Optical Sources for Sensing for Nano-CEMMS

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Goals

- Design novel micro-cavity semiconductor lasers for sensing.
- Use Nano-CEMMS processes for laser manufacturing.

Mapping to Center’s Objectives

- Nanoscale positioning for Nano-CEMMS toolbit.
- Rapid, low-cost manufacture of nano-patterned lasers.

Fundamental Questions/Challenges

- What are the limits of position sensing resolution?
- Which structures work best with Nano-CEMMS processes?

Research Plan

- Fabricate and package integrated VCSEL-PIN detectors.
- Design, simulate, and fabricate novel metallic PhC lasers.

Research Results

- Packaged VCSEL-PIN detectors for position sensing trials: >90% measurement repeatability, within 2% accuracy
- Designed and simulated novel metallic PhC laser: Achieved theoretical Q-factor > 500, with room temperature losses included.

Broader Impact

- Nanomanufacturing enabled by high-precision position sensing.
- Wavelength tunable laser for bio/chemical sensing and communication that can be made cheaply and easily.

Interaction with Other Projects

- Profs. Ferreira and Fang: Superionic Solid State Stamping
- Prof. Alleyne: Large, multi-axis positioner

Future Efforts

- Demonstrate optically pumped metal PhC lasers manufactured using Nano-CEMMS stamping process.
- Integrate VCSEL-PIN detector into Nano-CEMMS toolbit.