

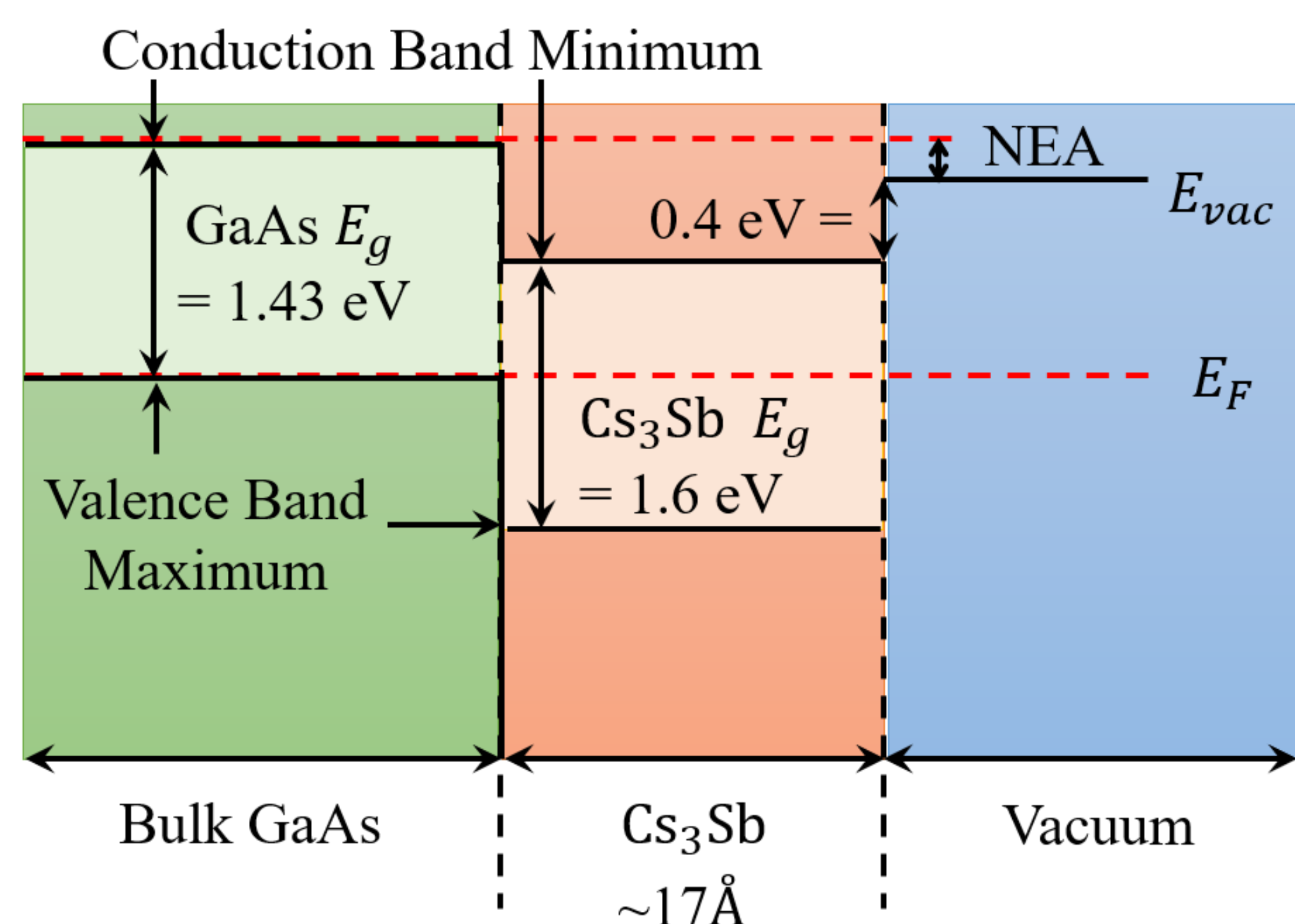
## Enhanced Robustness of GaAs-based Photocathodes Activated by Cs, Sb, and O<sub>2</sub>

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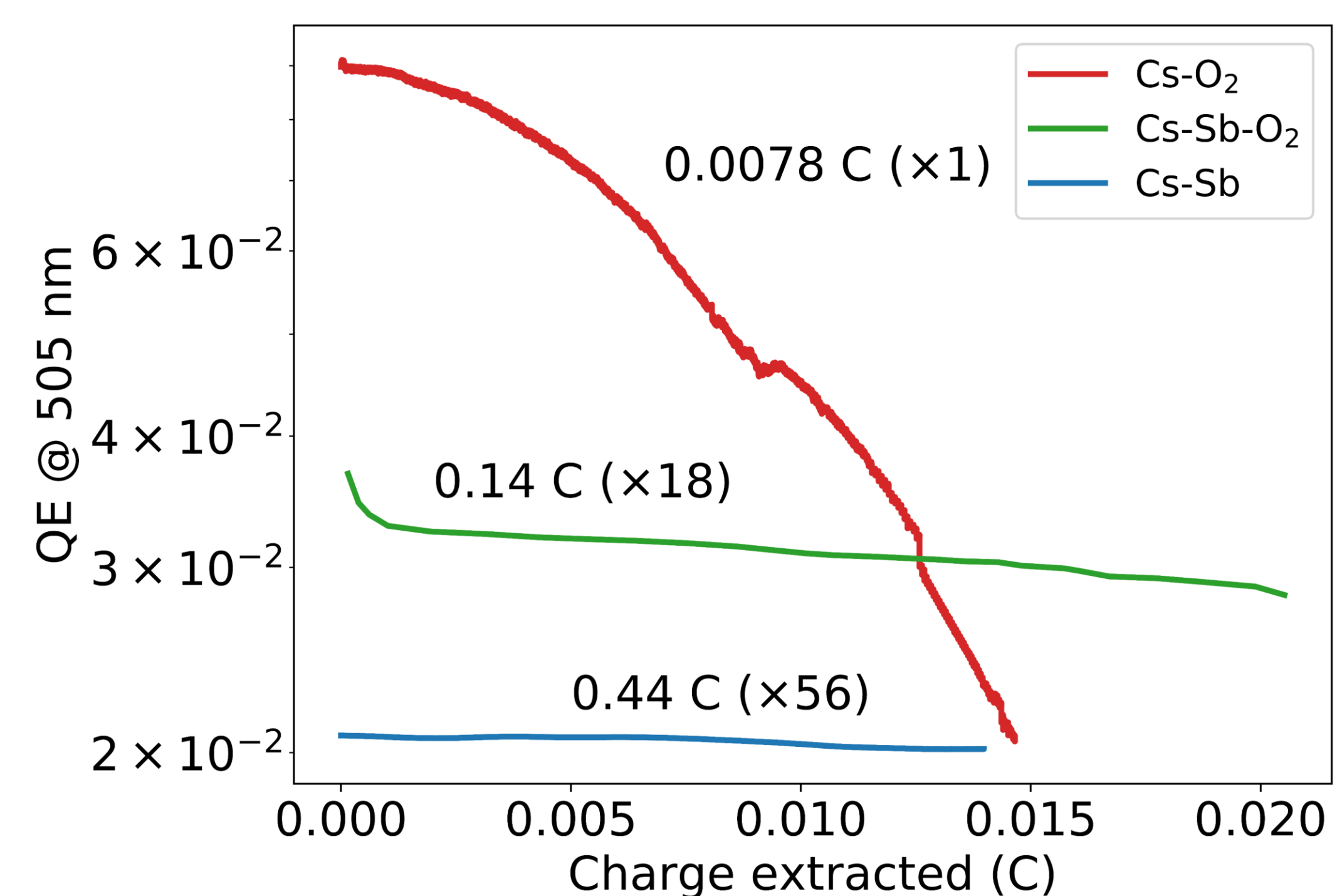
### Background

GaAs-based photocathodes are widely used to produce highly spin polarized electron beams at high currents. Spin polarized photoemission requires activation to achieve Negative Electron Affinity (NEA). The NEA surface is extremely vacuum sensitive, and this results in rapid QE degradation.

In this work, we activated GaAs samples with unconventional methods using Cs and Sb. We confirmed NEA activation on GaAs surfaces and more than an order of magnitude enhancement in charge extraction lifetime compared to the standard Cs-O<sub>2</sub> activation without significant loss in spin polarization.

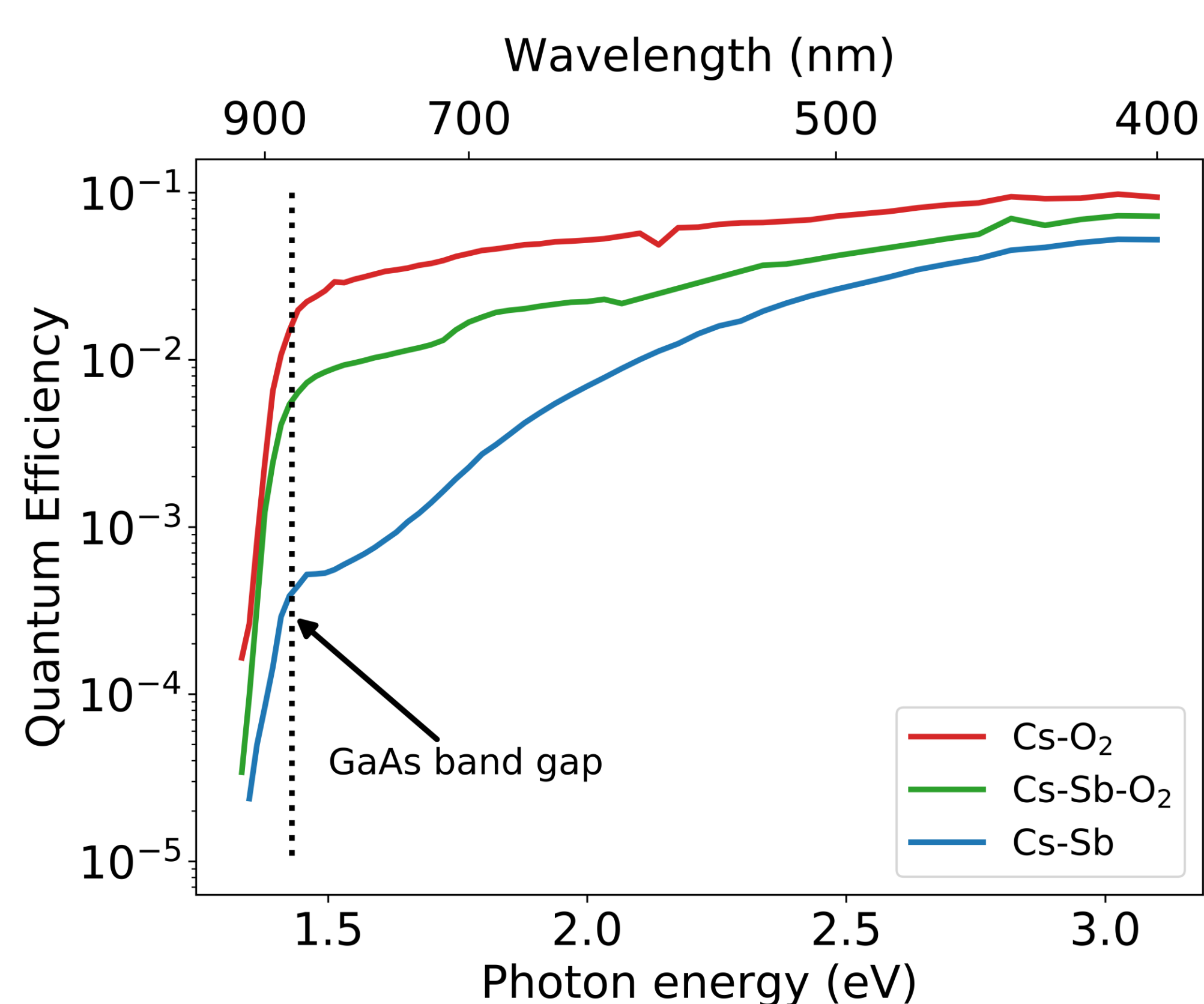


### Lifetime



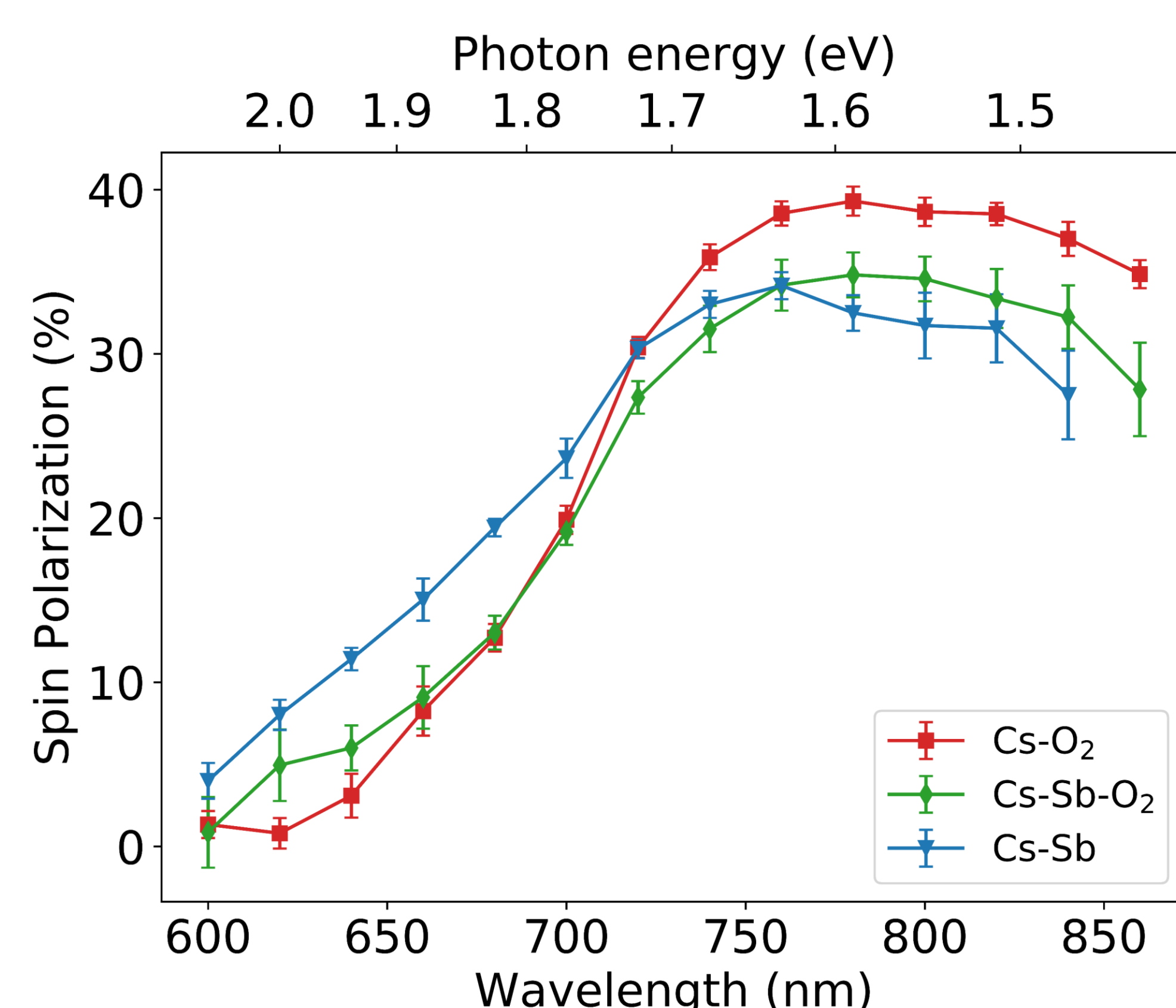
- Charge extraction lifetime, defined as the amount of charge extracted from a photocathode until the QE drops by a factor of  $e$ , was used as a metric to compare robustness of each sample.
- The numbers next to each curve are charge extraction lifetime calculated by fitting the curves to an exponential function.
- The standard Cs-O<sub>2</sub> activation has the highest QE, but falls quickly below Sb deposited samples. Sb deposited samples showed more than an order of magnitude improvement in lifetime.

### Spectral Response



- Negative Electron Affinity (NEA) is required to achieve a high Quantum Efficiency (QE) and spin polarized photoemission.
- Photoemission with photon energy near GaAs band gap indicates NEA achieved on the surface.
- QE can vary depending on the magnitude of NEA.

### Spin Polarization



- Spin polarization of photoelectrons were measured with a Mott polarimeter that operates at 20 kV.
- Sb deposited samples showed a lower spin polarization at 780 nm by  $\sim 5\%$ .