

# Quantum Dot Lasers Grown on Silicon

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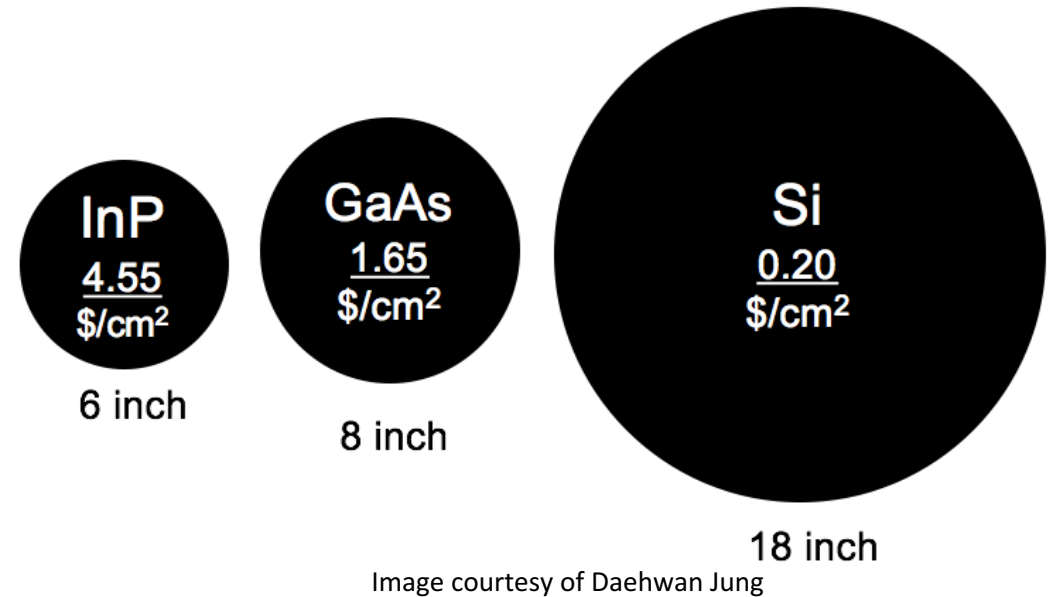
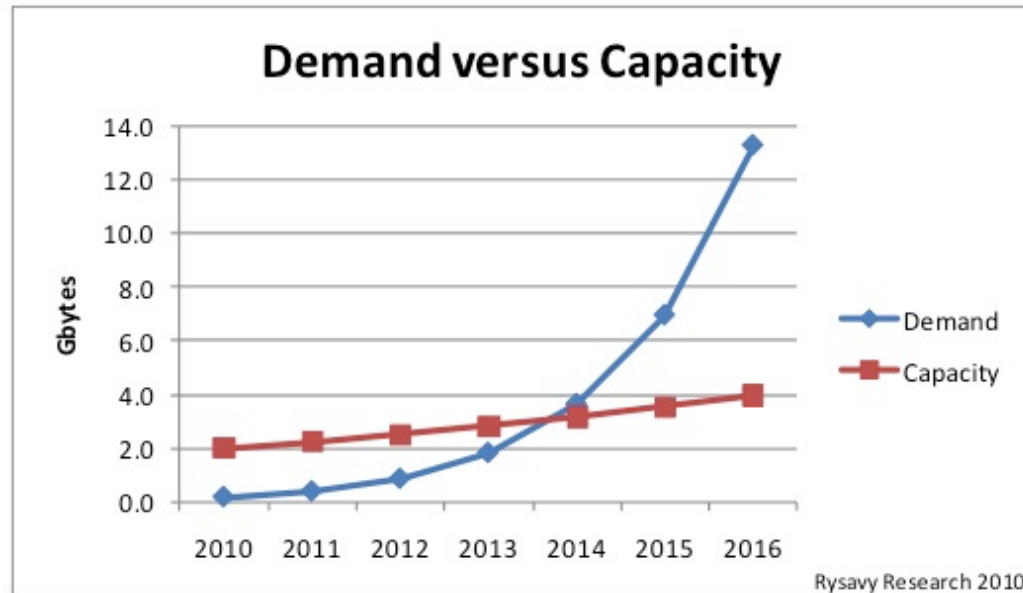
Justin Norman, John Bowers; Electrical & Computer Engineering

Funding: AIM Photonics, ARPA-E



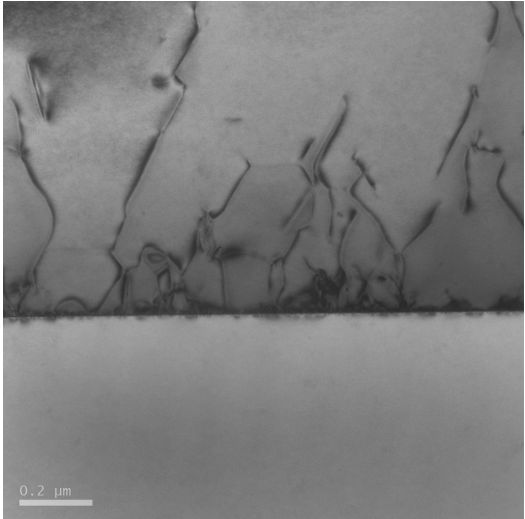
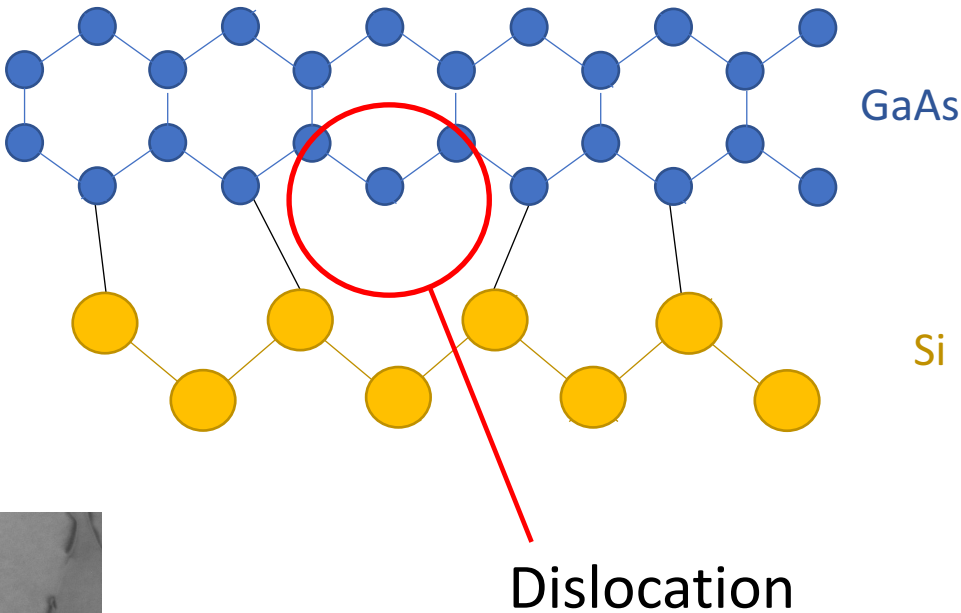
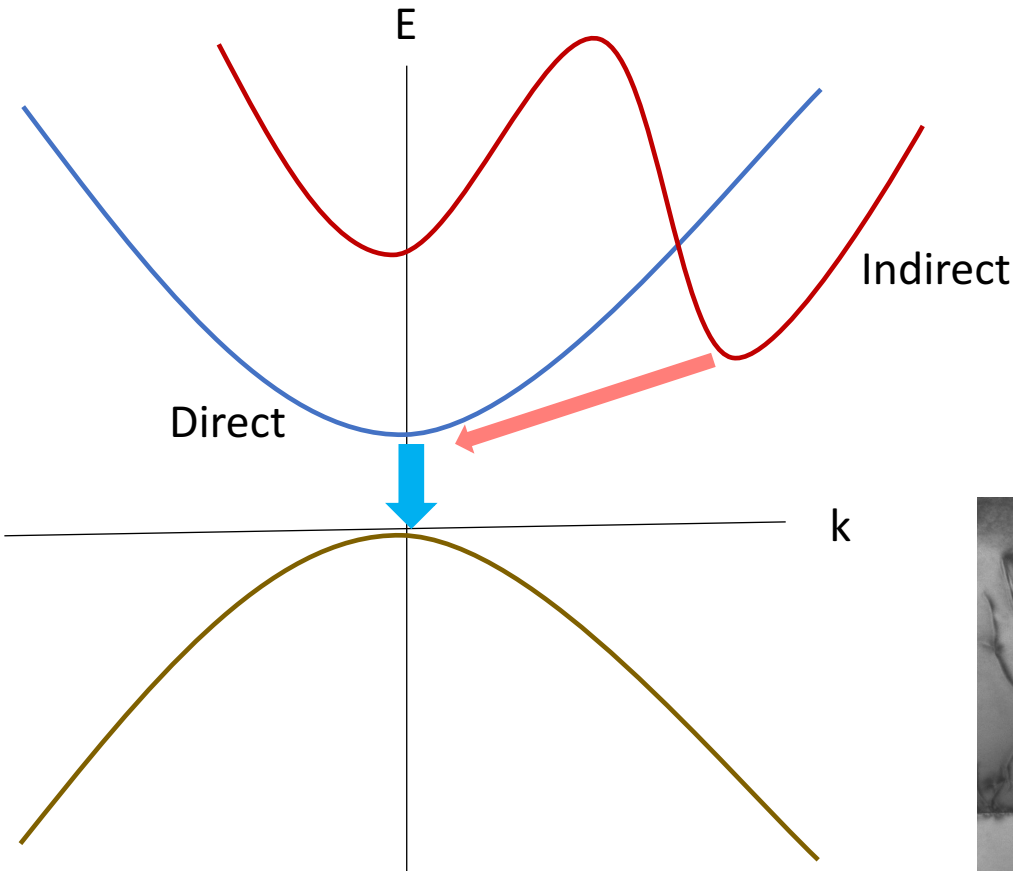
# Silicon Photonics

Increasing demand for bandwidth



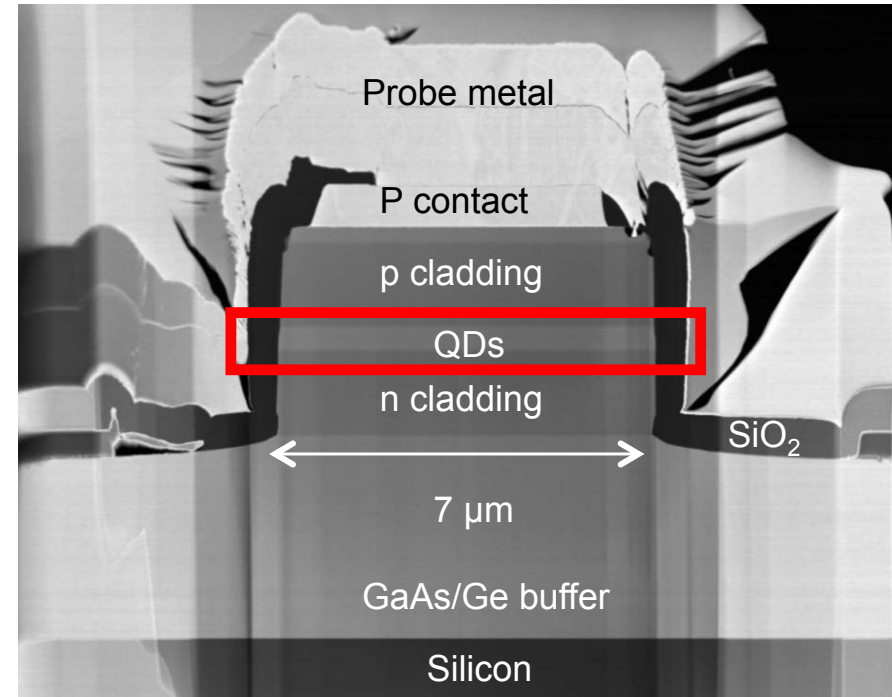
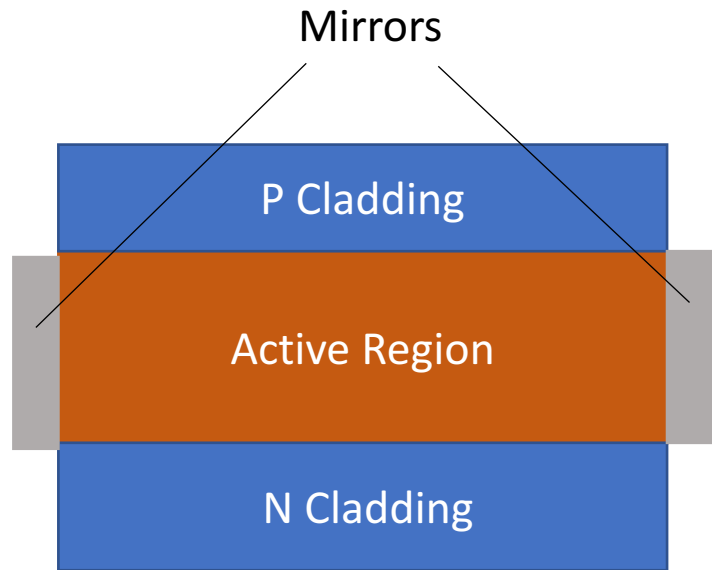
Silicon offers an economic-friendly solution

# The Flaws of Using Silicon

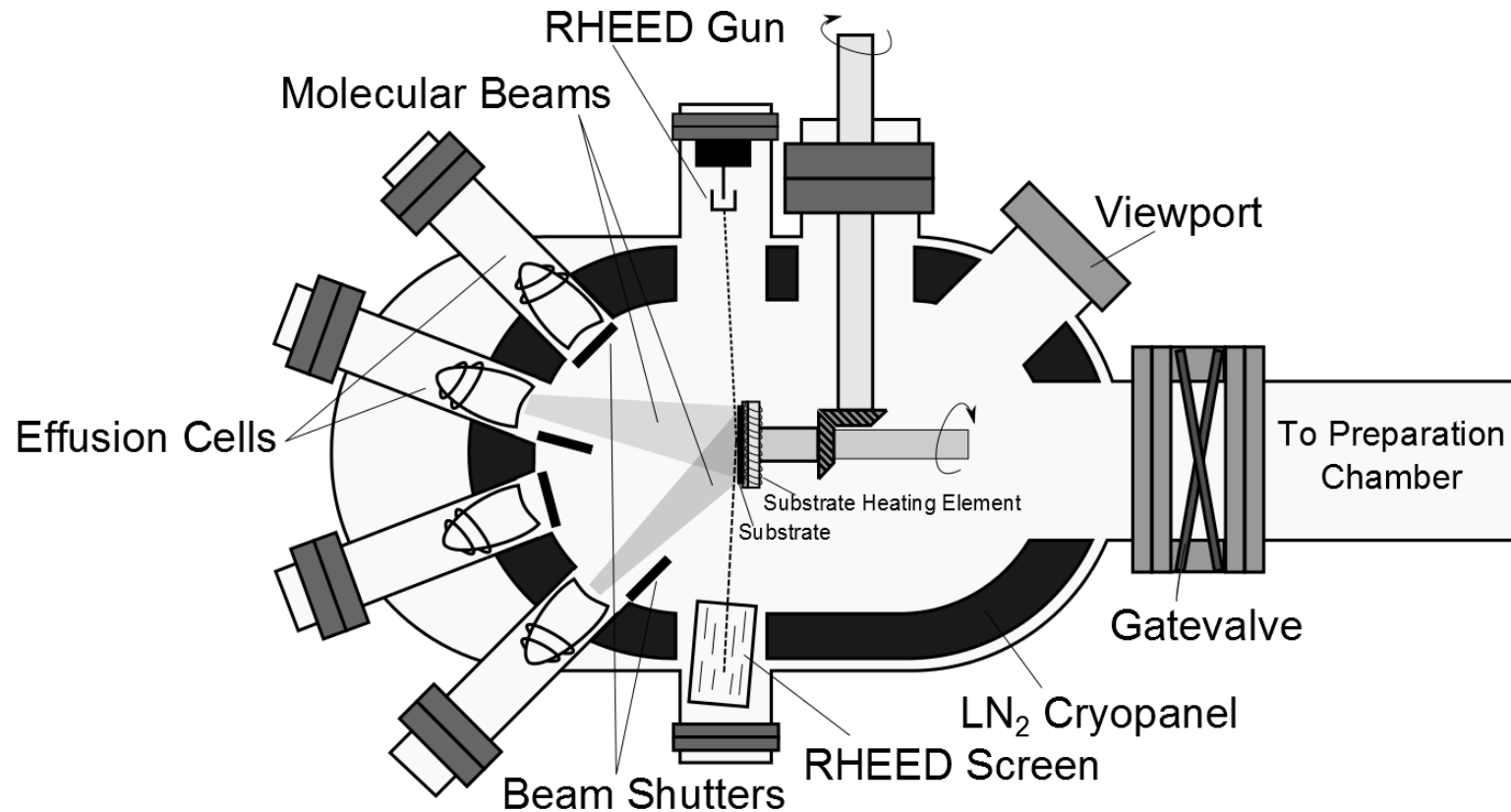


- Dislocations from the GaAs-Si mismatch cause diminishing device performance

# Quantum Dot Laser Structure



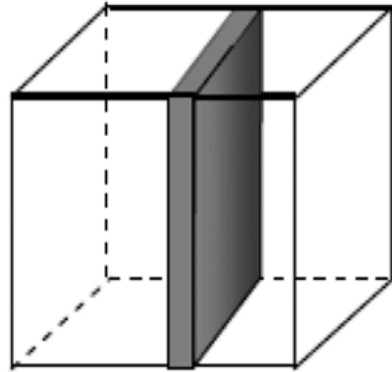
# Molecular Beam Epitaxy



# Quantum Dots

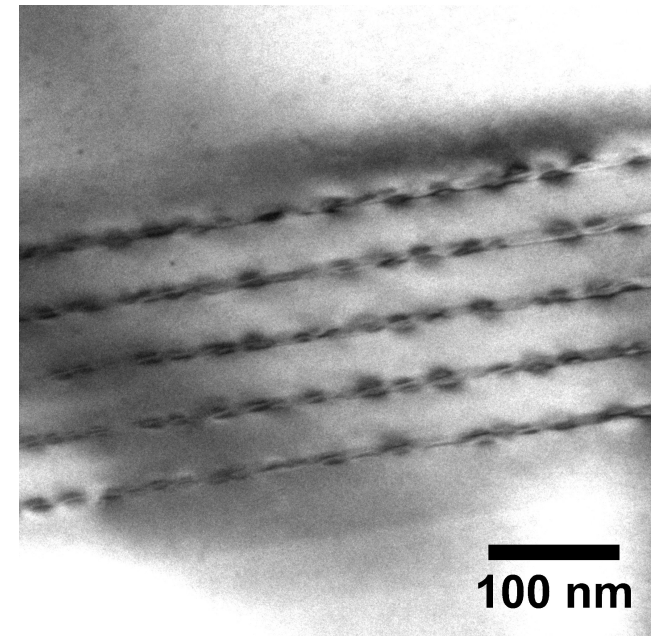
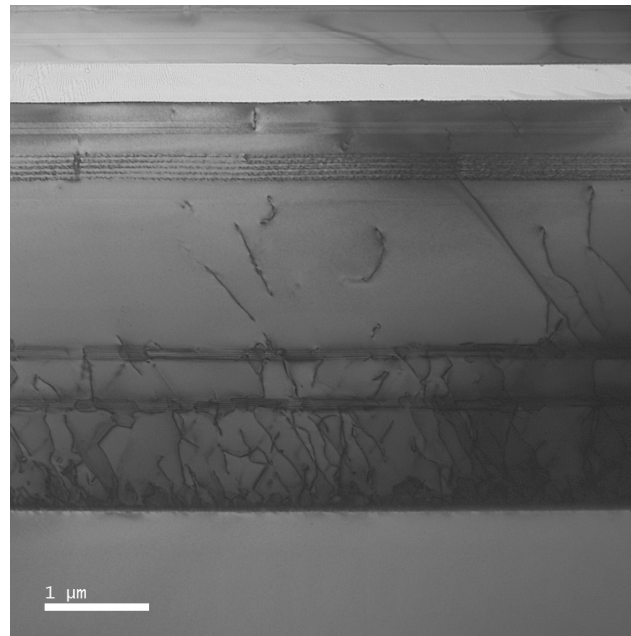
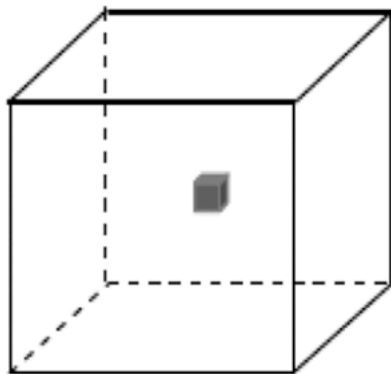
## Quantum well

- 2-D confinement
- Discrete energy levels



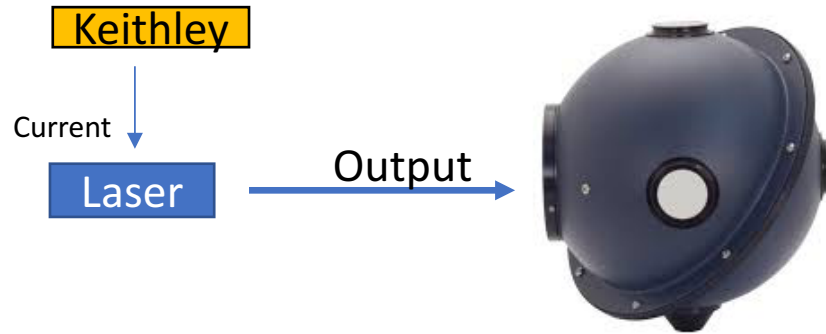
## Quantum Dot

- 3-D confinement
- Discrete energy levels

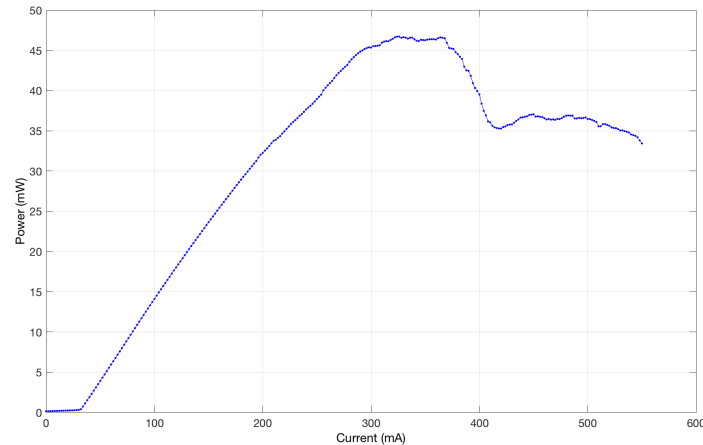


# Characterizing a Laser

## Modular Integrating Sphere

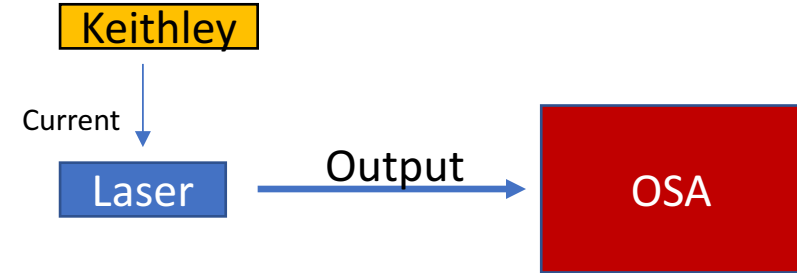


Gathers power output from laser

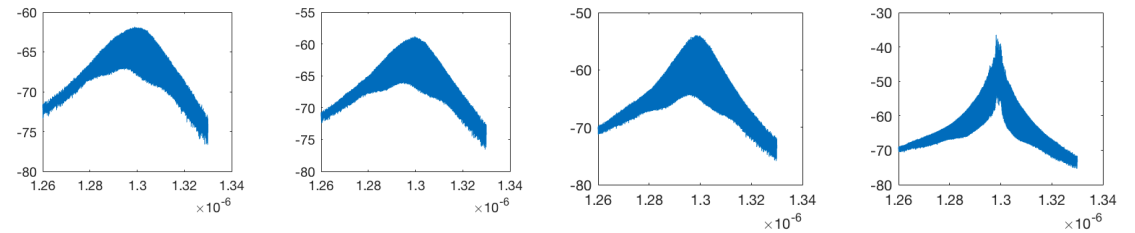


Power vs. Current

## Optical Spectrum Analyzer (OSA)

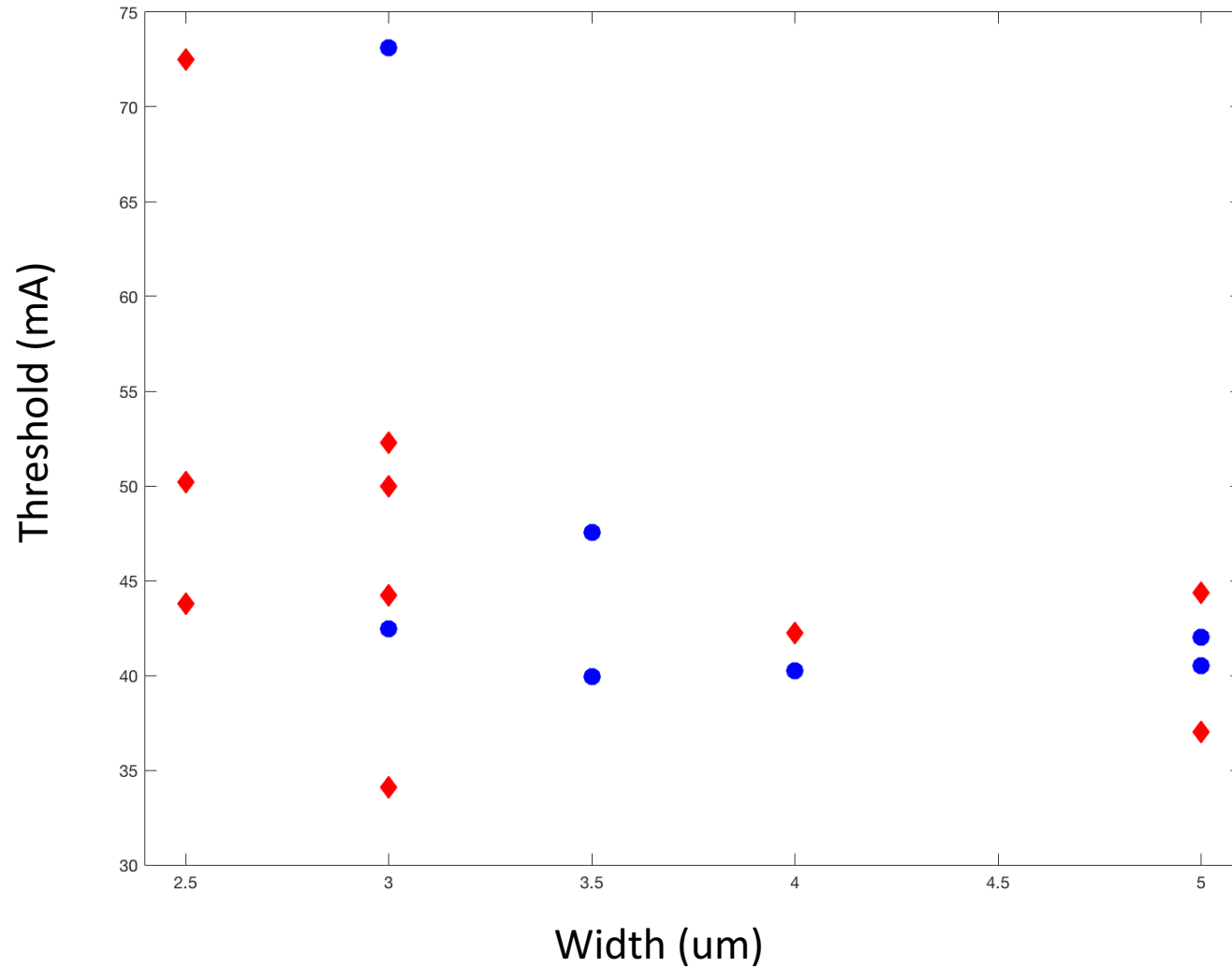


Gathers wavelengths emitted from laser



Power vs. Wavelength

# Device Threshold



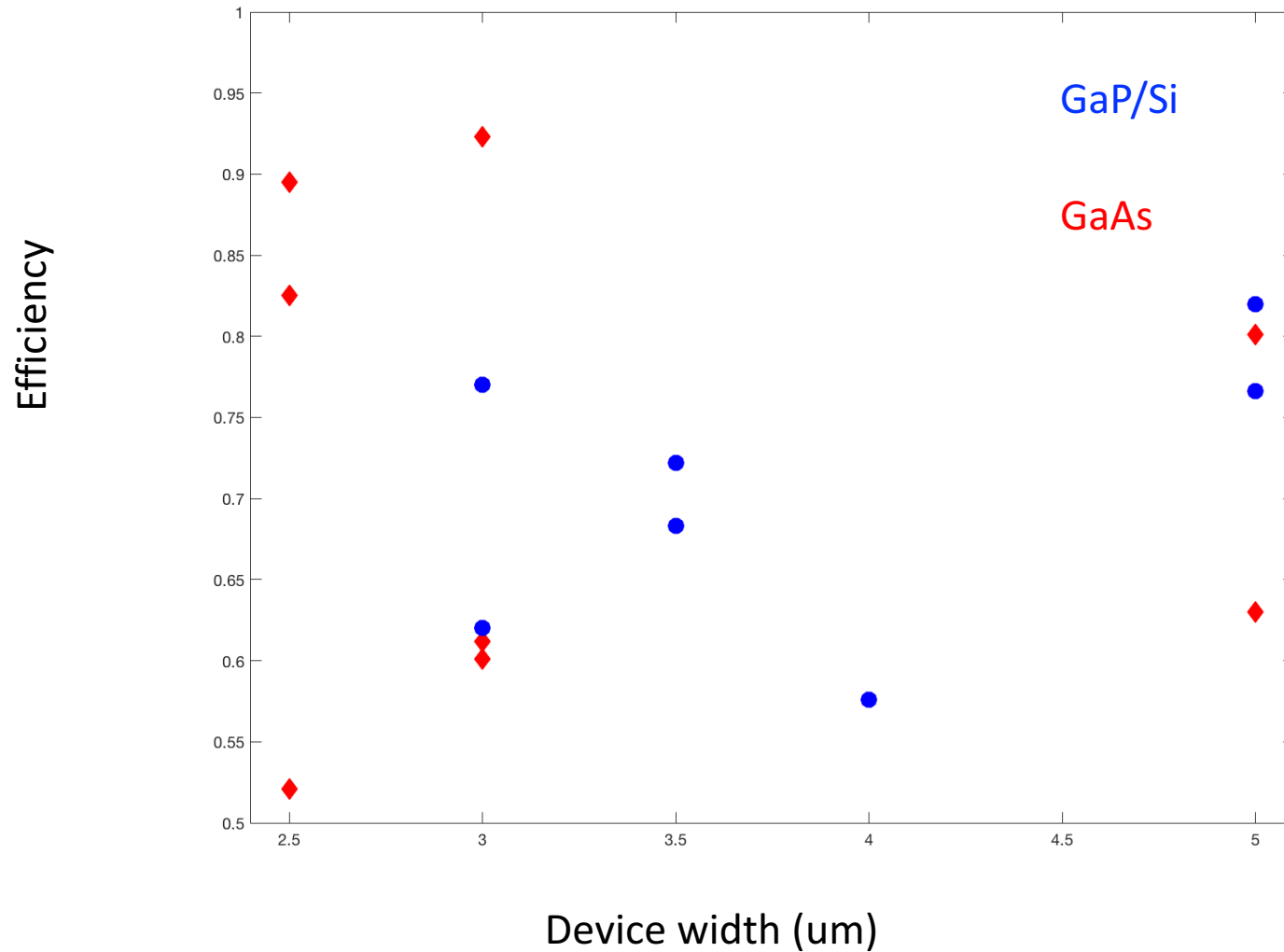
GaAs (red) Avg: 44.2 mA

Quantum Dot (blue) Avg: 42.1 mA

- Thresholds for quantum dot lasers are comparable to those grown on GaAs



# Device Injection Efficiency



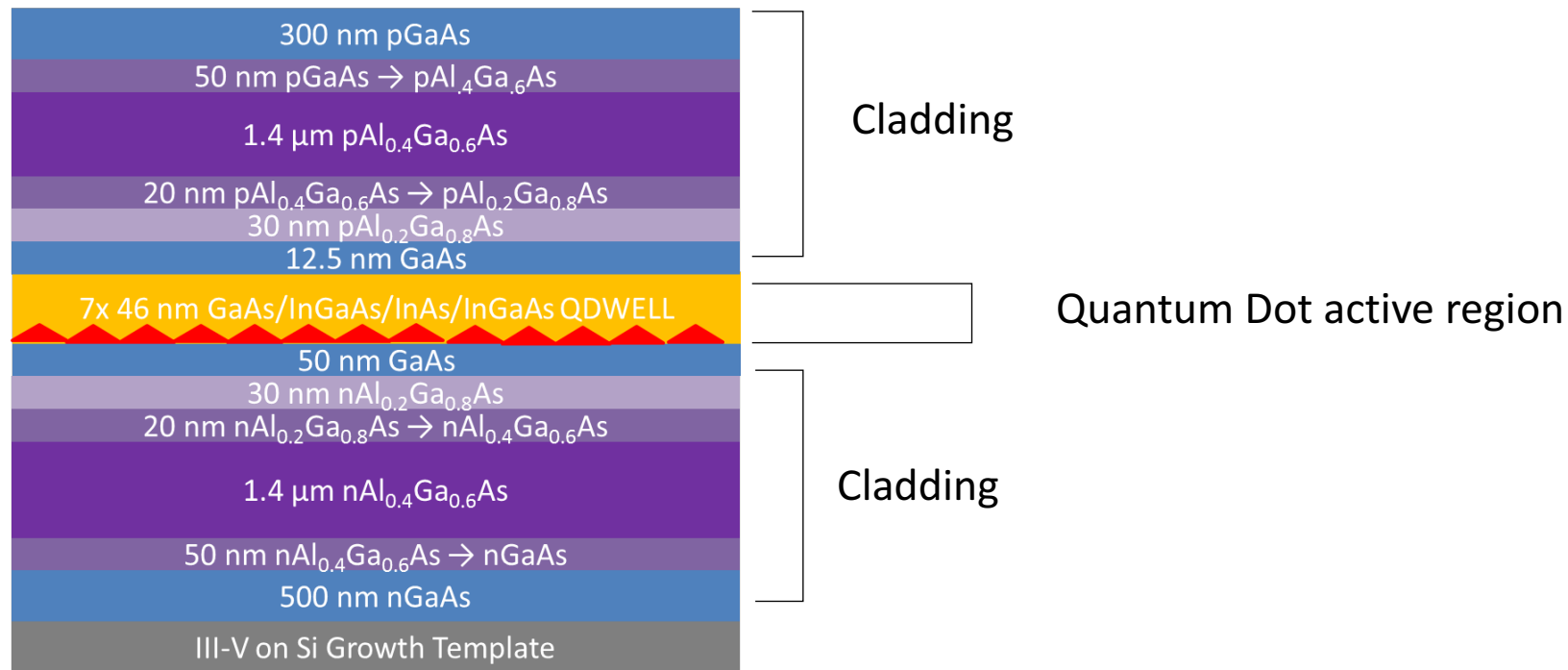
- Efficiency of quantum dot lasers comparable to GaAs

# Summary

- GaP/Si devices performed within range of similar GaAs devices
- Commercial viability
- Applications in data centers

# Future steps

Comparing different compositions and thicknesses of cladding layers



# Acknowledgements

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- Award Information:
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