Los Alamos NATIONAL LABORATORY

Interference enhanced photocathodes

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November 12, 2021

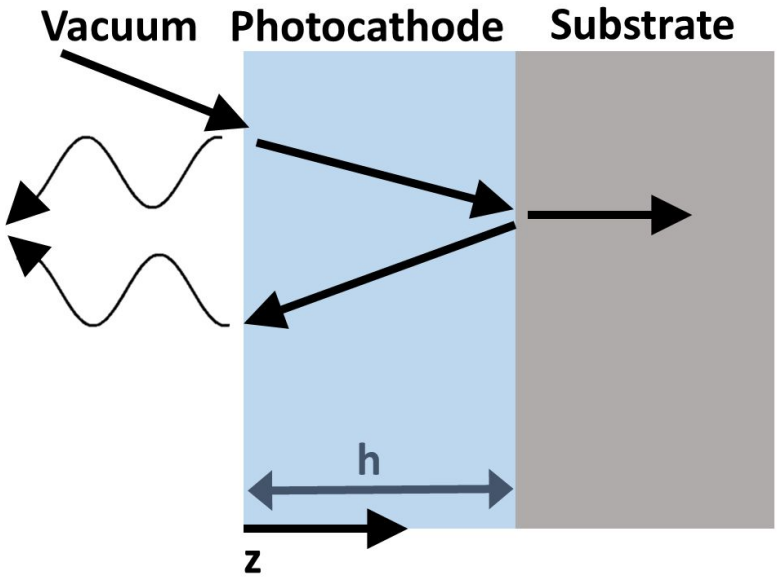
LA-UR 21-30957

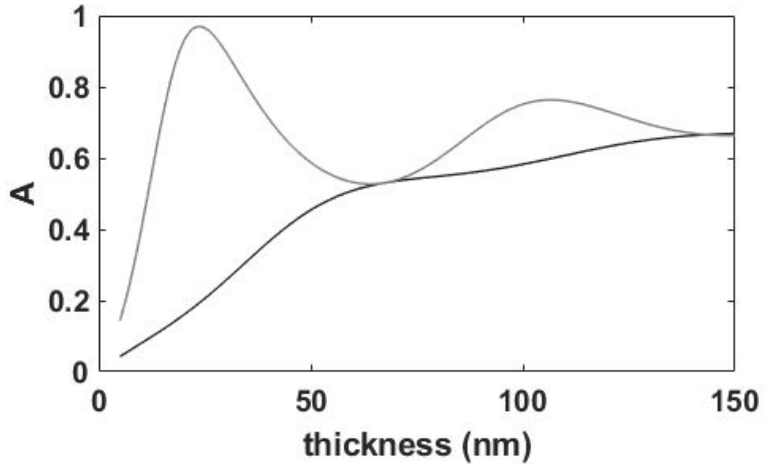
Motivation

- Tradeoffs between QE and emittance due to underlying physics
- Increasing absorption can increase QE without emittance increase
- Wide variety of applications

What is an interference photocathode?

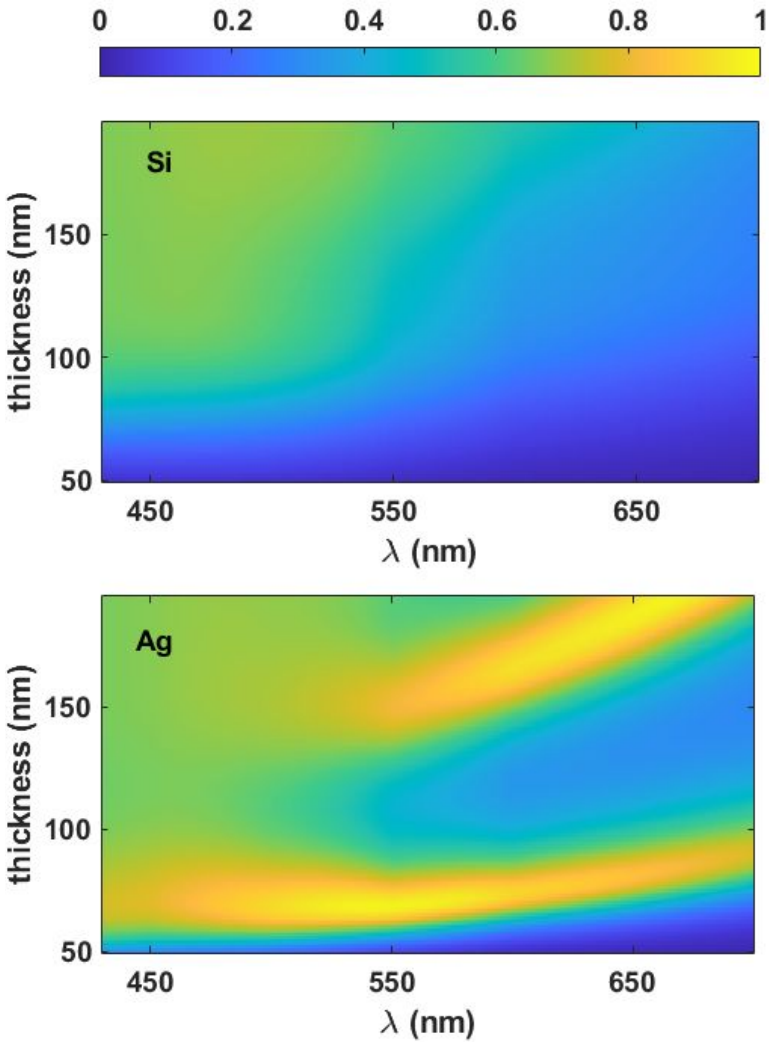
- Optical interferences maximize the absorption in the photocathode by trapping the light
- Interference results in a QE peak as the cathode thickness increases
- Material properties do not change
- Optimize thickness and substrate to ↑ QE
- Easy to incorporate into growth processes





What is the expected behavior?

- Broadband QE enhancement
- Peaks and troughs at each wavelength as the cathode grows
- Shift in peak to larger thicknesses at higher wavelengths



What is the expected behavior?

- Vertical ex
- add labels for color bar

- Peaks and troughs at each wavelength as the cathode grows

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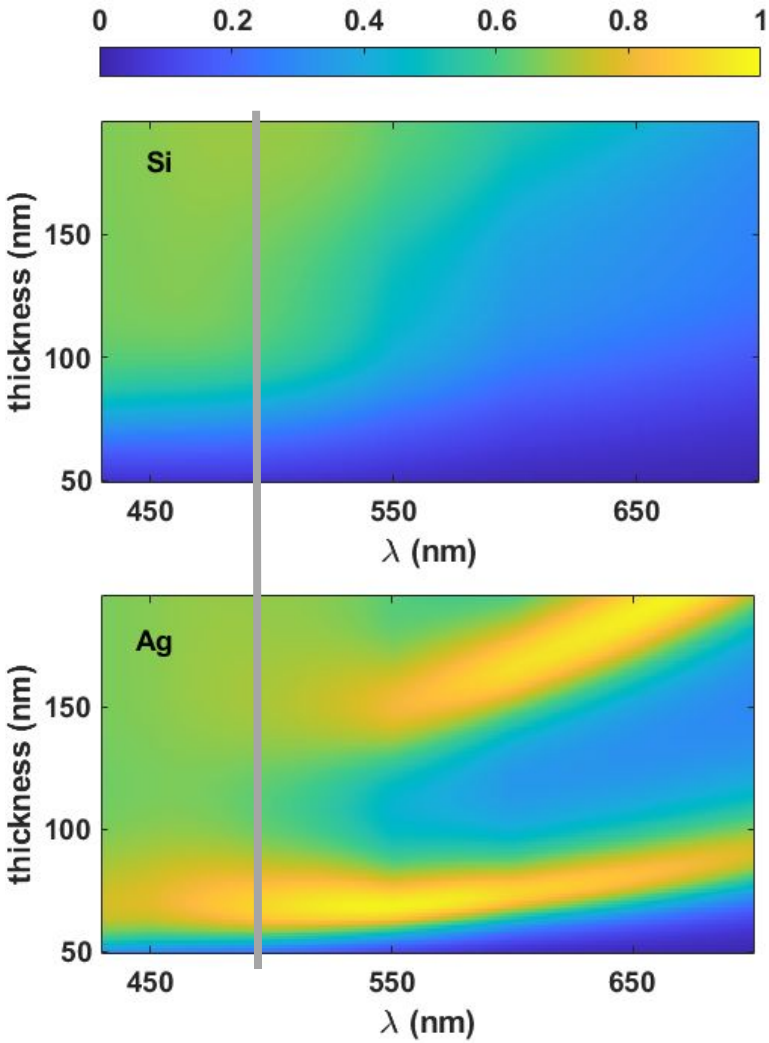

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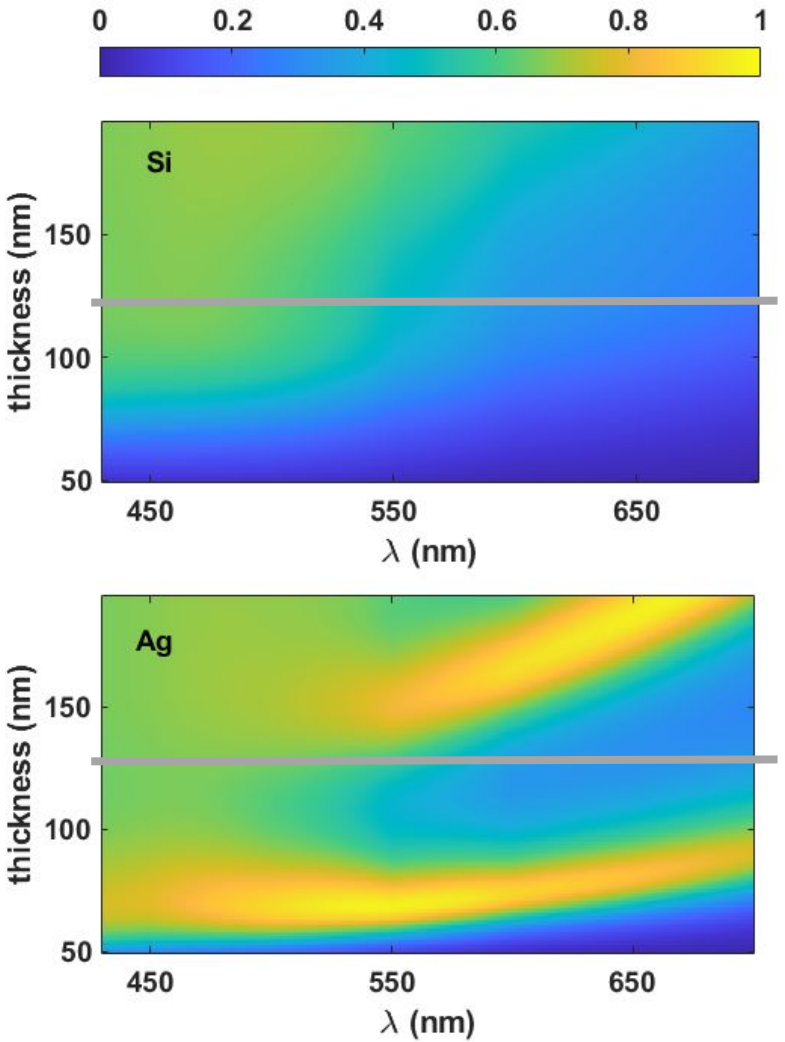

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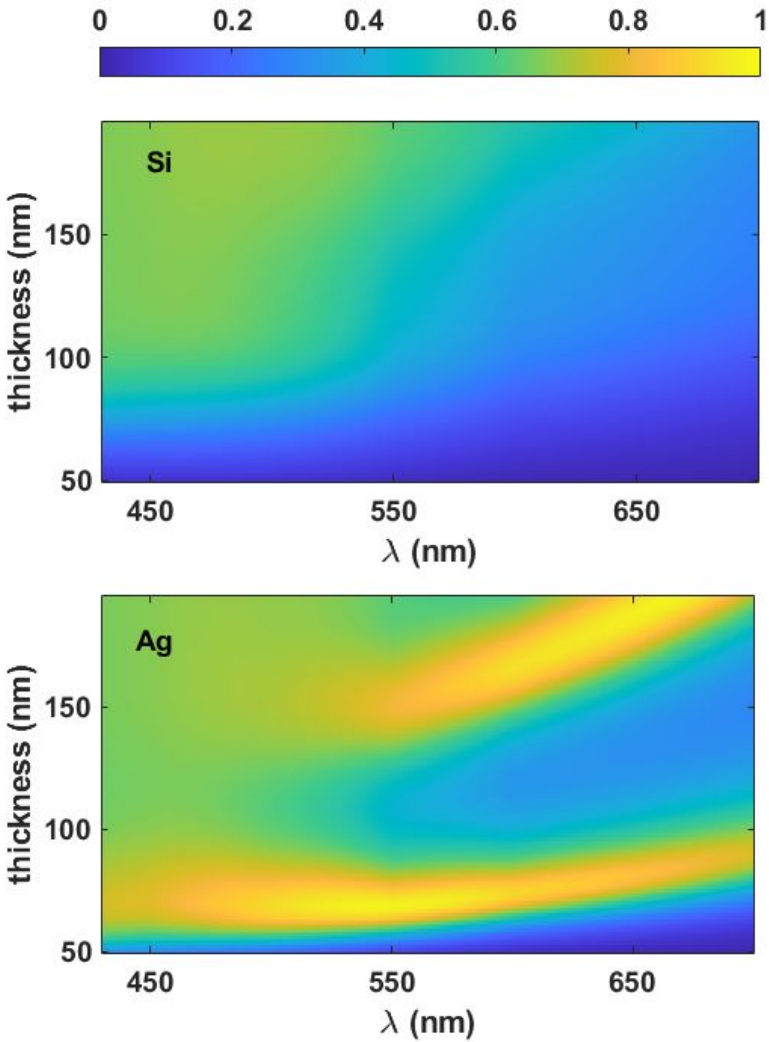
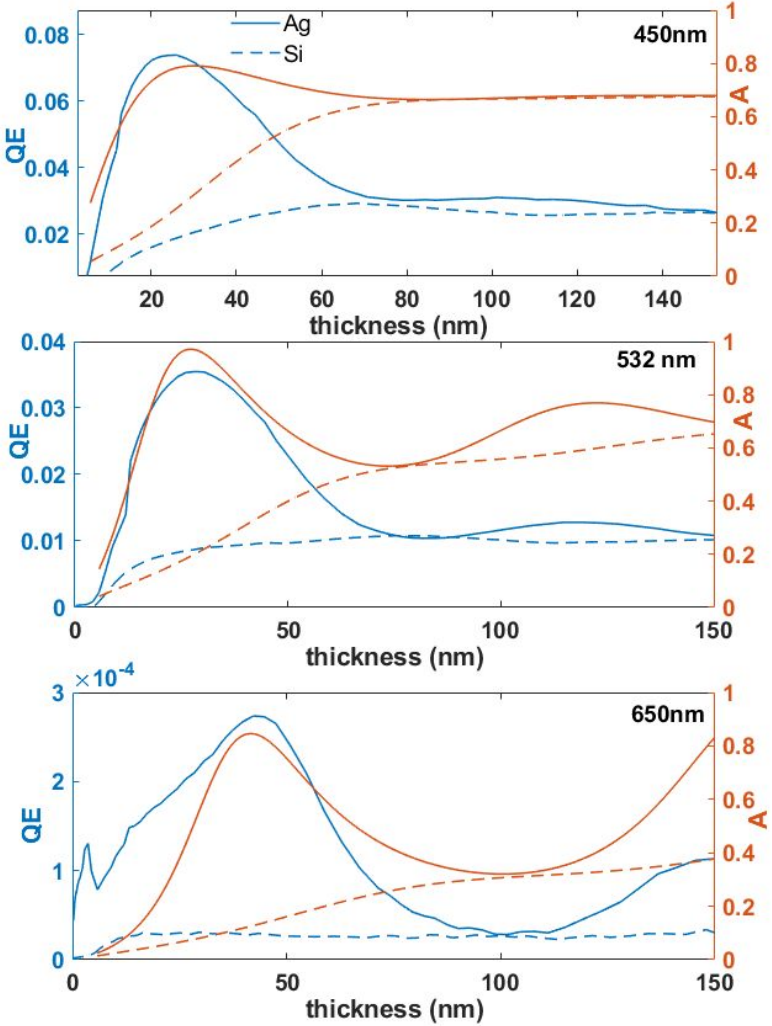


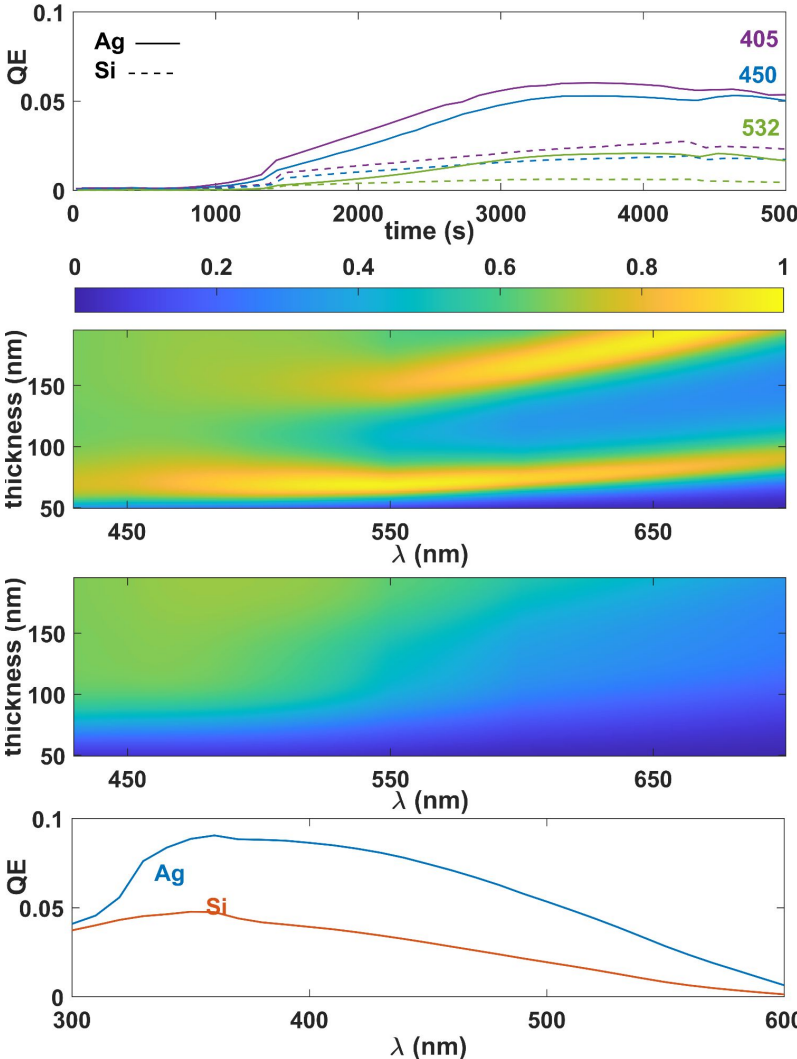
Characteristic Interference QE peaks

- Most cathodes grown until “infinitely thick” to maximize QE from material
- Standard substrates have monotonic QE increase
- Interferences result in characteristic superimposed absorption peaks and QE peaks as the cathode grows
- QE peak is HIGHER than max QE value on Si substrate



Broadband QE enhancement

- Broadband QE enhancement
- Easy to do: grow until the QE peaks, then stop
- QE enhancement HIGHER near threshold



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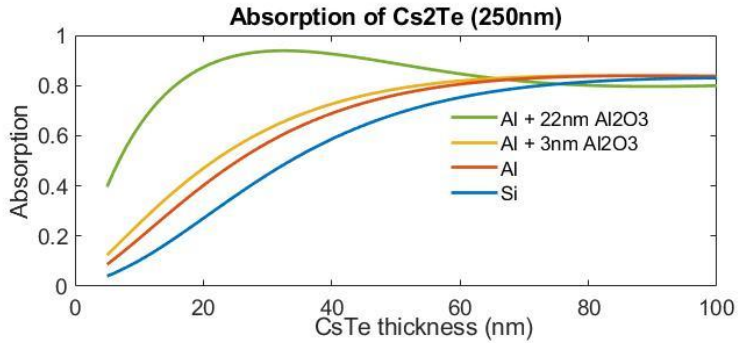
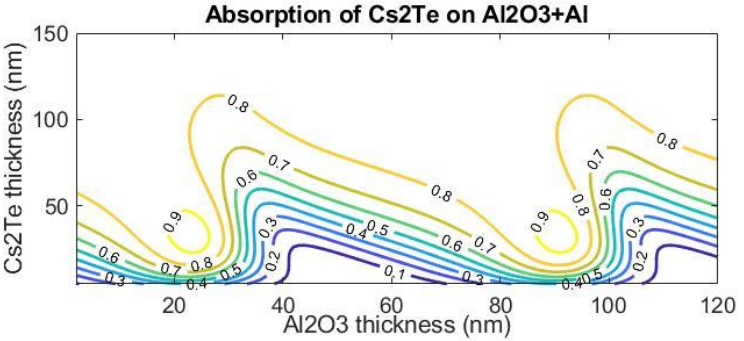
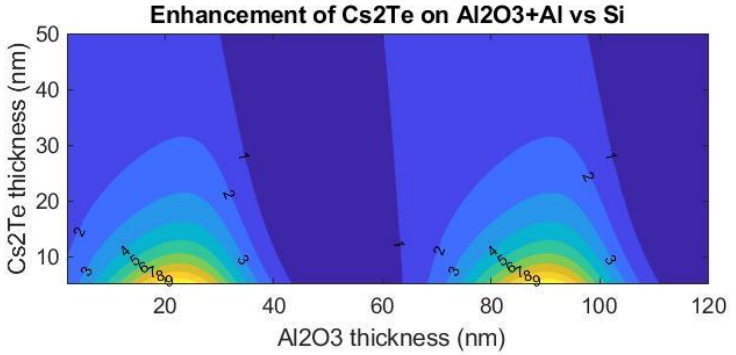
Future directions: What about Cs2Te or epitaxy?

- limited improvement with just a metal- few metallic materials in the UV
- improved results if a dielectric layer is added
- better QE improvement but better control of optical constants is needed
- dielectric layer adds material flexibility: this could be a lattice matched substrate







Summary

- Interferences produce large QE enhancement
- Easy to achieve with growth on metals even if cathode properties are poorly characterized
- Compatible with epitaxial and nonmetal substrates
- Clear tradeoff between max QE improvement and substrate complexity, control of cathode material properties
- Work recently published in AIP advances