Center for Energy Efficient Electronics Science

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Dark-Field Microscopy on Optical Antennas at Near-Infrared Frequencies

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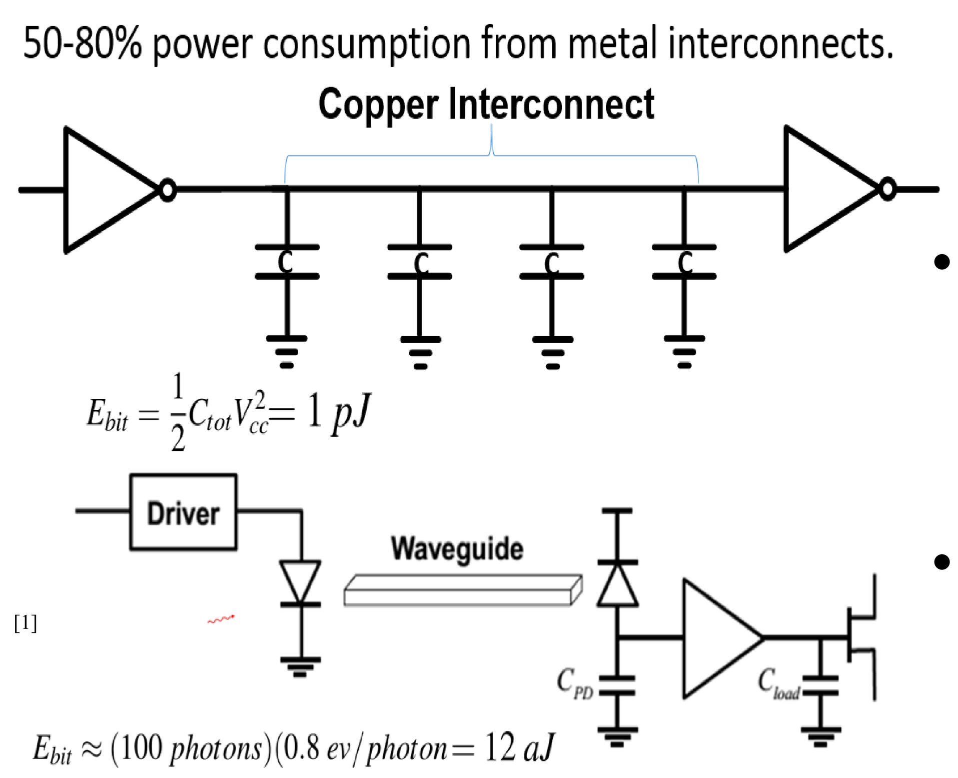
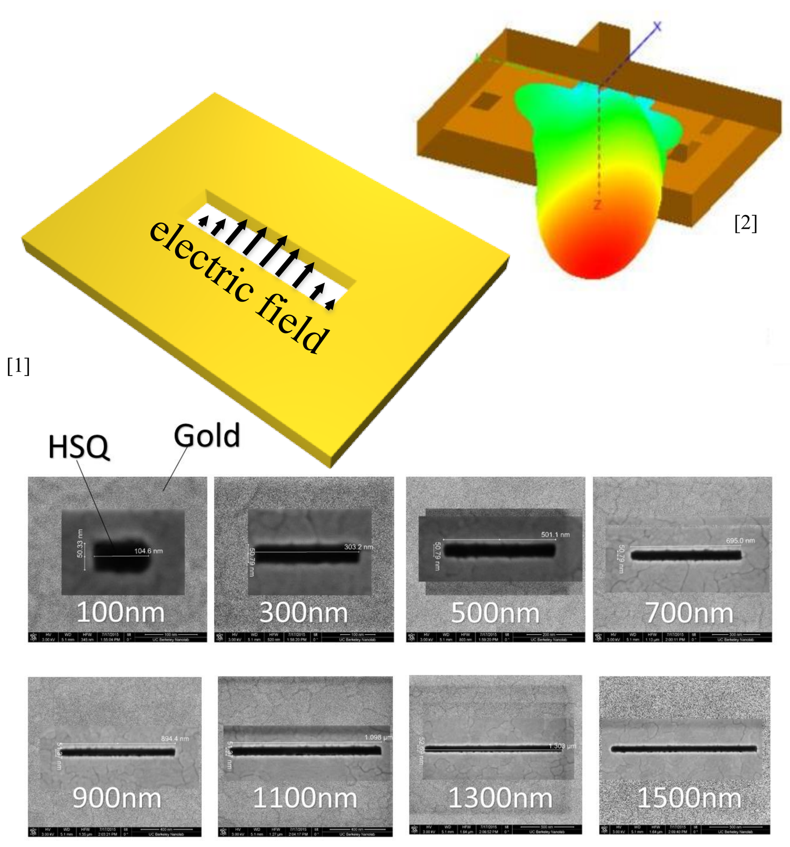
Abstract: Optical interconnects that contain nanoLEDs coupled with optical antennas have been proven to be more energy efficient than traditional metal interconnects. At near-infrared (IR) frequencies, the waveguides that are coupled into the optical interconnect are transparent and therefore have lower attenuation than other frequencies. An experiment was setup to measure the resonance frequencies of cavity-backed slot antennas at near IR. This measurement had not been done with the current equipment available to the Berkeley Photonics team, and it was not known if the current InGaAsP detector could measure resonance at near-IR frequencies.

Background and Motivation

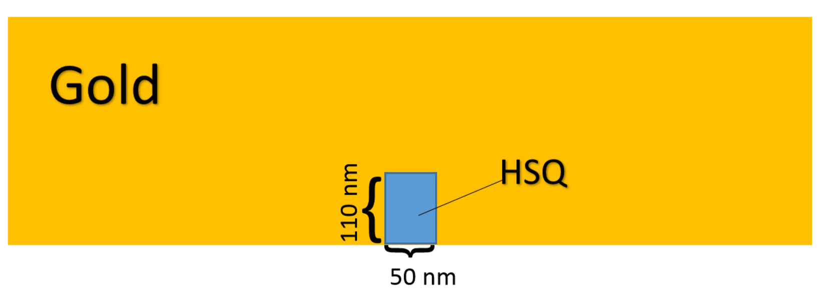


- Copper interconnects have been proven to be significantly less efficient than optical interconnects
- NanoLEDs coupled with optical antennas are efficient light emitters for optical interconnects
- At near-IR frequencies, waveguides are transparent and provide a low-loss way to transfer information

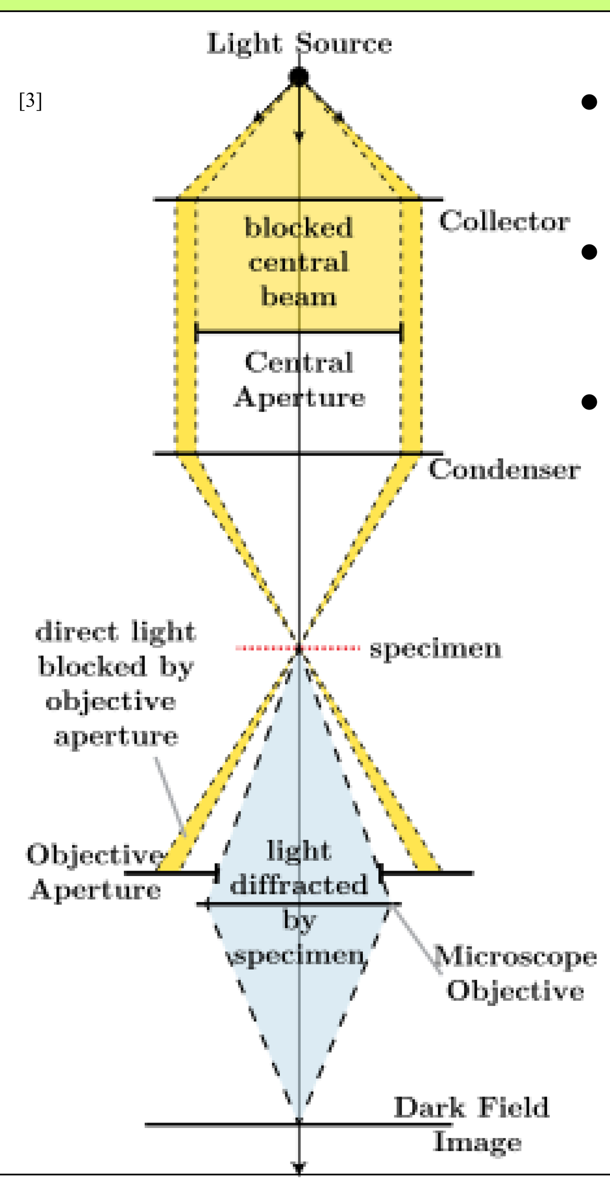
Methods



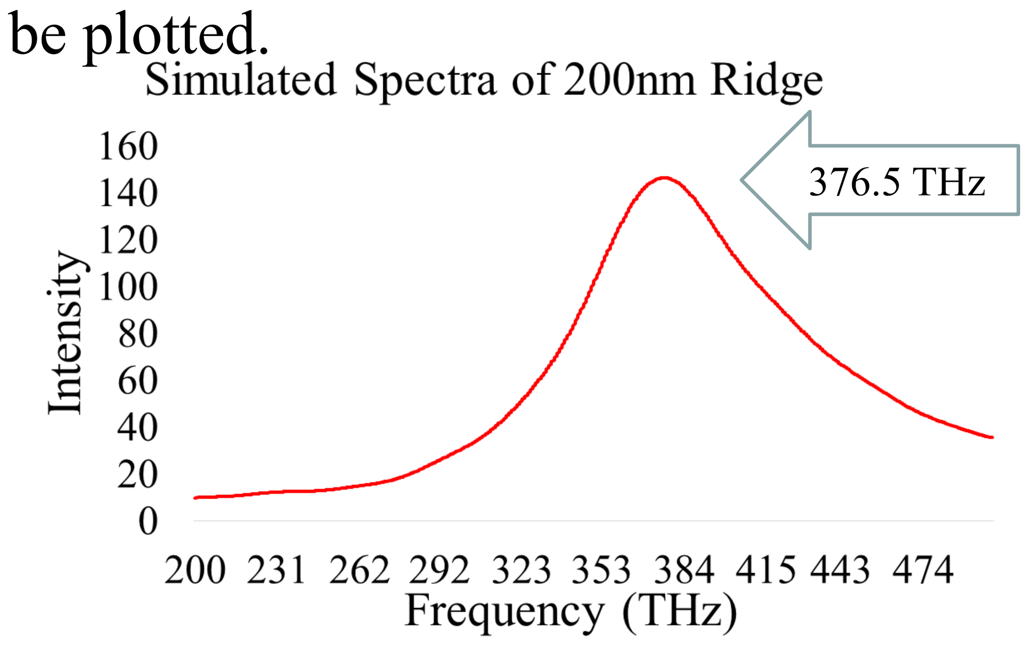
- A gold cavity-backed slot antenna was used with a Hydrogen Silsesquioxane (HSQ) dielectric in the slot
- All slots were 50 nm wide by 110 nm tall, but the lengths varied from 100 nm-1500 nm in increments of 100 nm



Dark Field Measurement

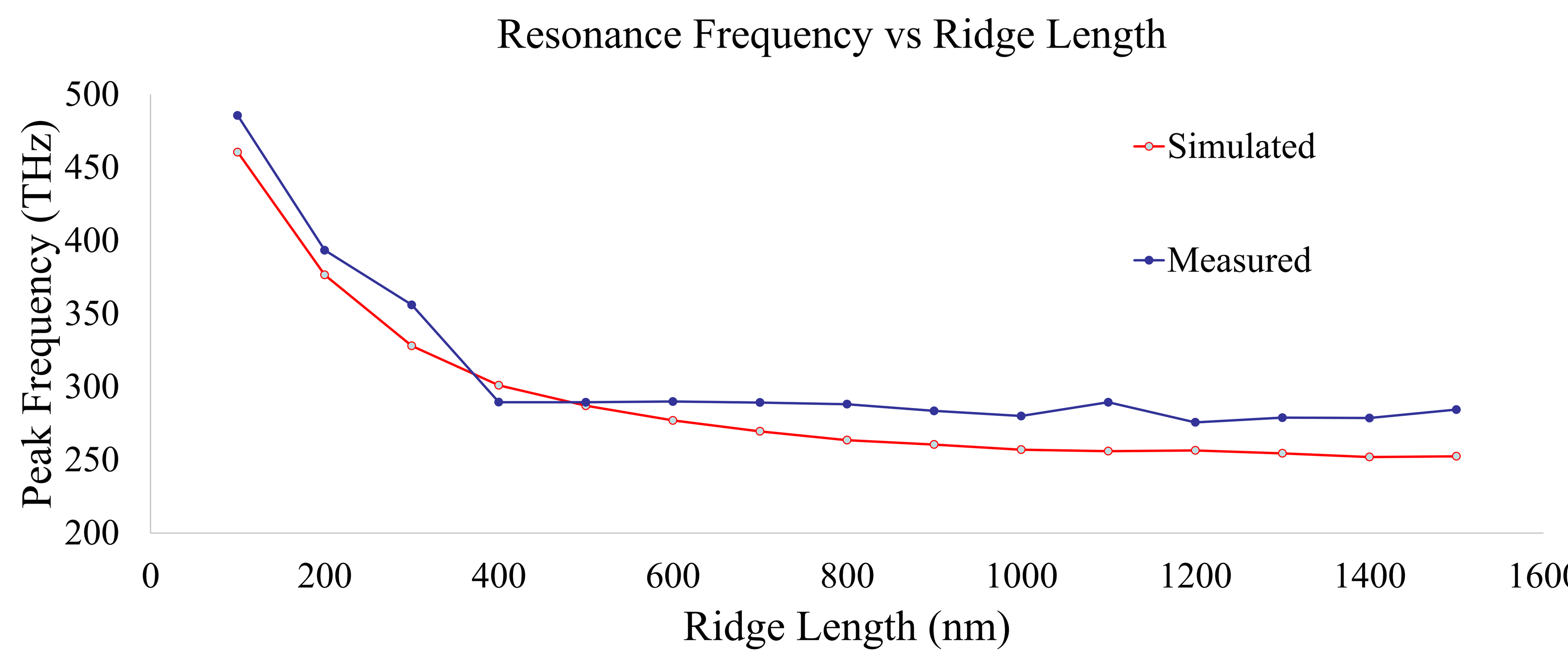


- Measures the light scattered off of a sample by blocking the central aperture of the light source
- This technique provides a high-contrast way to measure the light radiated by the antennas
- The image is then reflected into the InGaAsP detector and an intensity vs. frequency graph can be plotted.

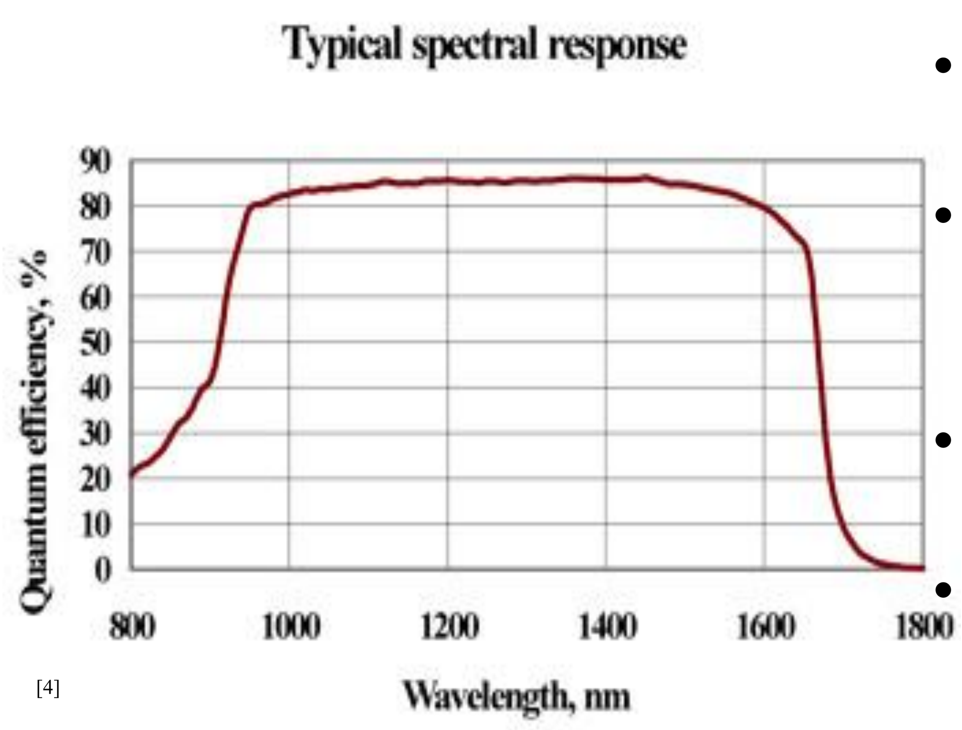


Results

- Peak resonance frequencies were indexed and plotted as a function of ridge length
- The measured data was then compared to a simulation of the experiment in CST Studios



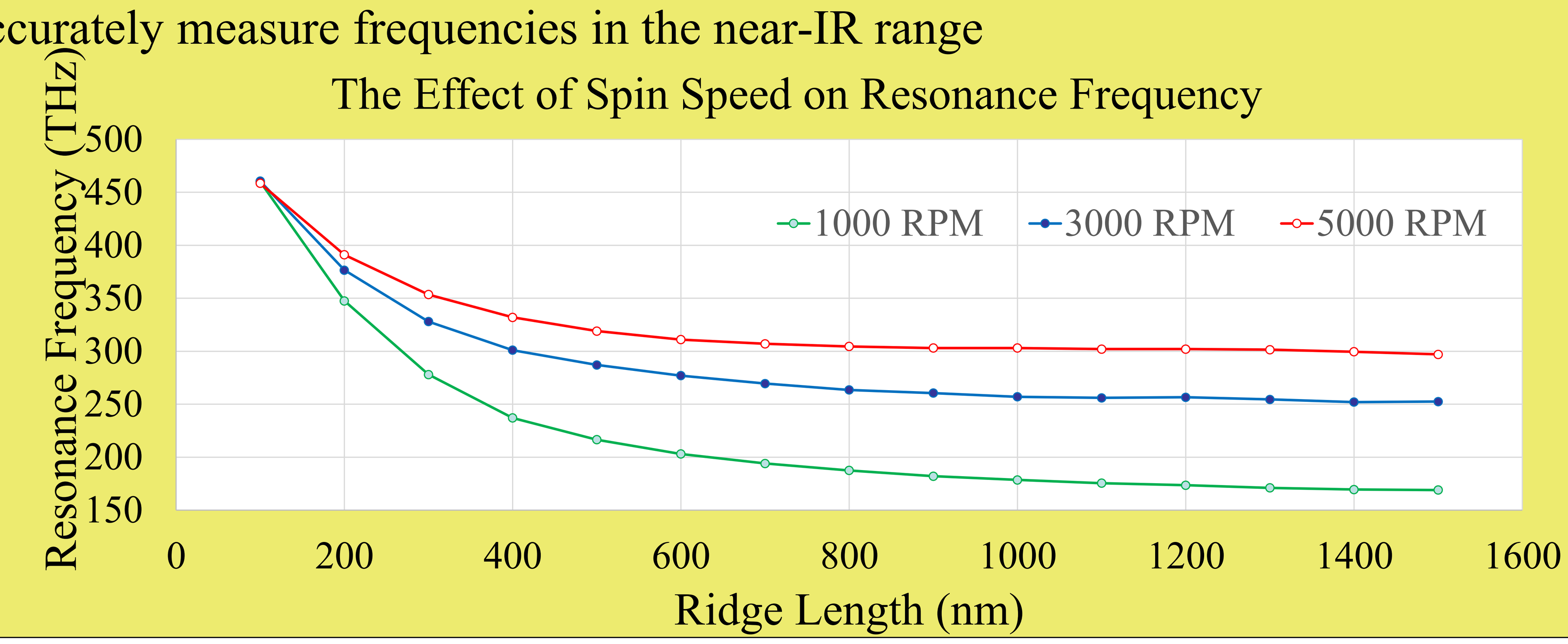
Conclusion



- Simulation suggests that the experiment worked properly
- At higher ridge lengths, the peak does not significantly change as the ridge is elongated
- The detector drops off in quantum efficiency around 315 THz
- Future research must be done to ensure the set up works properly

Implications & Future Research

- HSQ thickness is dependent on the angular velocity at which the sample was spun
- The HSQ in this experiment was spun at 3000 RPM
- Simulation suggests that different spin speeds affect the results of the experiment
- Repeating the experiment at 1000 RPM will likely prove that the detector can accurately measure frequencies in the near-IR range



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References

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Support Information

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