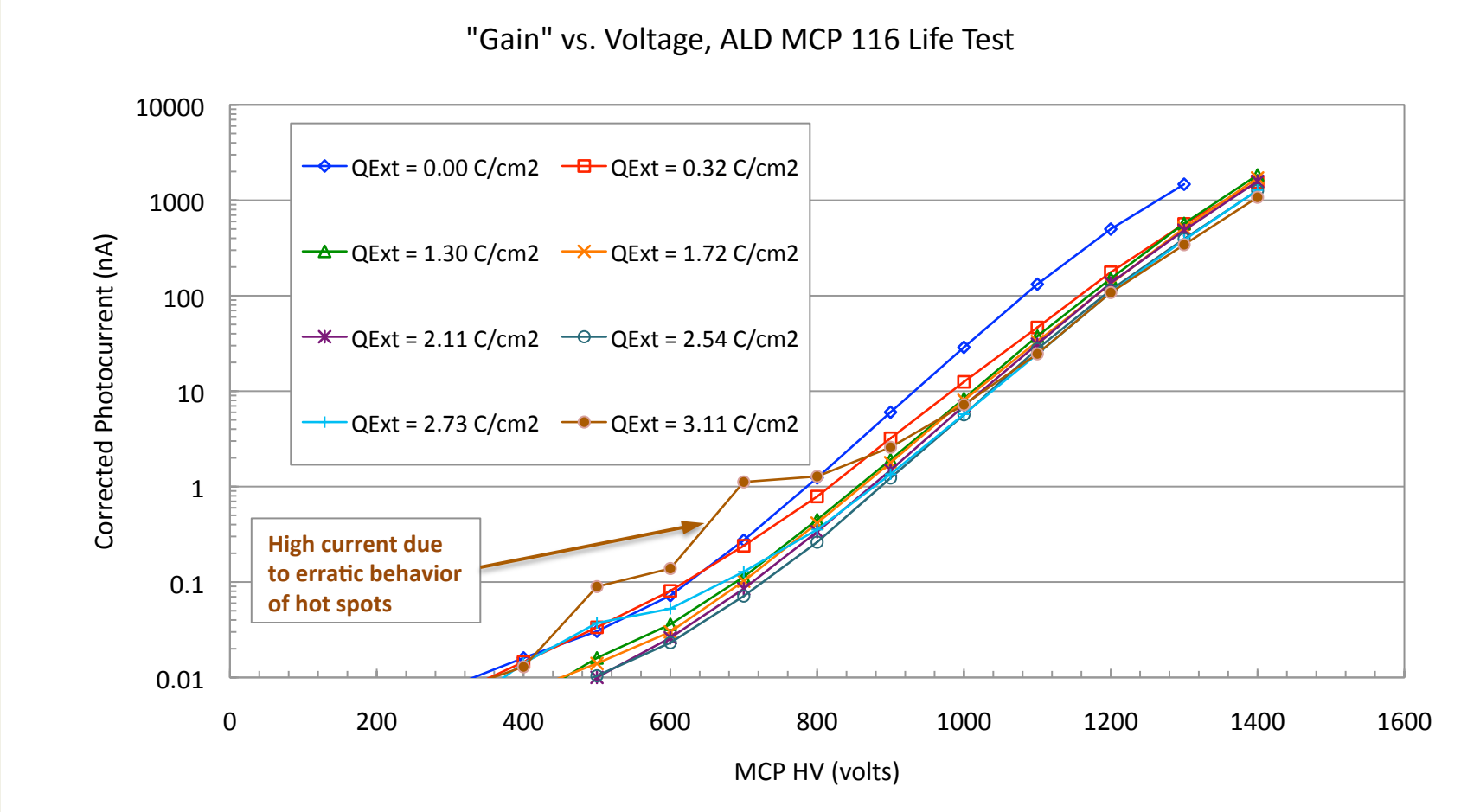
Life Test System



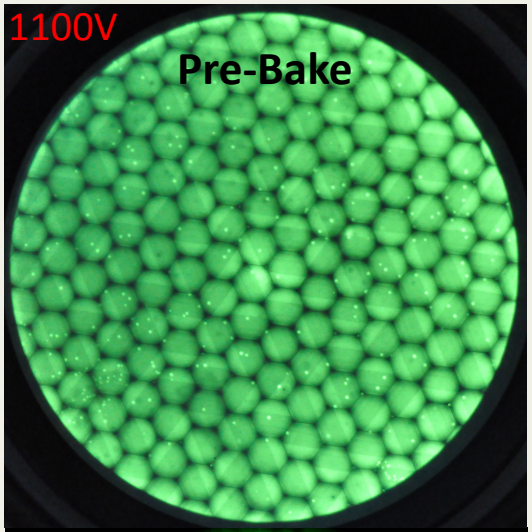
Initial Scrub
Relative Gain vs. Extracted Charge

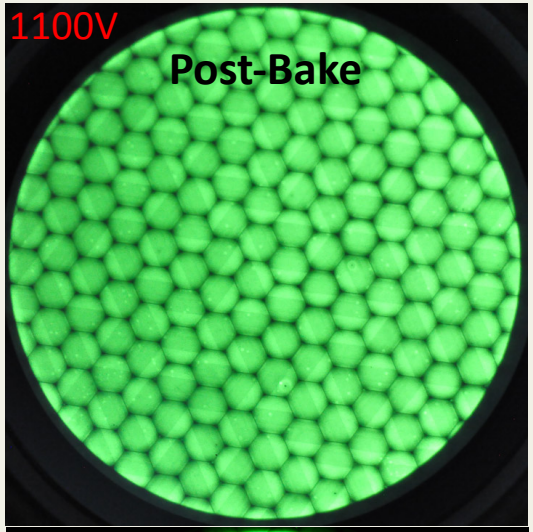


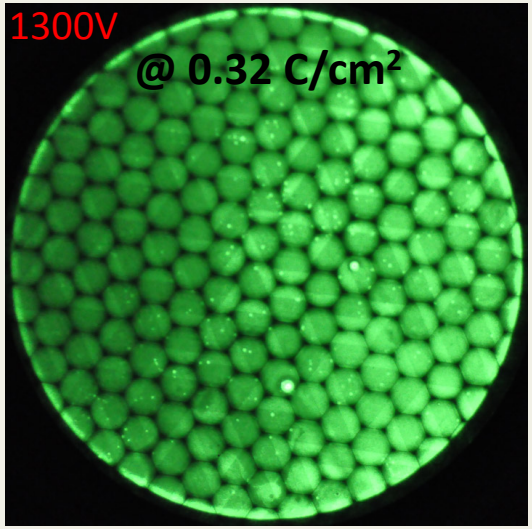
Initial Scrub
Photocurrent vs. Voltage

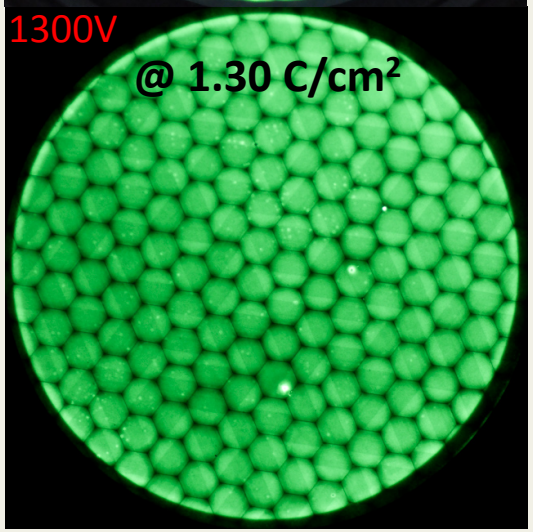


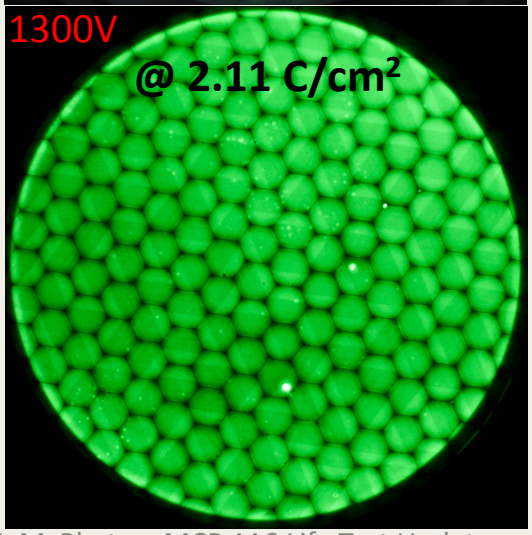
UV Flats Overview











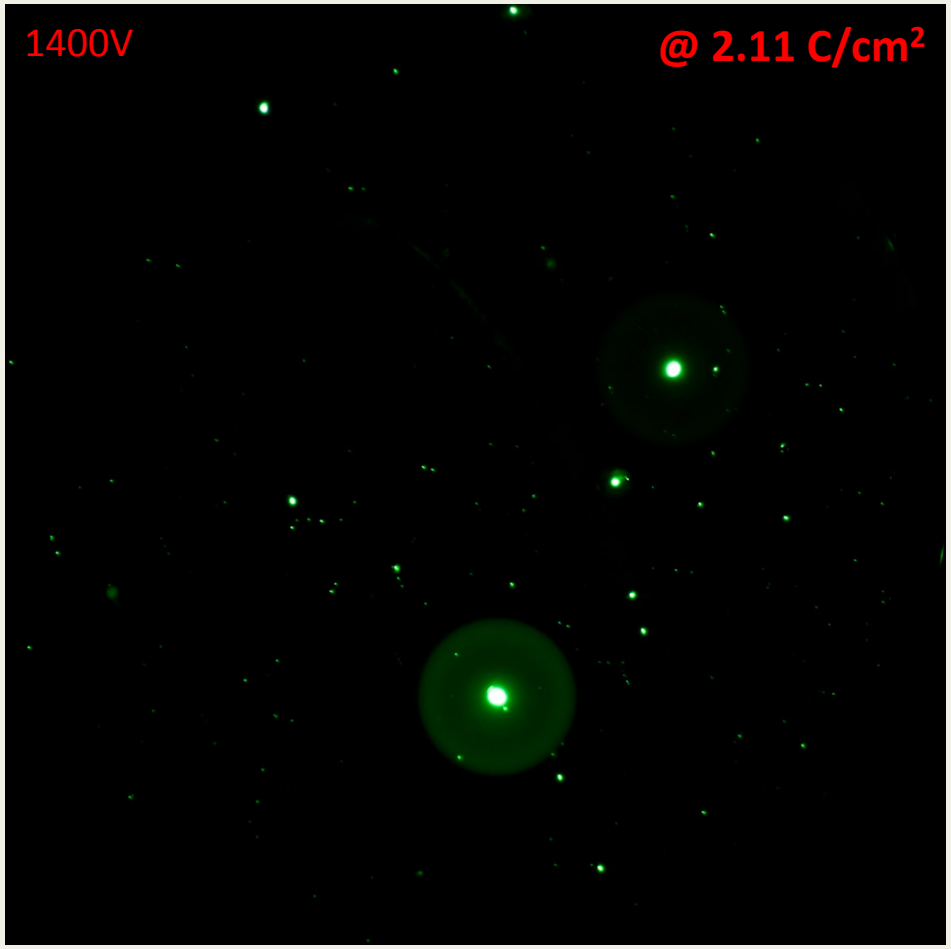
- Bright spots from exposed NiCr decreased through scrub (but did not disappear).
- No indication of non-uniform ageing.
- Hot spots developed immediately and became prohibitive to imaging.
- No significant change in gain variation at the edge of the multi-fibers.

Hot Spot Development

- No hot spots pre-scrub

- Hot spots develop and worsen as scrub progressed
- Hot spots largely associated with substrate gaps and voids
- Hot spot activity seems to be sporadic, with some blinking on and off, others changing brightness

- Spiky scrub current observed during last half of scrub caused by flaring hot spots

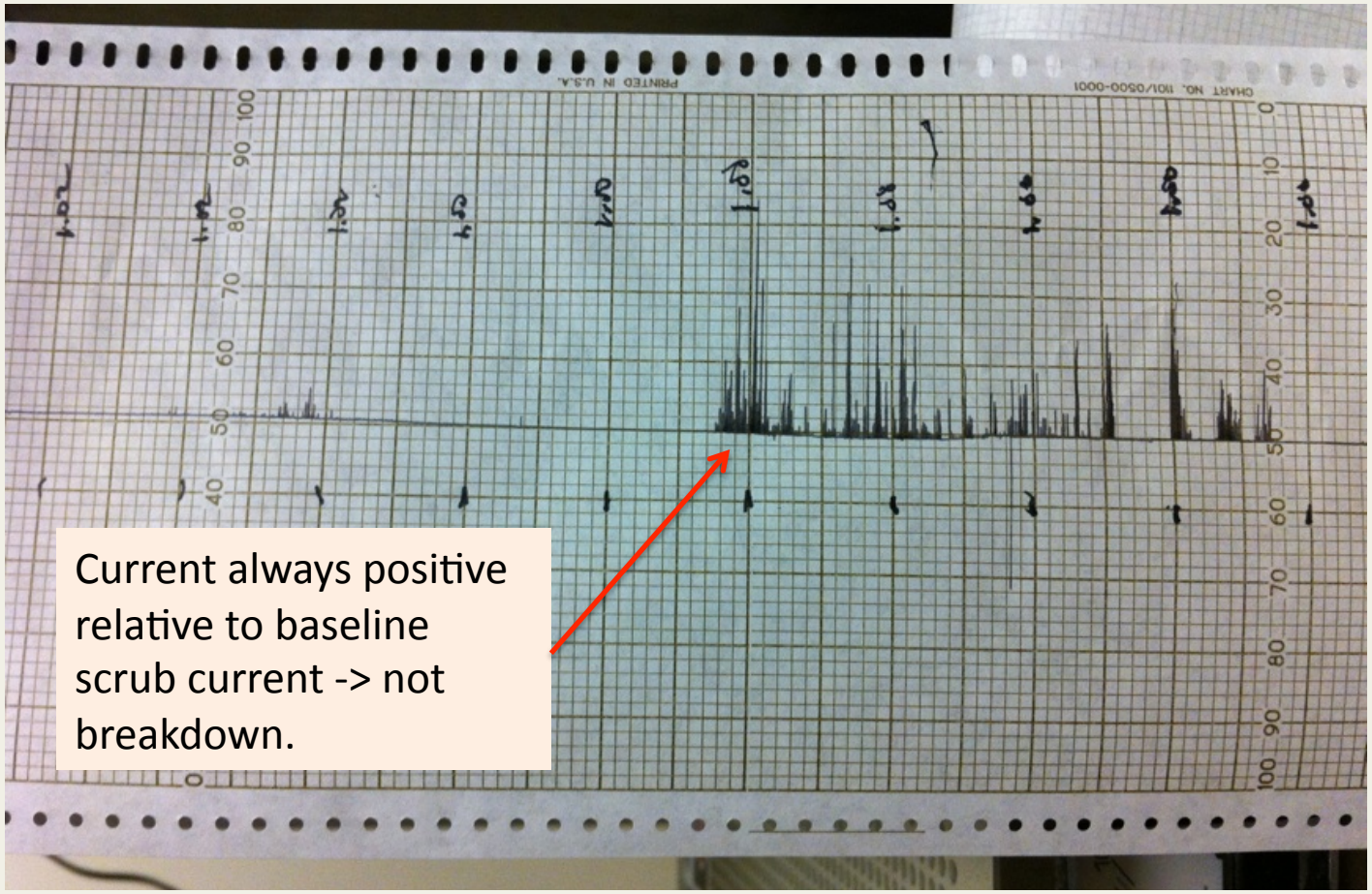


Spiky Scrub Current

2 µA

1 µA

0 µA



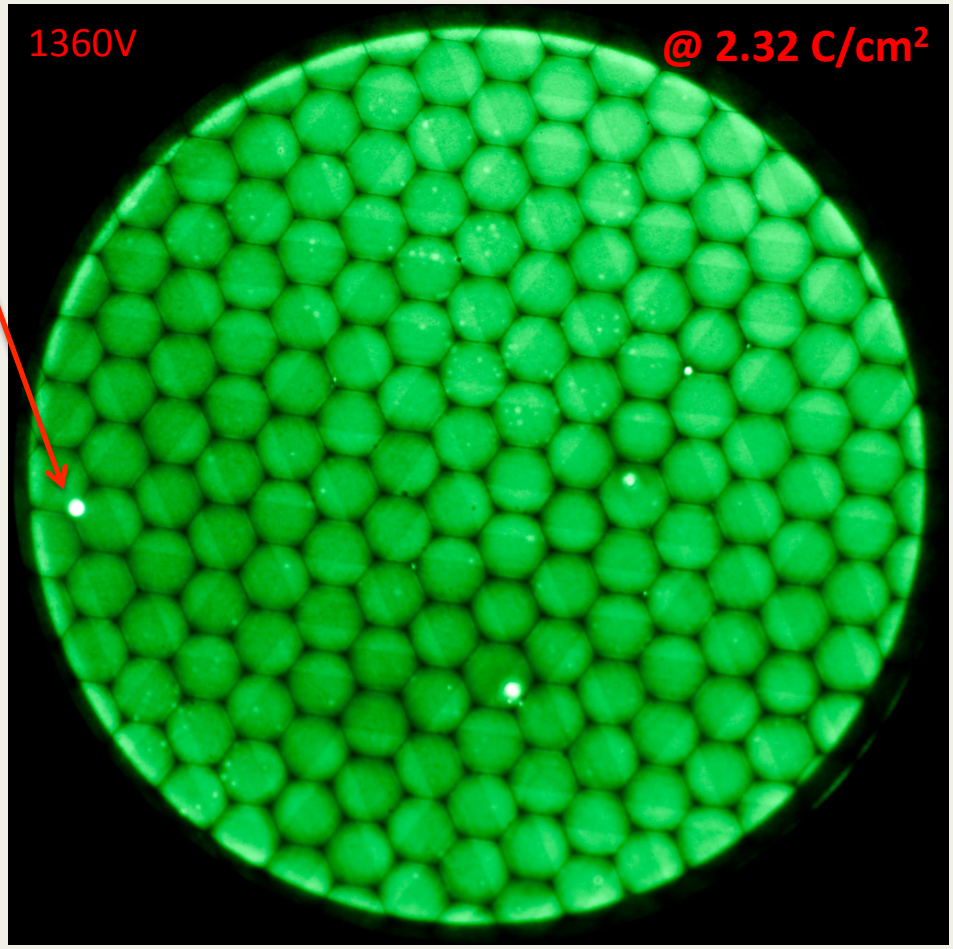
Current always positive relative to baseline scrub current -> not breakdown.

Image During Outburst Mode

- Particularly bright and very erratic hot spot. Later destroyed phosphor screen

- Presence of hot spots like these on the top plate of a chevron pair will make the detector inoperable

- As they are primarily associated with triple points we hope the improved substrates will not have these



Life Test Summary

- Extracted charge > 3 C/cm^2 at about 1 μA photocurrent (~ 2% of strip current)
- Final gain about 30% of original with a very slow linear downward slope
- Scrubbing occurred uniformly across the MCP
- Significant hot spots developed, eventually destroying the phosphor screen
- Need to test new substrates
- Need to test outgassing and scrub characteristics of high temperature baked (350°C) MCPs (in progress)

Post-Scrub GN_2 Exposure

- After ending the scrub backfilled with GN_2 gas boil-off from an LN_2 dewar, and immediately pumped down again. MCP GN_2 exposure ~10 seconds.
- Performed photocurrent vs. voltage test.
- Operational voltage "gain" about 40% higher than post-scrub.
- Backfilled to GN_2 to soak overnight (16.5 hours).
- Another photocurrent vs. voltage test.
- Operational voltage gain about 2X post-scrub gain.

Post-GN_2 Re-Scrub

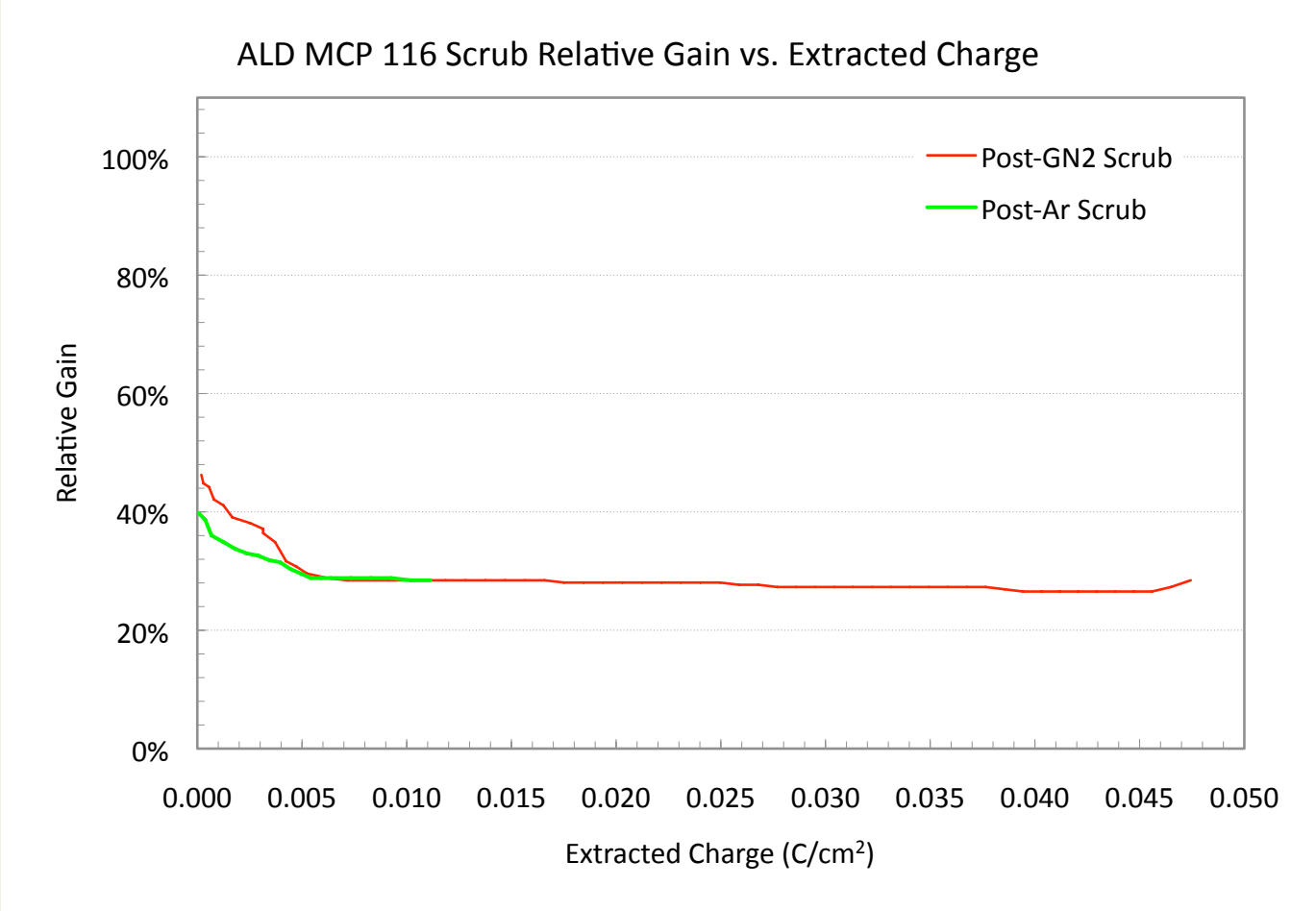
- Initiated another scrub with the same settings as at the end of the initial scrub. Slight change of illumination shielding.
- Quickly (~12 hours) scrubbed down to stable current
- Resultant gain ~10% higher than end of initial scrub (could easily be lamp shielding change)

Argon Exposure

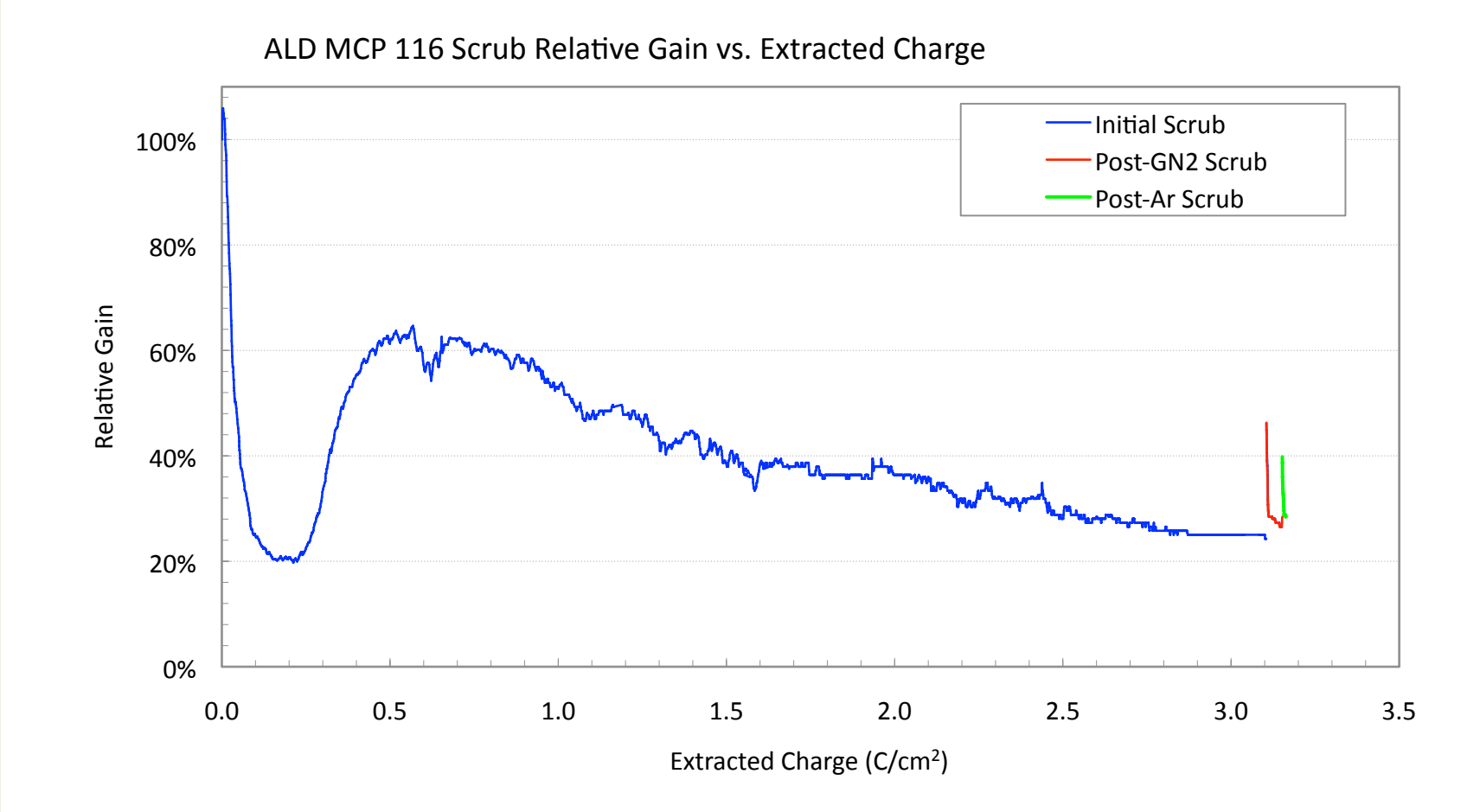
- Backfilled to argon (4.8 purity) and soaked overnight.
- Similar gain increase as seen with GN_2.
- Rescrubbed to stable current in about 12 hours.

- However, the argon presented a loading problem for the ion pump (even after pumping to 2e-6 on turbo first). It took a long time (days) to recover normal base pressure.
- We will do no further noble gas backfills.

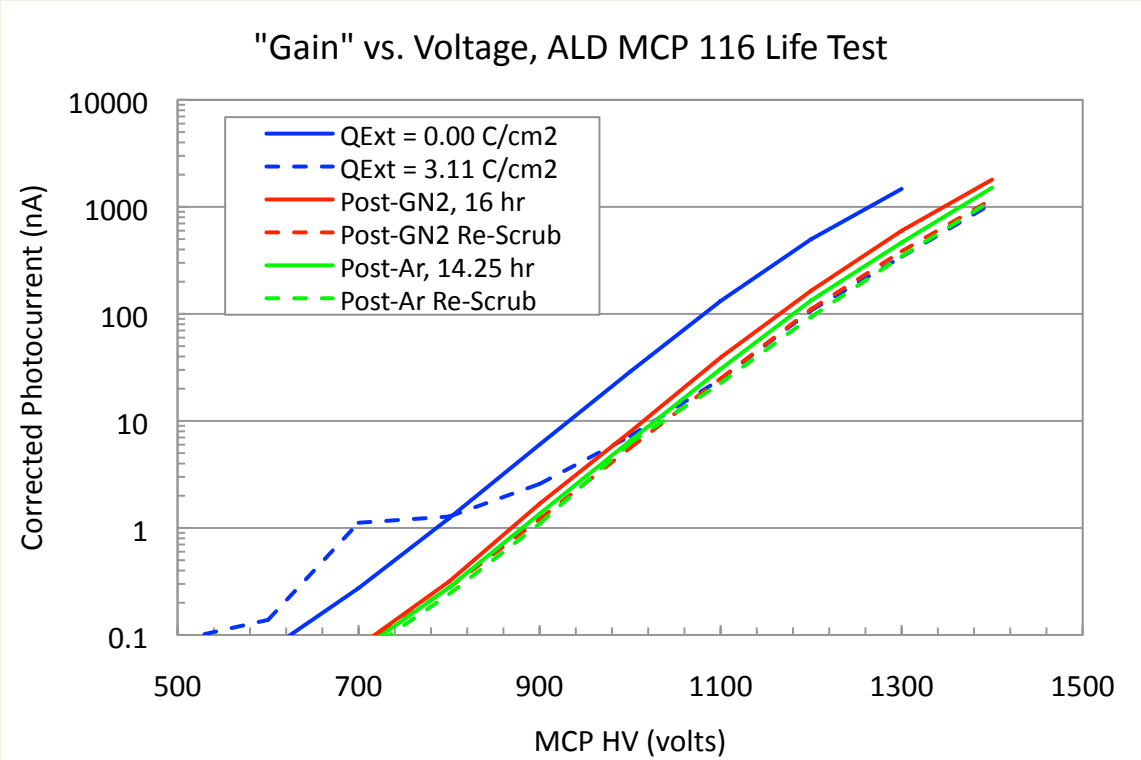
Post-(GN_2 / Ar) Soak Re-Scrubs Relative Gain vs. Extracted Charge



Initial and Post-Exposure Scrubs Relative Gain vs. Extracted Charge



Post-Gas Soak Re-Scrub Photocurrent vs. Voltage



Gas Exposure Summary

- Exposure to dry gasses does not seem to significantly reverse scrub conditioning
- Presents the idea of doing a long pre-scrub prior to final build, then minimizing (eliminating?) air exposure, followed by an abbreviated scrub during processing.
- This flow presents significant difficulties in the build – probably not useful in a serial process such as ours.
- Follow up similarly with other gasses. Other gasses in house: O_2, H_2, dry air, room air. (No more nobles – bad for the ion pump.)
- No CO or CO_2 in house (the carbon gunks up our lamps)
- How different from standard glass MCPs are these? Will our ~40% RH room air cause significant loss of scrub?