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Nanophotonics and Microcavities for Dense WDM Systems

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The Photonics Center @ USC

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Integrated Nanophotonic Technology

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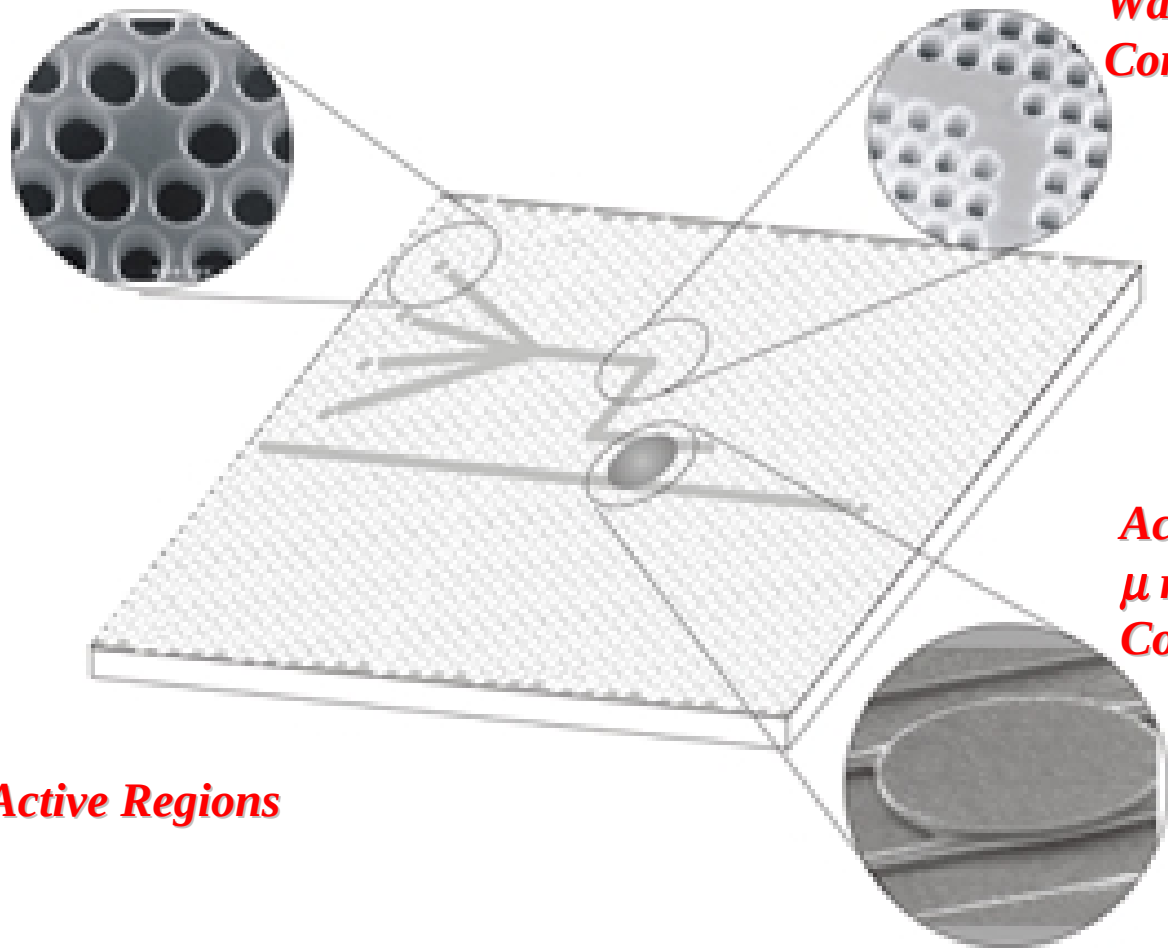
Photonic Crystal Defect Nanolasers

Photonic Crystal Waveguide Components



Active and Passive μ resonator Components

QW and QD Active Regions

μ Disk and Photonic Crystal Devices for DWDM Systems

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- **High Density Integrated Systems**

  VLSI Photonic Integrated Circuits

- **Compact, Low Power Components**

  Millimeters ⟶ Microns

- **Single or Multi-wavelength Resonant Components**
- **New Functionality in Active Components**

Integrable Nanophotonic Components

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- *DWDM μ-Disk and Nanolasers and Arrays*
- *Tunable Lasers*
- *Dispersive, Superprism Propagation*
- *Low Voltage, High Bit Rate Modulators*
- *Wavelength Selective Switches*
- *Narrow Band Tunable Filters and Detectors*
- *Wavelength Selective Couplers and Splitters*
- *Chemical and Biological Sensor Elements*
- *Waveguide to Fiber Couplers*

Nanophotonic Technologies

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- ***High Q Resonators***

✓ ***Heterogeneous Integration***

✓ ***Electron Beam Lithography***

✓ ***Highly Asymmetric Dry Etching***

✓ ***Selective Area Epitaxy***

✓ ***QW and QD Active Regions***

Selectively Grown Active Regions

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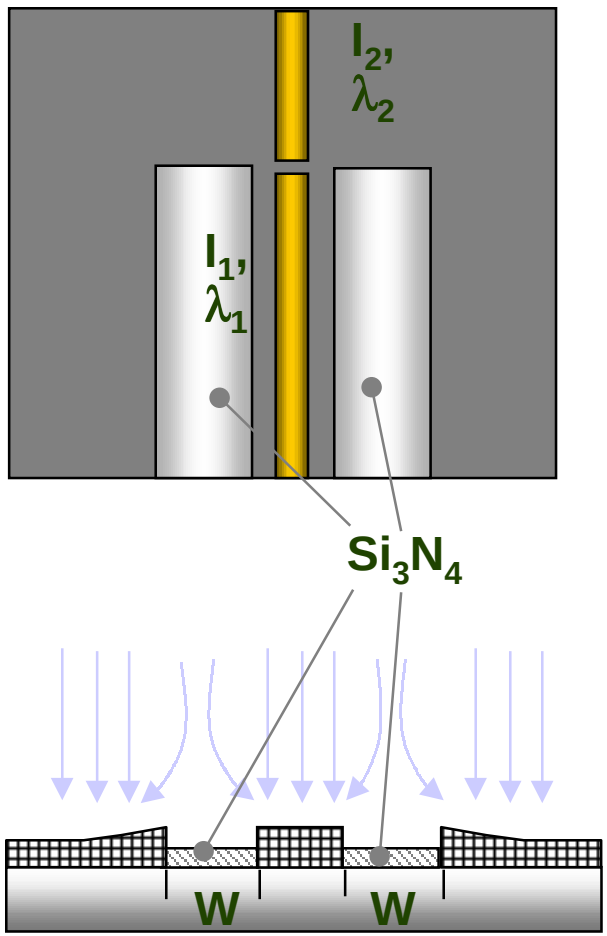

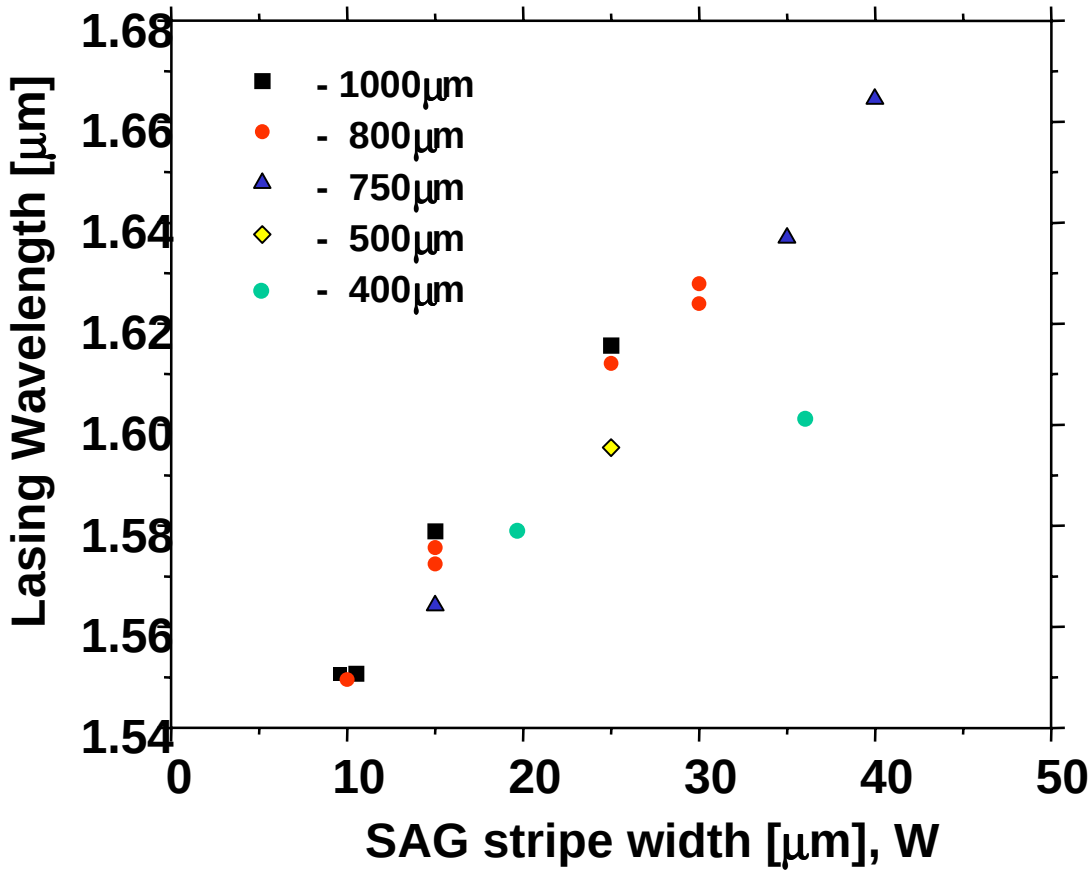

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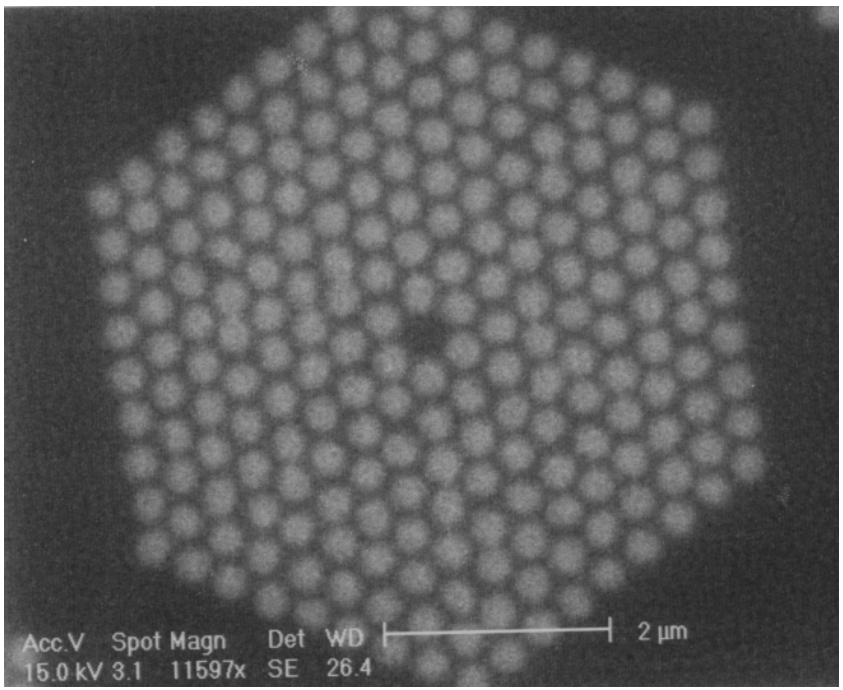
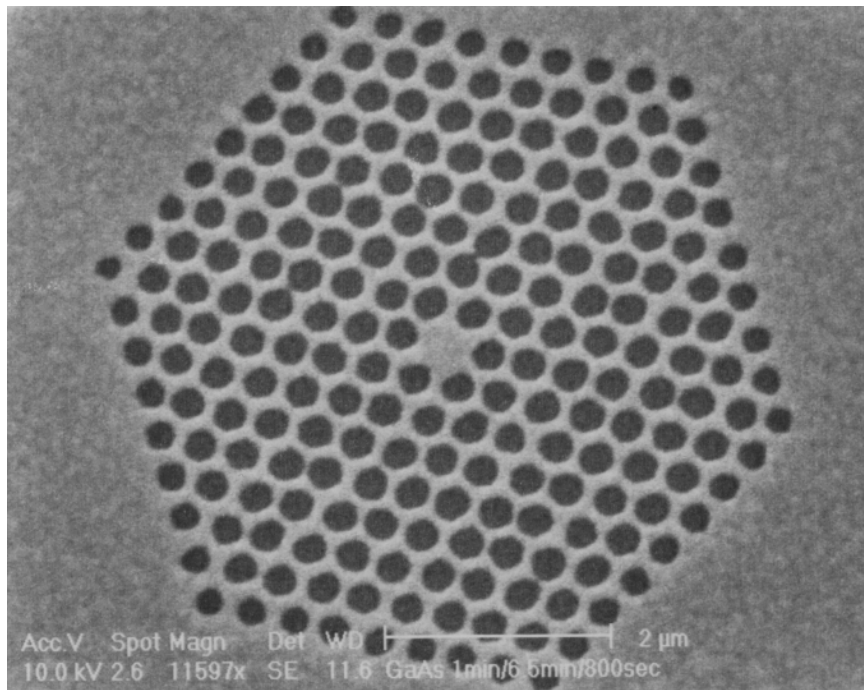
Resonant Cavity Structures

r = 135 nm
a = 400 nm



After Lithography



After RIE Etch

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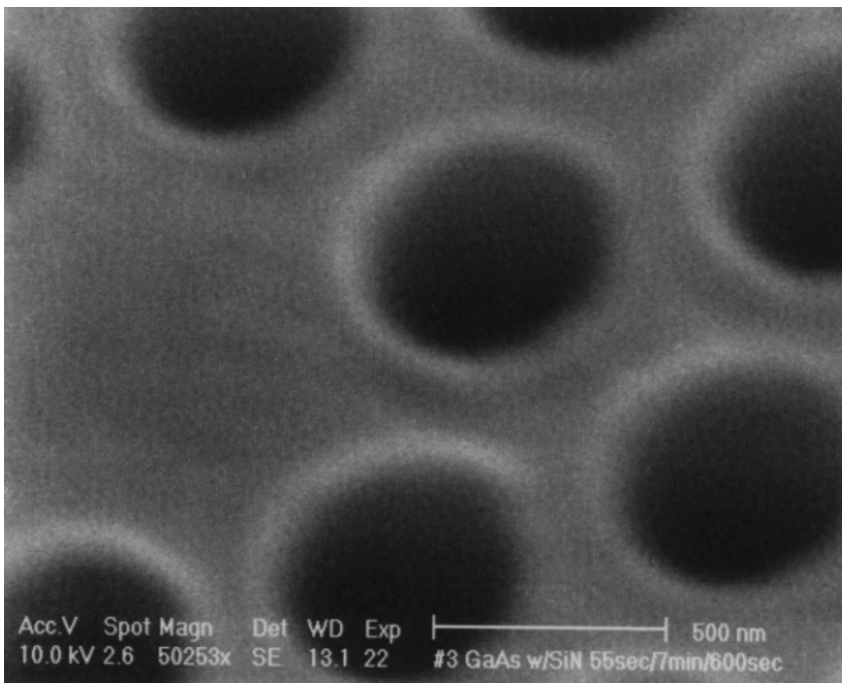
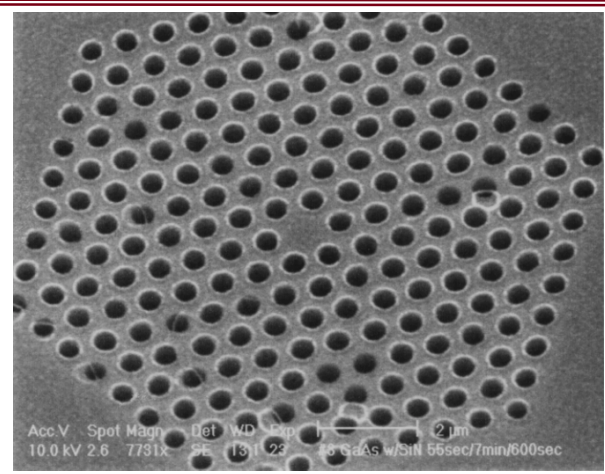
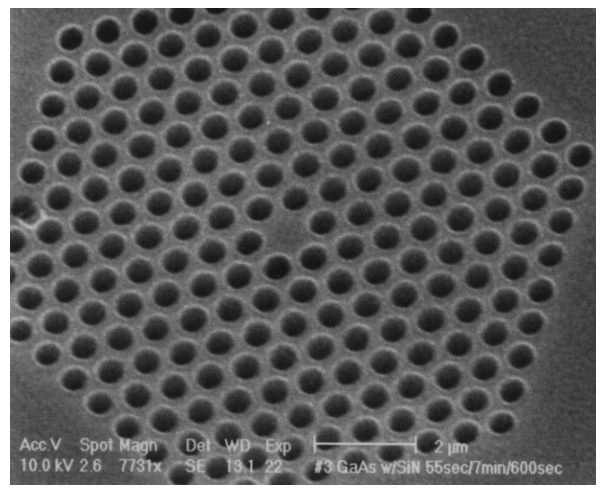
Top Views of GaAs PBGs after ECR etch







Magnitude of the Electric Field in the Defect Cavity

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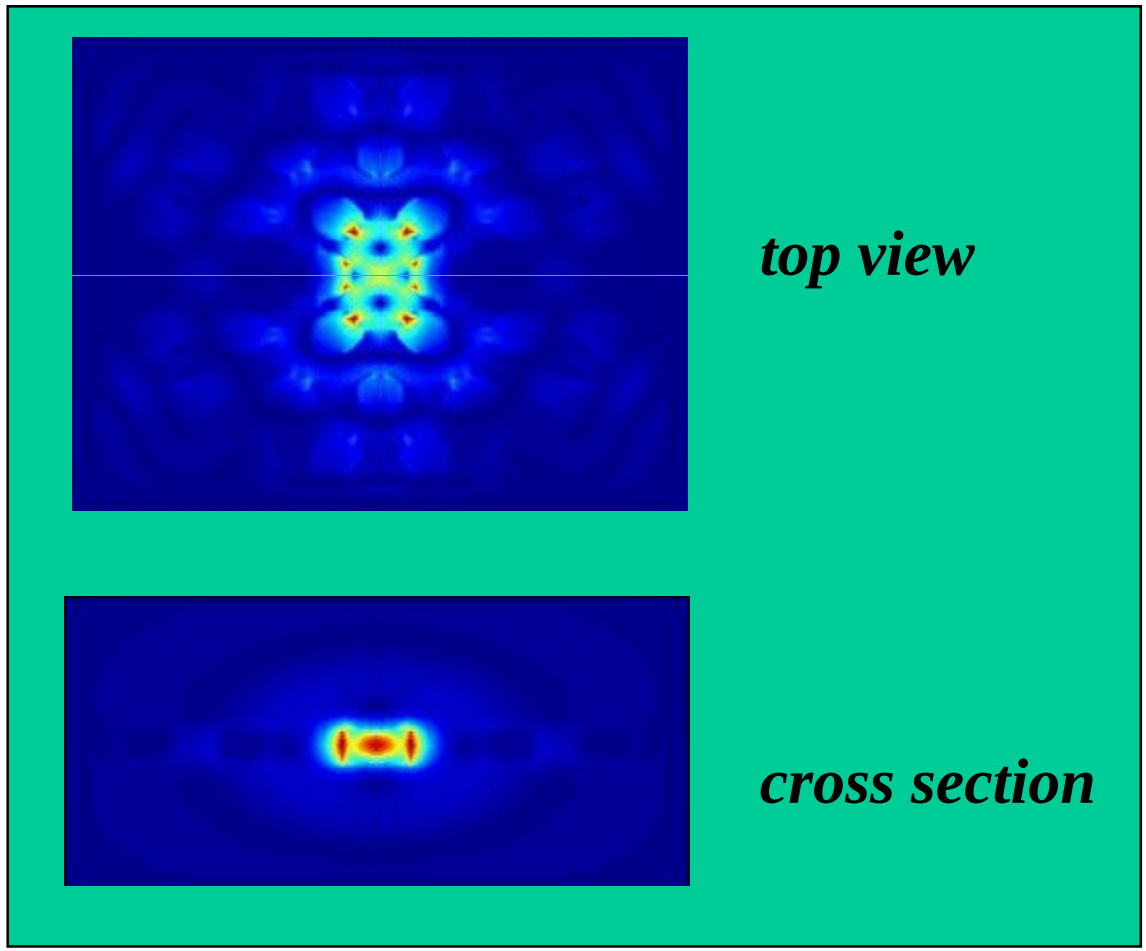

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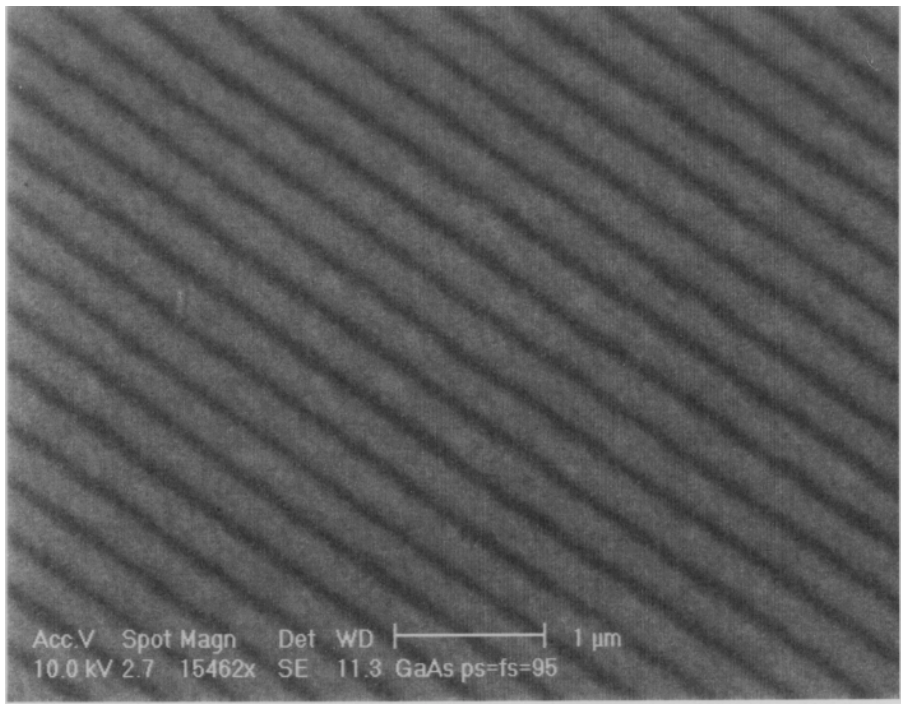
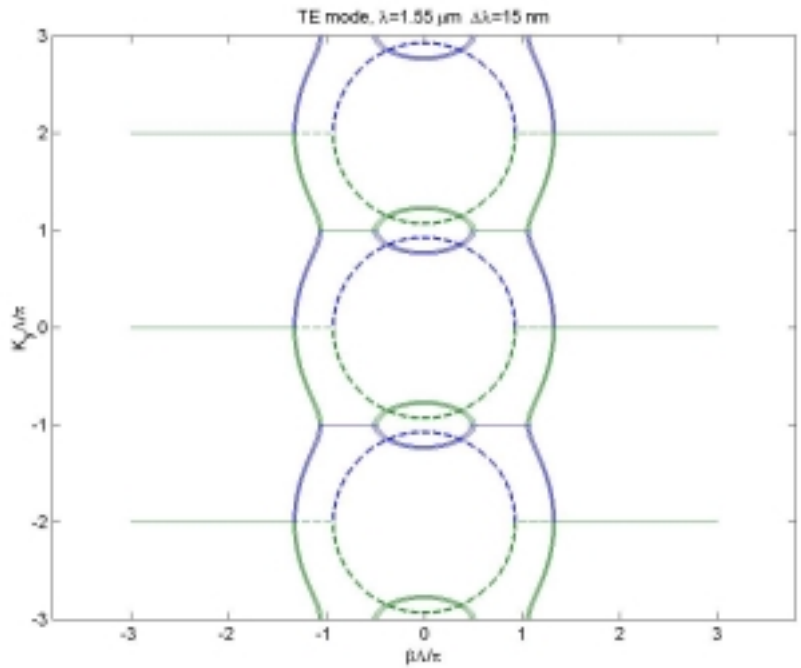
One-Dimensional Lattices

sample after lithography



dispersion surface



Superprism effect can be used for routing or multiplexing/demultiplexing

$$\vec{v}_g = \nabla_{\vec{k}}\omega(k)$$

Magnitude of the Electric Field in the Defect Cavity

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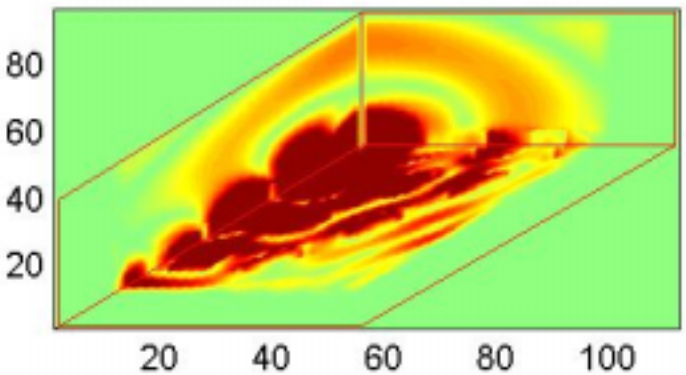
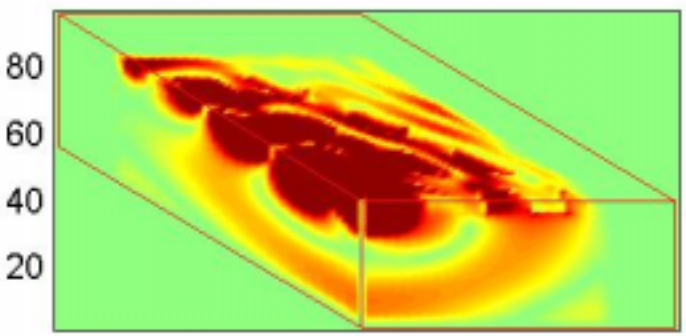
symmetric cladding

top

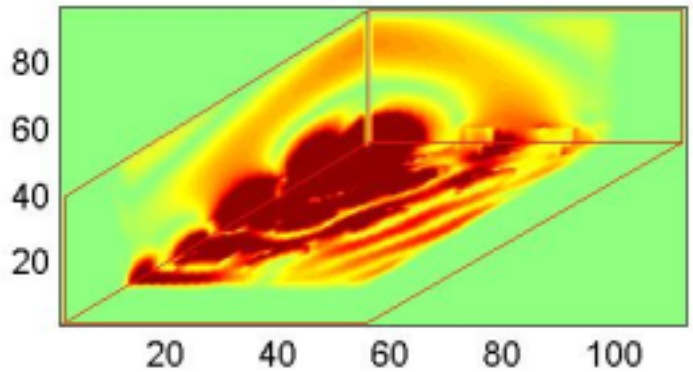


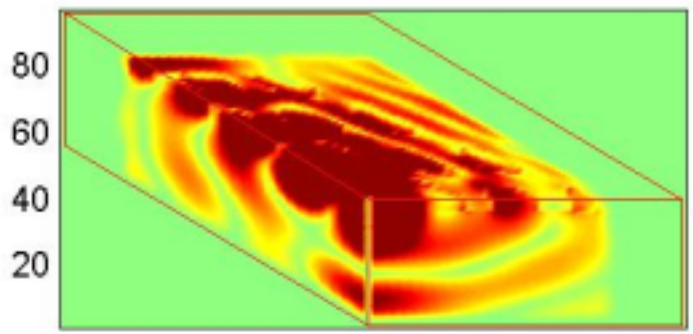


bottom

asymmetric cladding

top





bottom

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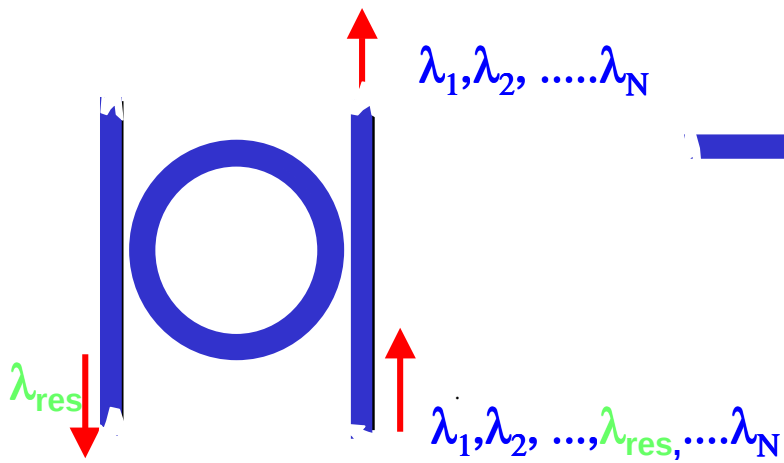
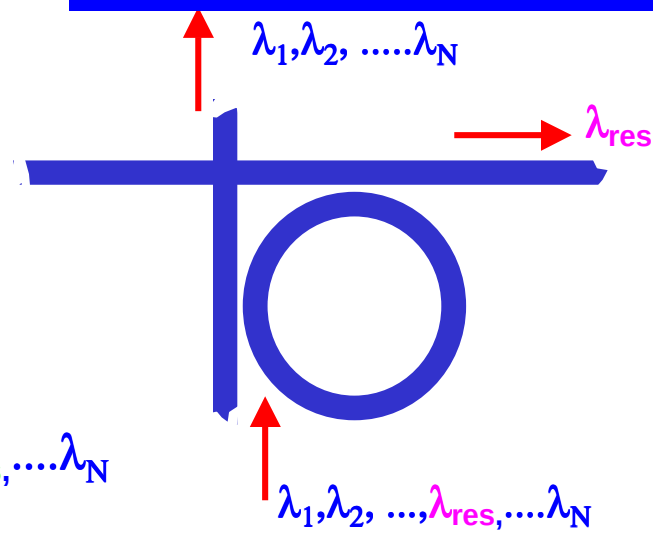
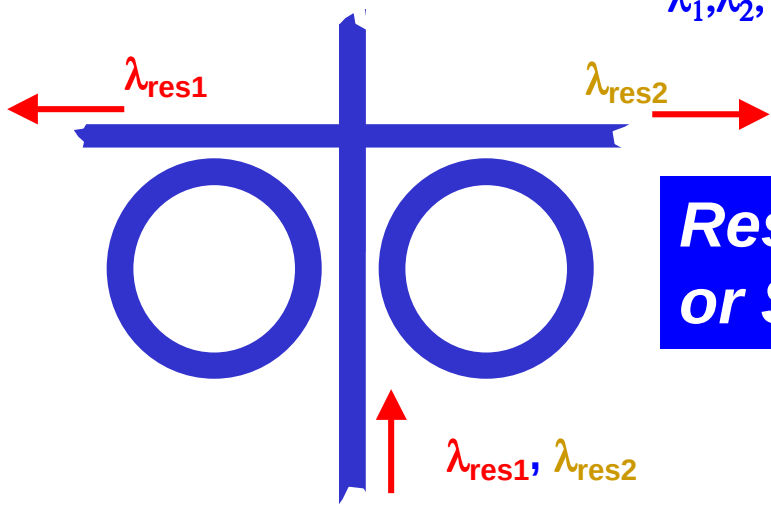
μ Resonator Structures

Resonant Filter / Switch



Resonant Y or Splitter





Resonant T or Splitter

Vertical Coupler Fabricated by Heterogeneous Integration

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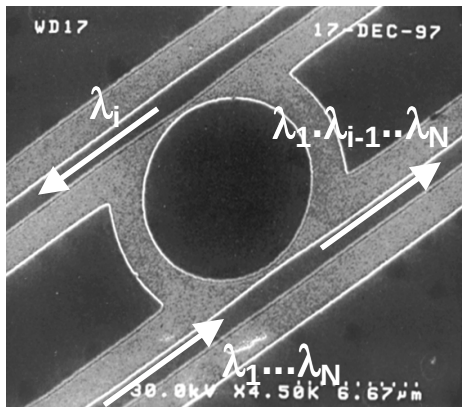
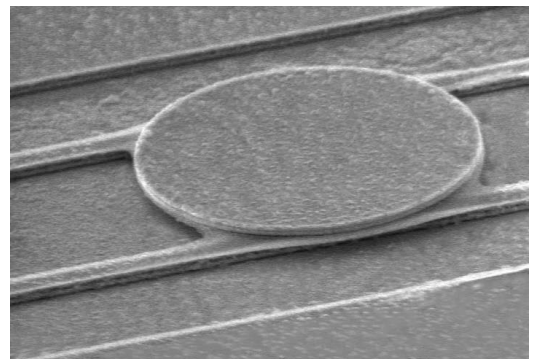


Laterally Coupled Disk
- Air Couping
- Sub Micron Control

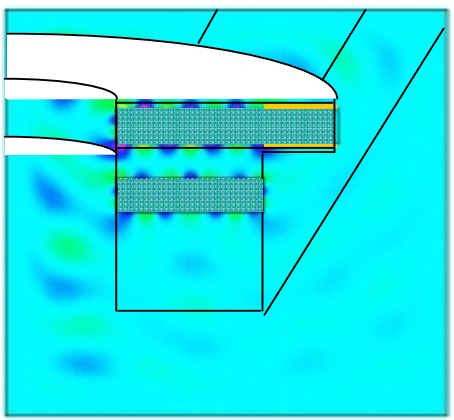
OLD

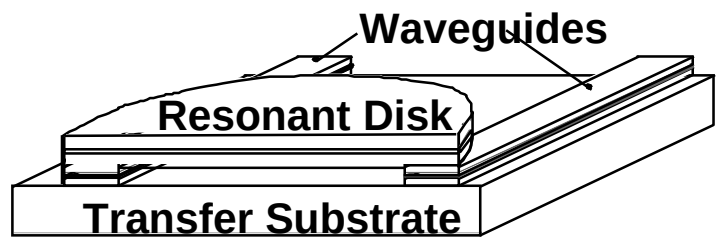
NEW



Vertically Coupled Disk
- Epi Layer Coupling
- Control Coupling by Epilayer Thickness

- **Add-Drop Filters**
- **Resonant Detectors**
- **Integrated Lasers**
- **Resonant Modulators**





μ Disk Resonant Components

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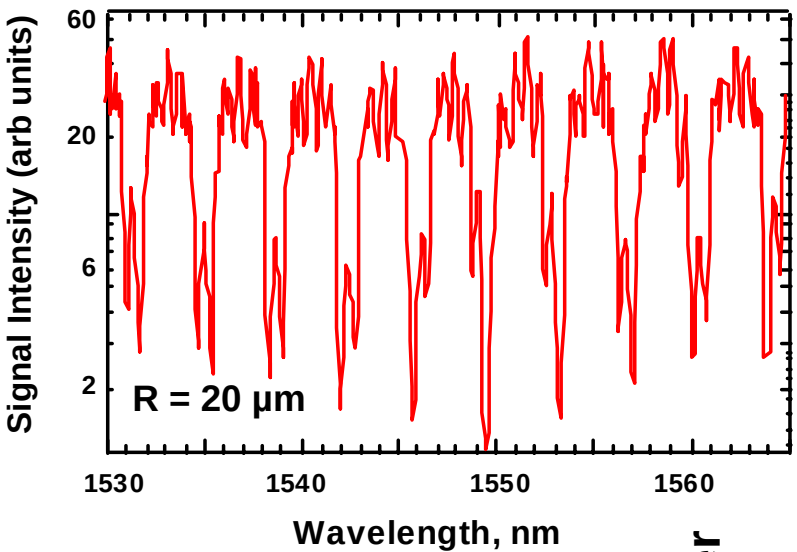

Passive μ disk coupler

Active μ disk tunable filter / switch