Spin-polarized Photocathodes

Greg Blume[1]

[1]Department of Physics, Old Dominion University, Norfolk VA, 23529 USA

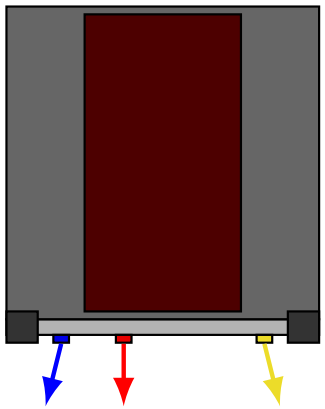
Outline

- Review of activation/measurement process
- Results
  - Heat cleaning optimization
  - Surface uniformity improvement
  - Lifetime requirements
  - Number of superlattice pairs
- Conclusion

Review - Activation

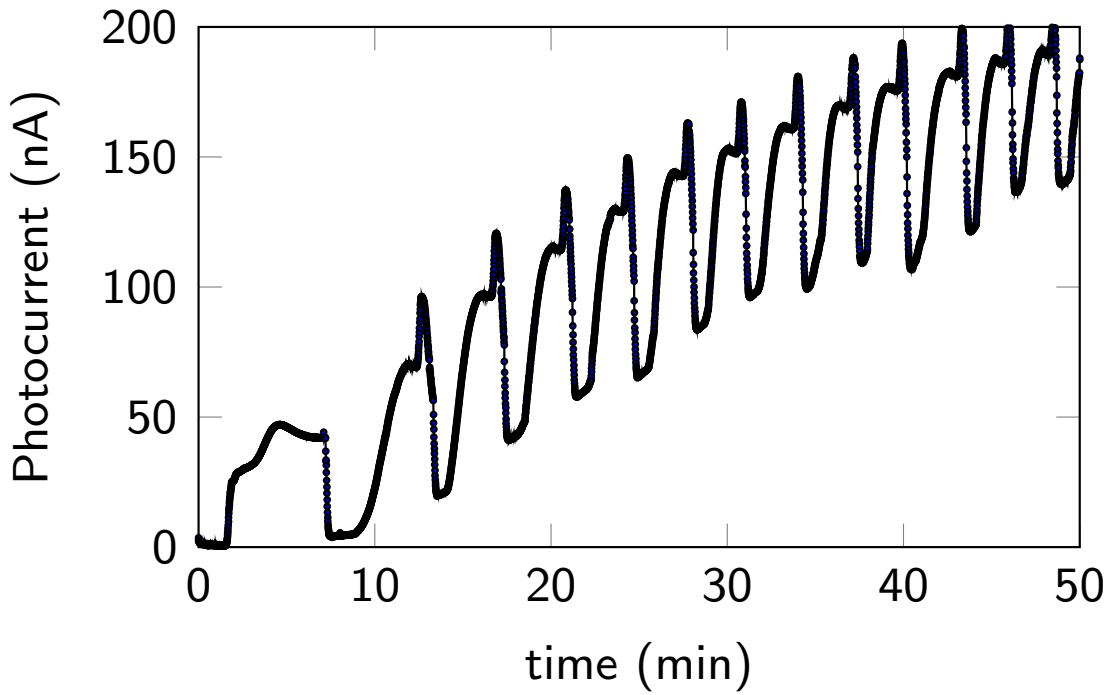
Cleaning

- Heated to remove material from surface



- 450 C minimum to remove any surface contaminants

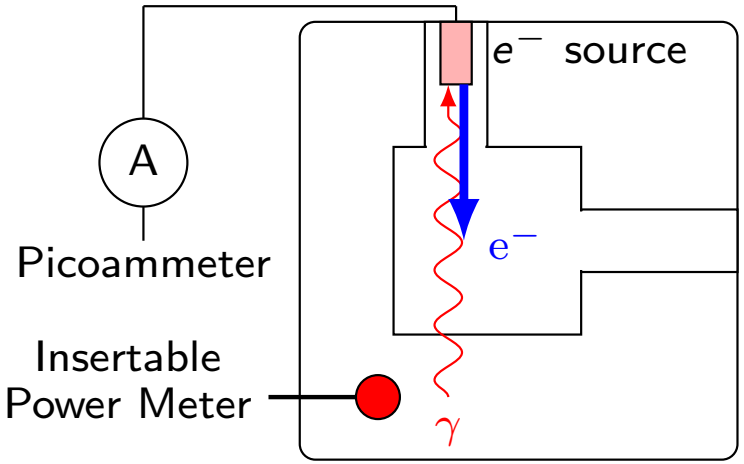
Activation



- "yo-yo" process until gain < 5 %

Review - Measurement Process

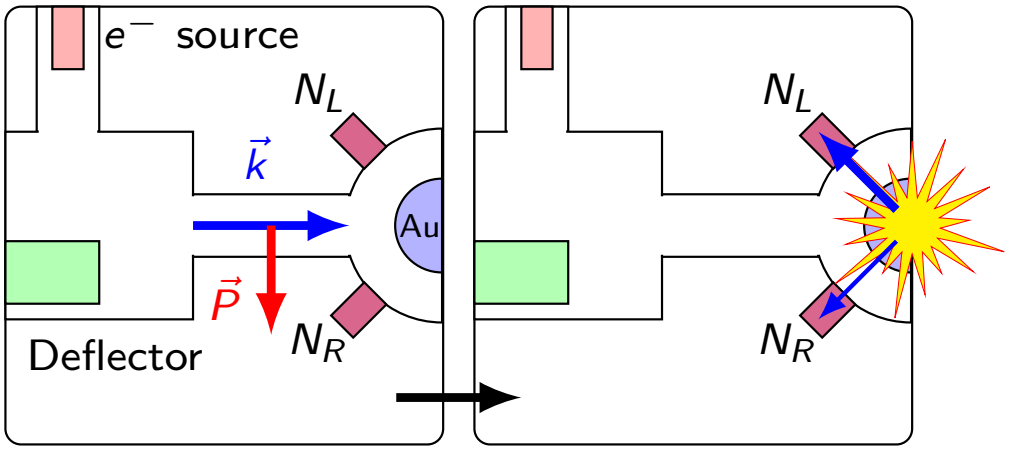
Quantum Efficiency



- # of electrons out vs. # of photons in

$$QE = \frac{hc}{\lambda}\frac{I}{P}$$

Polarization



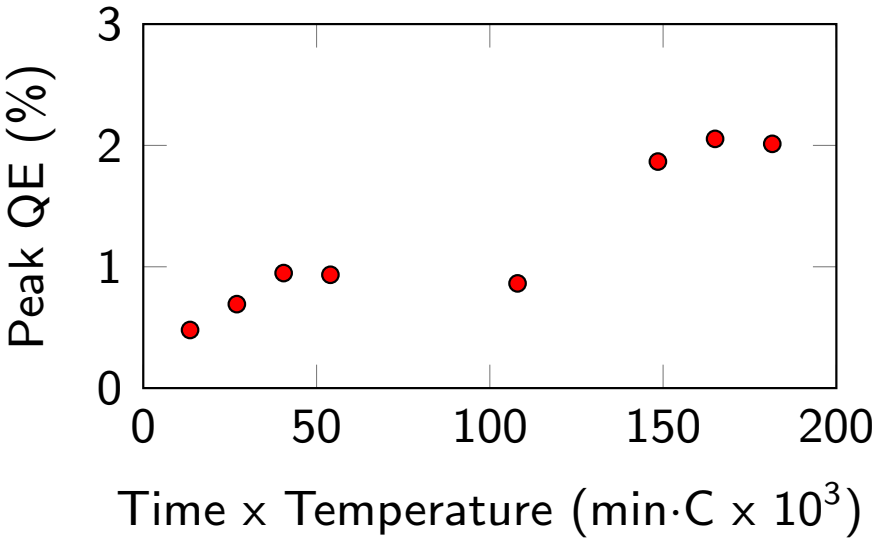
- Asymmetry in counts

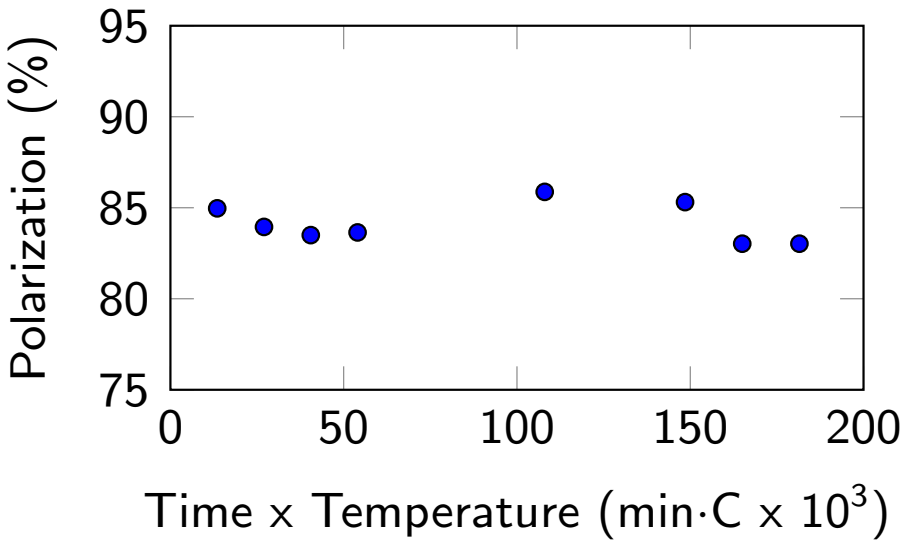
$$A = \frac{N_L - N_R}{N_L + N_R}$$

$$P = A/S(\theta)$$

Results - Performance vs Heat and Time

Five 450 C heat cleans followed by three at 550 C for DBR SL sample

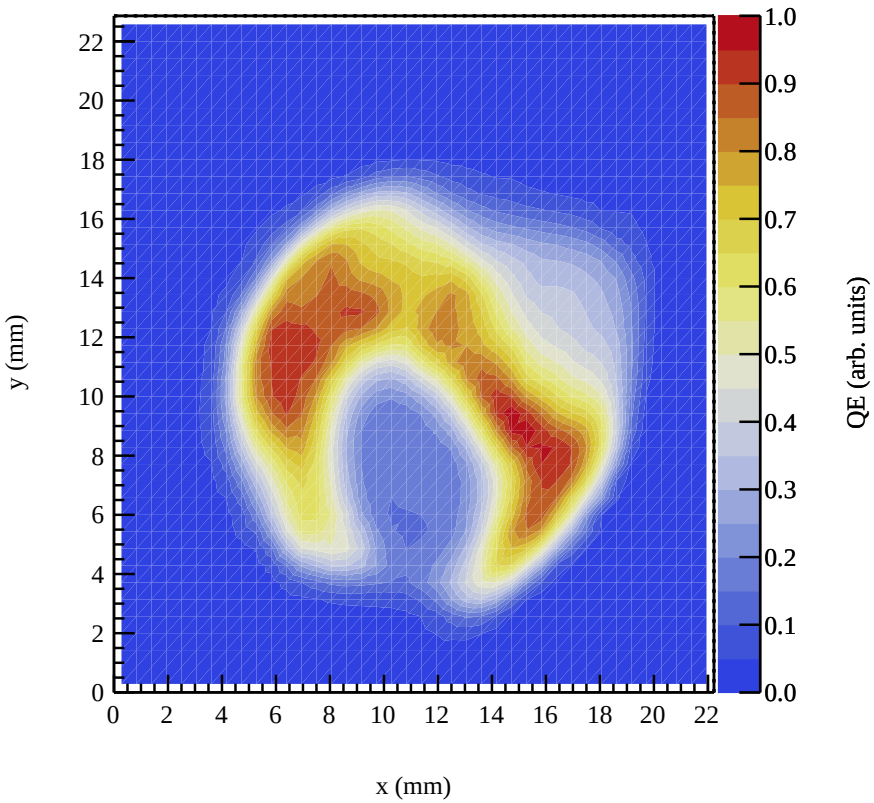




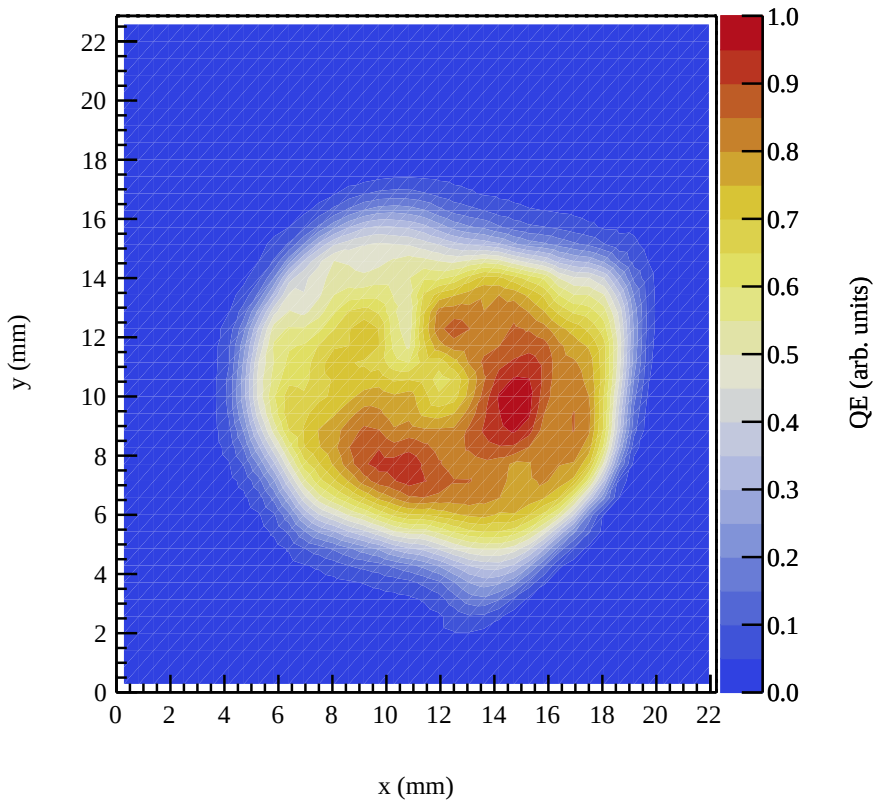
- DBR SL cathodes have a peak resonant wavelengths ($\sim$ 780 nm) - QE selected here
- Polarization is recorded at the peak QE wavelength, peak polarization does move

Results - Surface Quality vs Temperature

Surface uniformity increases with higher heat treatment



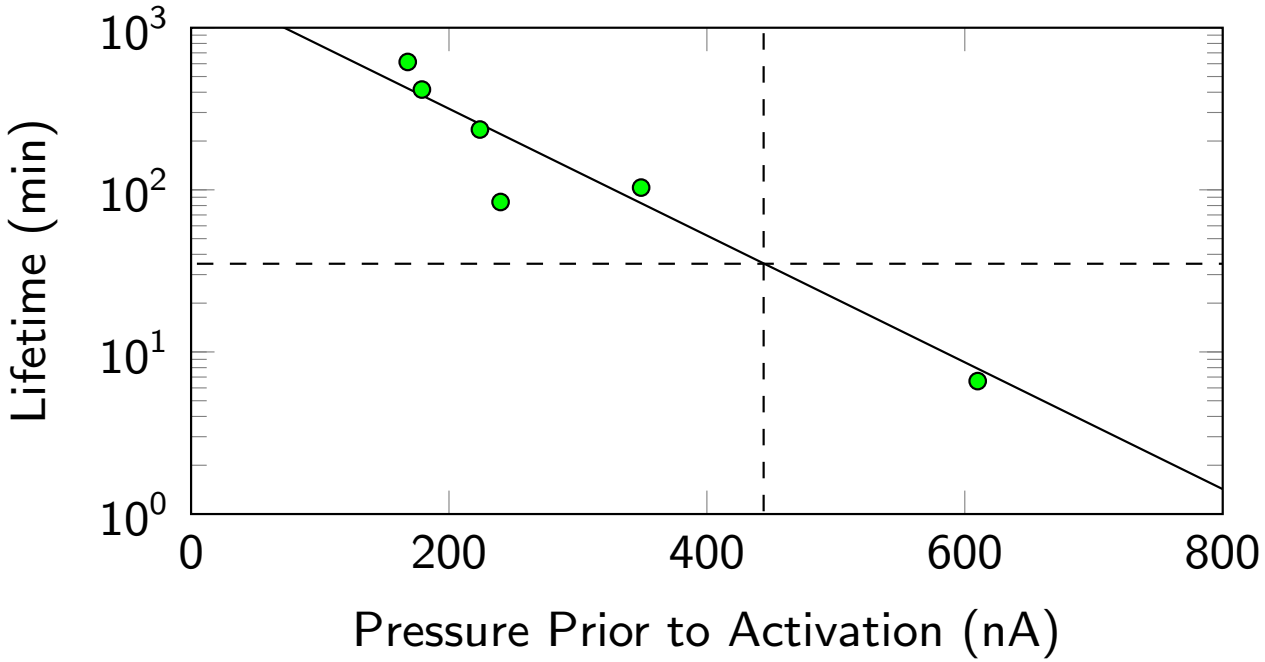
450 C



550 C

Results - Performance vs Pressure

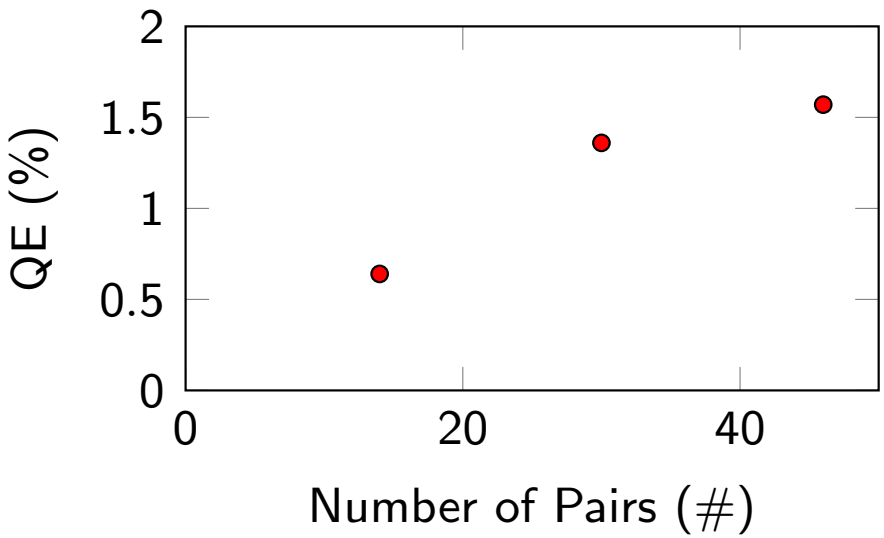
Lifetime for 3 non-DBR SL cathodes vs base activation pressure

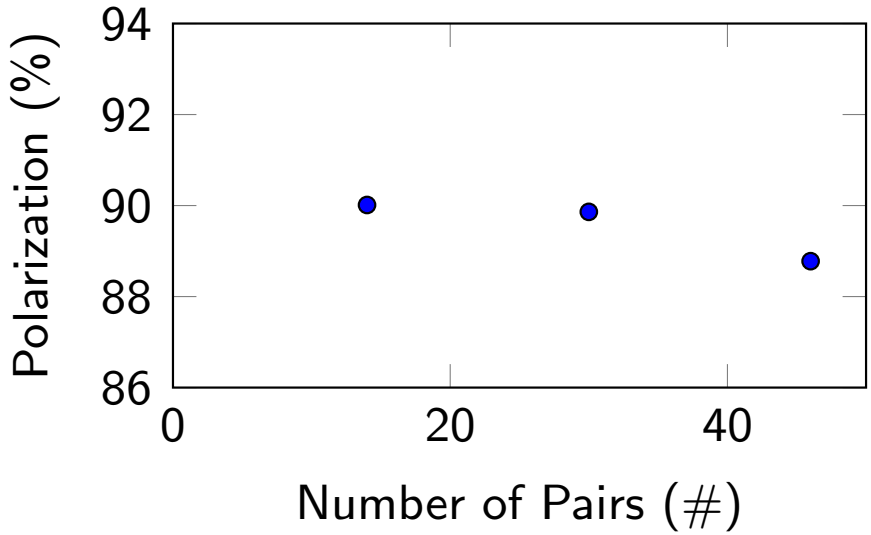


- 35 min lifetime required for polarization scan to be useful
- Requirement - less than 430 nA base pressure before activation
- Goal - around 200 nA to give comfortable lifetime

Results - Performance vs Number of SL pairs

Non-DBR SL cathodes with 14, 30 and 46 SL pairs





- Quantum Efficiency is measured at 780 nm for each cathode
- Polarization is selected at its peak which moves slightly

Conclusion

So far...

- Optimized our heat cleaning procedure at the microMott
- Improved surface quality of activation
- Determined maximum pressure limits
- Explored increased SL pairs

Whats next?

- Fill in blanks of SL pair study
- High pair DBR SL test for high QE and polarization