Technologies for All-Optical Networks

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Technologies for All-Optical Switching

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- **Active Microresonator Couplers**
  - ✓ Tunable OADM
  - ✓ Compact MUX / DEMUX
  - ✓ Optical Switches
  - ✓ On-Chip Sources
  - ✓ Slow Wave Delay Lines
- **Integrated Semiconductor Optical Amplifier – EA Modulators**
  - ✓ Wavelength Converters
  - ✓ Regenerators
  - ✓ Switching Networks
  - ✓ Wavelength Recognizing Switches
- **3 D Integration Technology**

Fabrication of Photonic Crystal Mach-Zender Structures in InP

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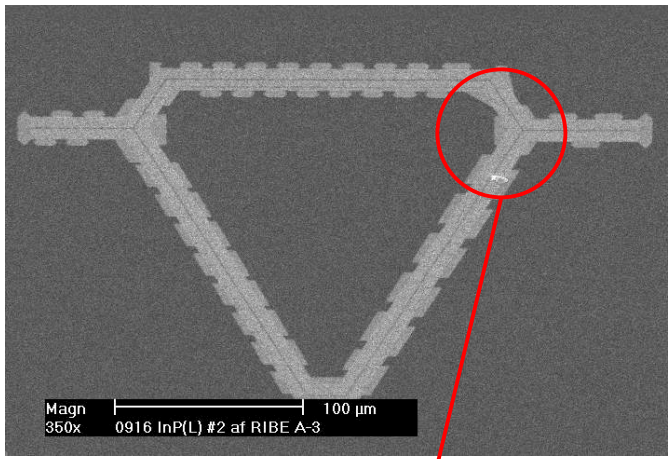
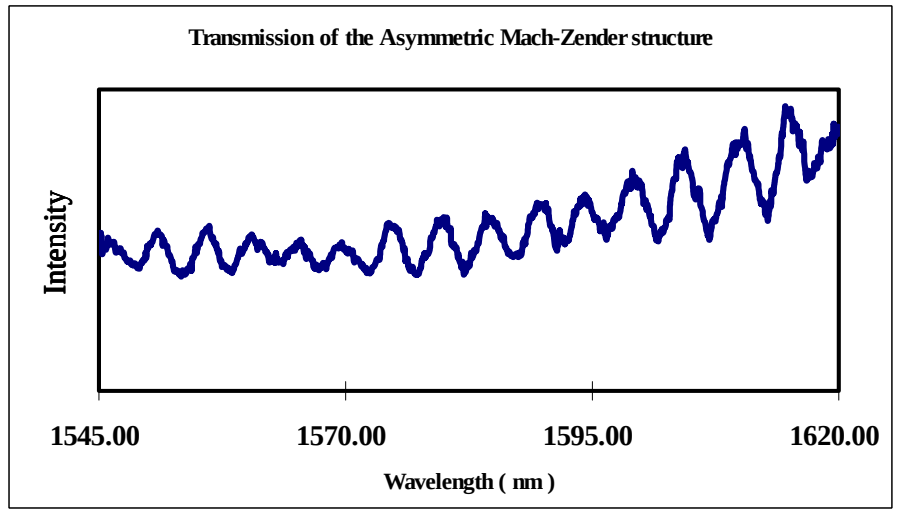
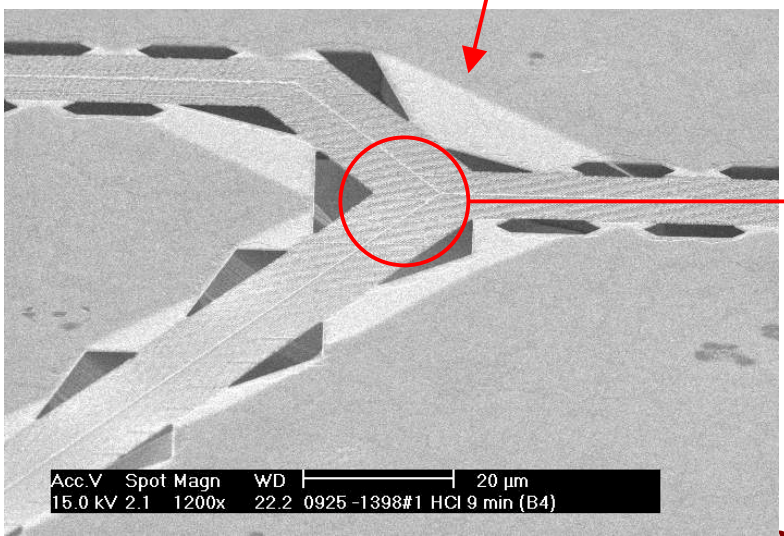
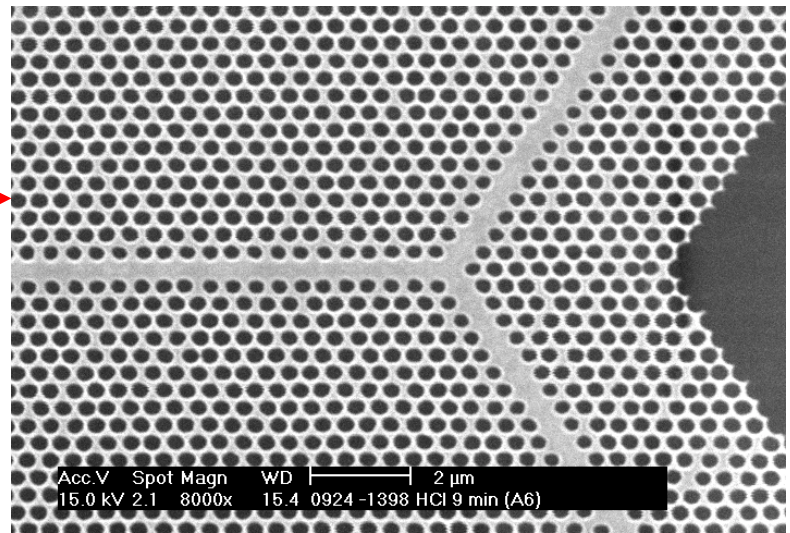
PCWG Membrane Structure



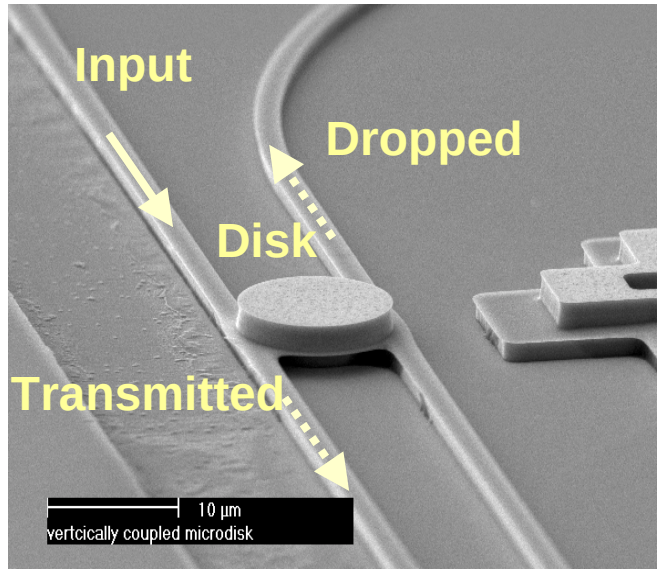






Resonator Couplers

- High Q resonators enable frequency selective coupling between waveguides.
- Active resonators provide functionality (tunability, switching, light emission and detection), and mitigate fabrication and environmental sensitivity issues.
- Vertical coupling permits control of critical coupling dimension by epitaxial growth and enables active resonator / passive waveguide integration.



Building block devices for PICs have been demonstrated

Modulators, switches - RFLICS

Filters, MUX, routers, detectors, amplifiers, lasers – CSWDM

Gain and Free Carrier Tuning and Modulation

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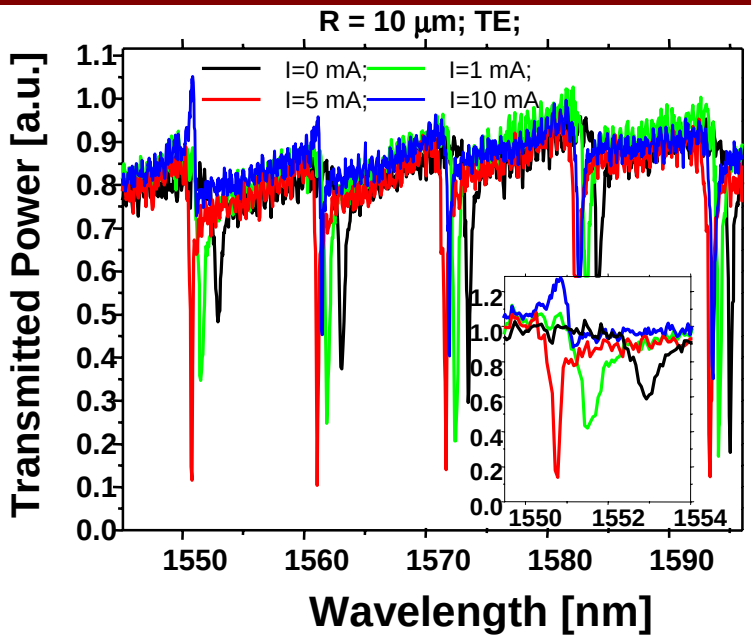

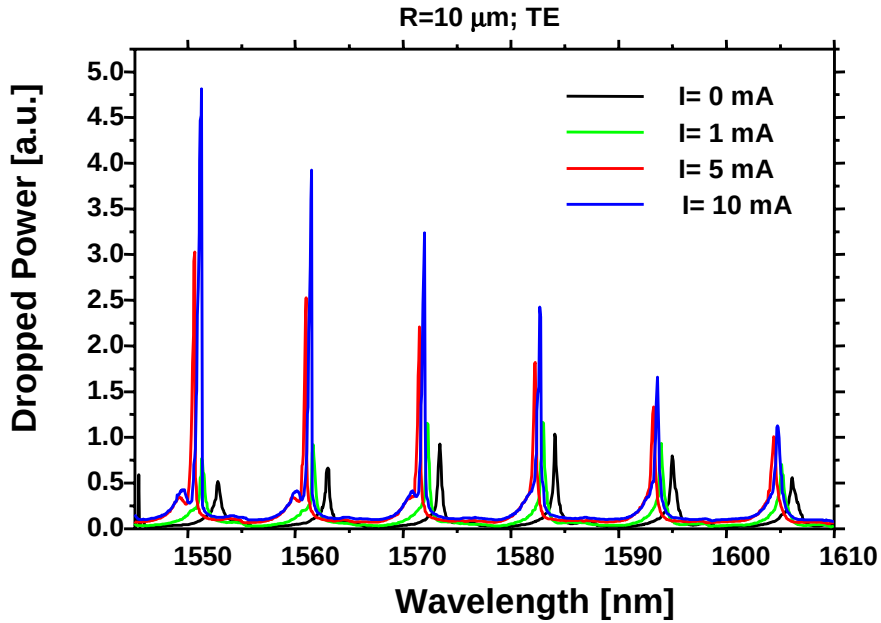

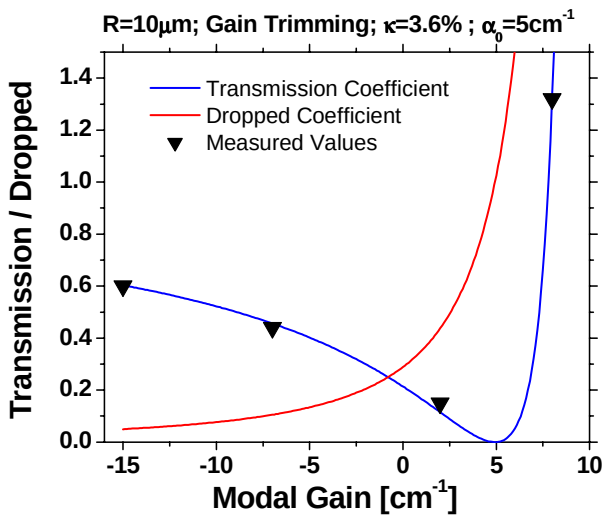

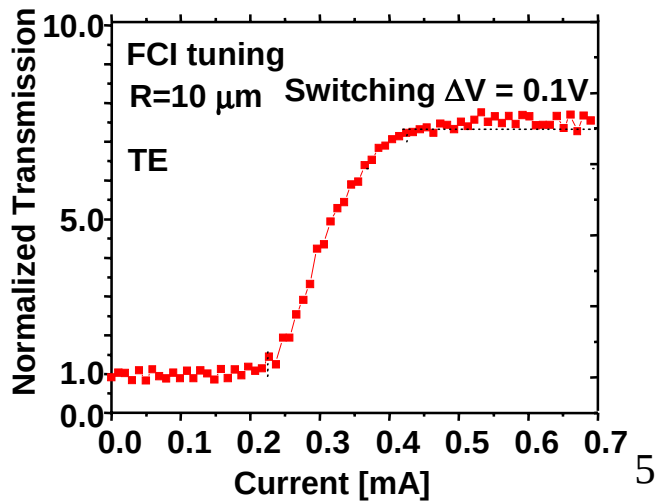

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Optical Switch

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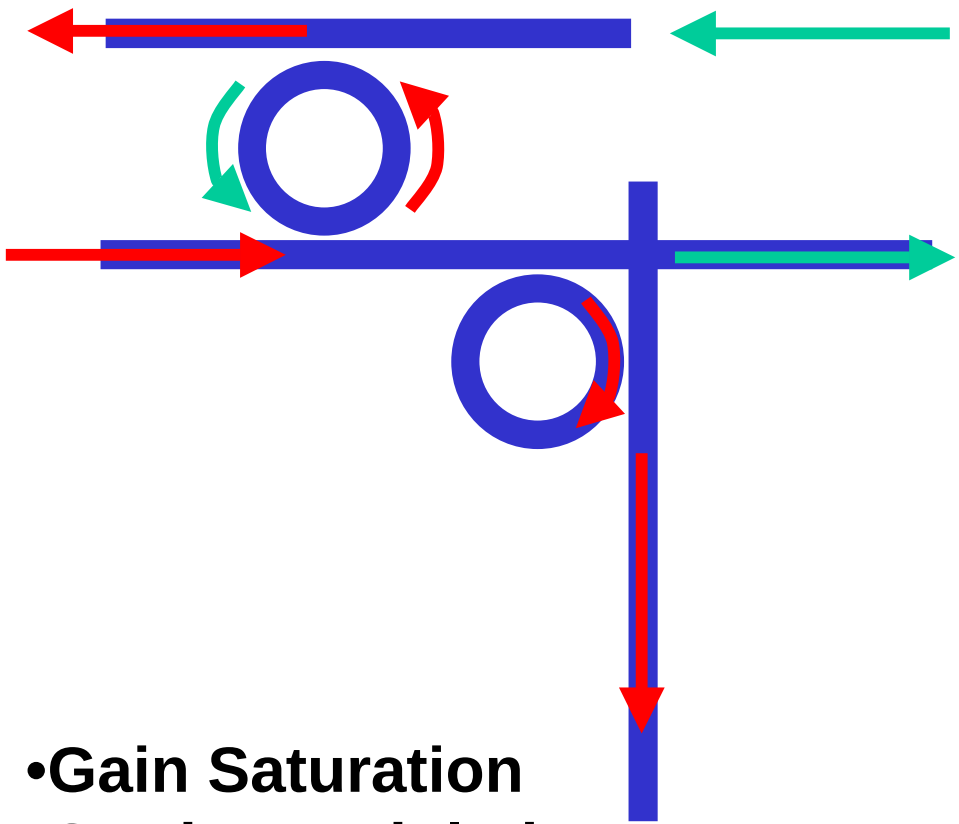
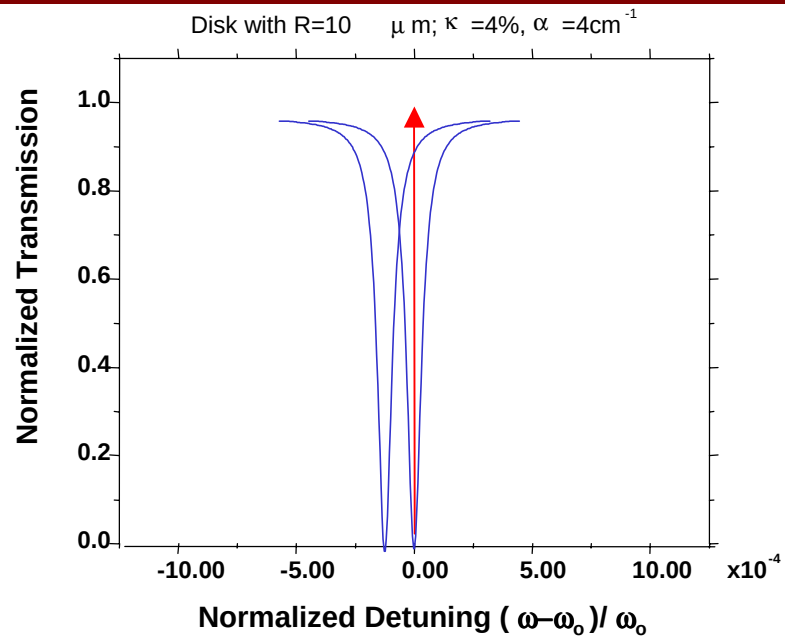
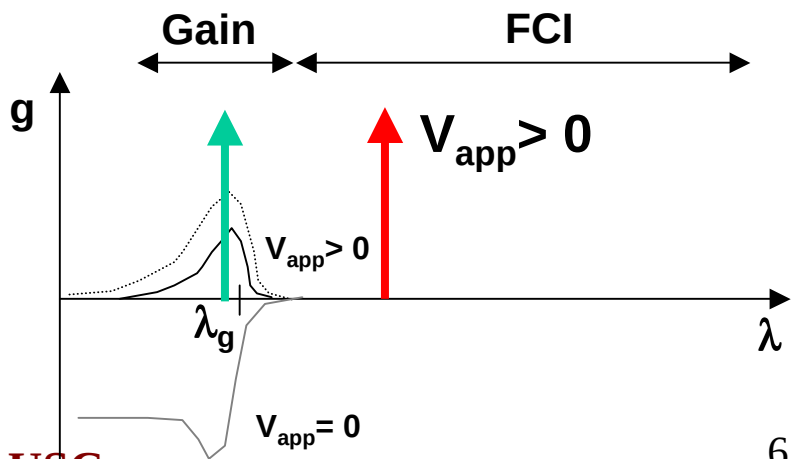




- Gain Saturation
- Carrier Modulation
- Loss Modulation



Integrated SOA EAM by SAG

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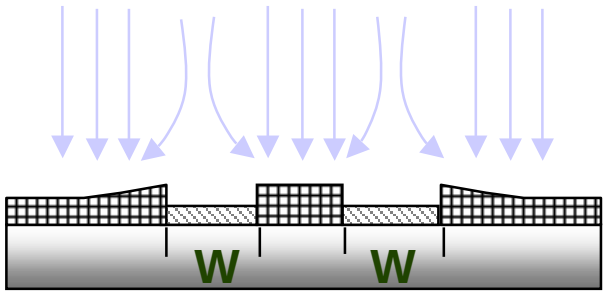
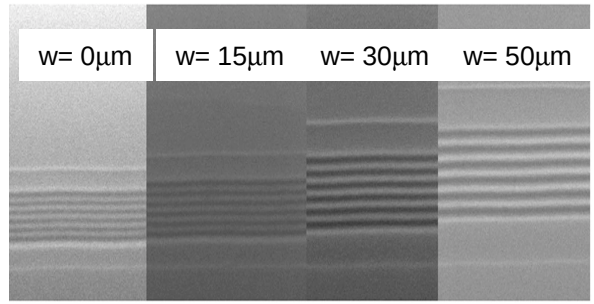
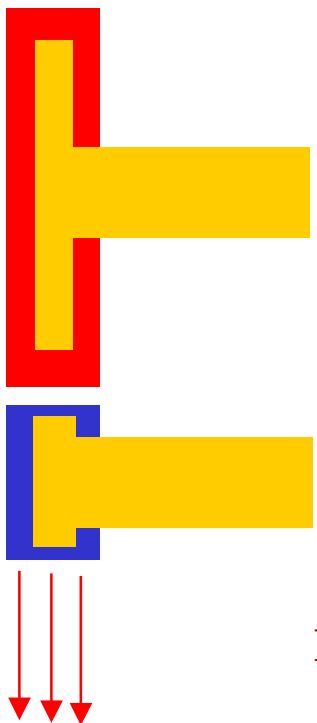
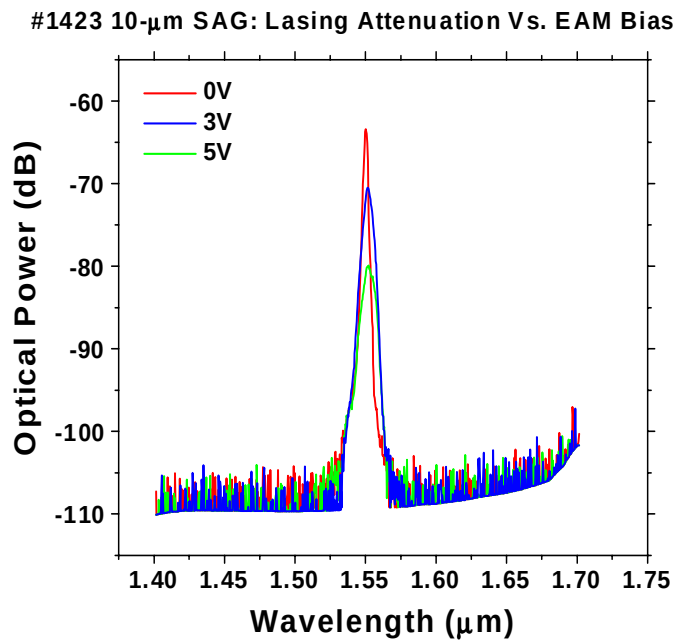




SAG - Grown SOA
λ (E_g) = 1.55 µm

EAM
λ (E_g) = 1.495 µm





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Wavelength Recognizing Switch

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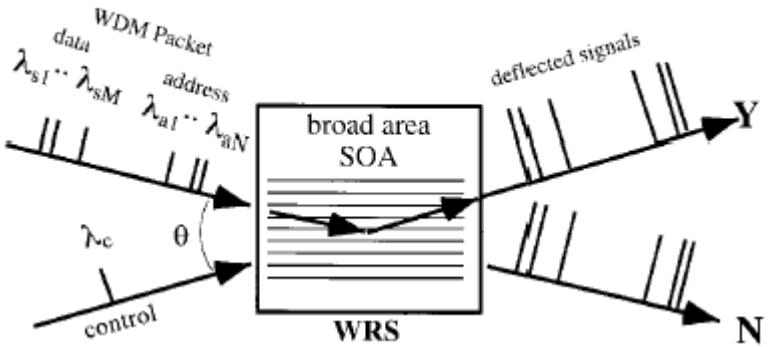

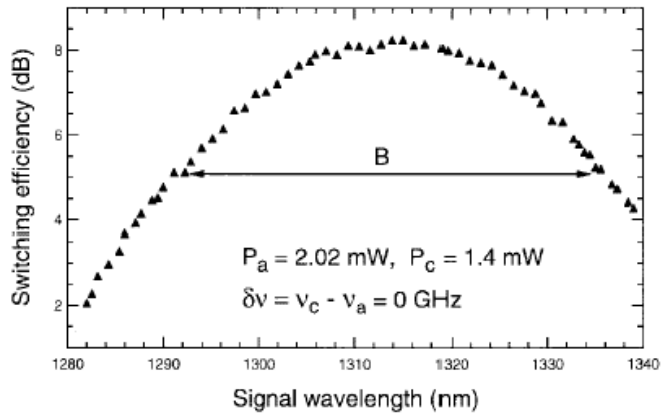

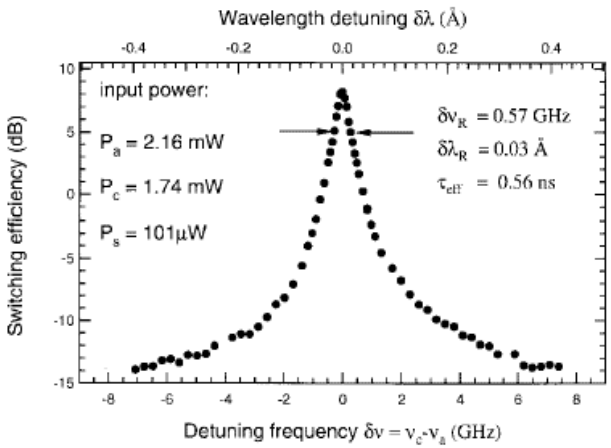

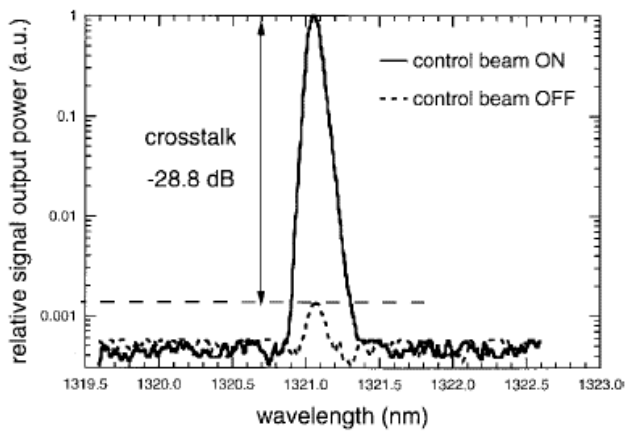

Daniel X. Zhu, Serge Dubovitsky, *Member, IEEE*, William H. Steier, *Fellow, IEEE*, Kushant Uppal, Denis Tishinin, Johan Burger, and P. Daniel Dapkus, *Fellow, IEEE*
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3D BH Integration

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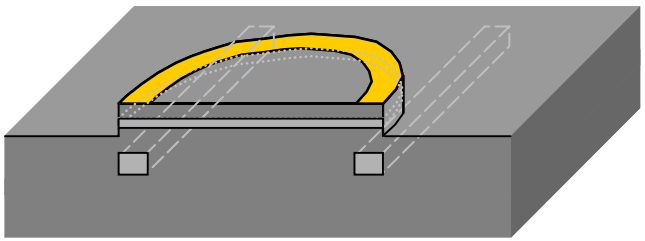
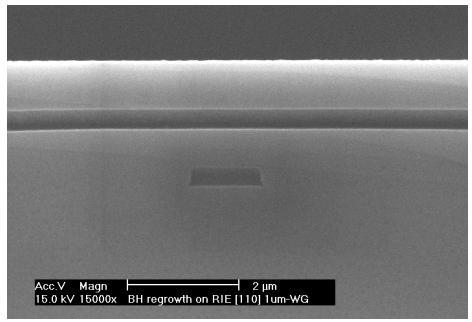
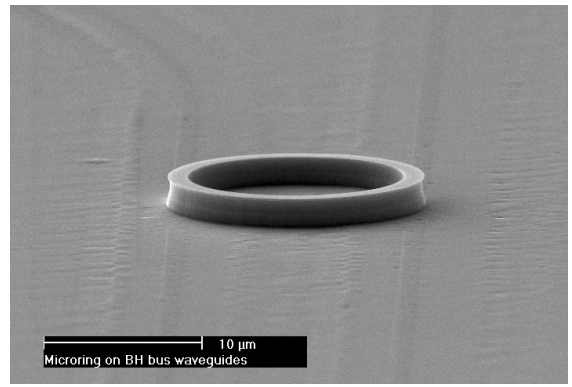




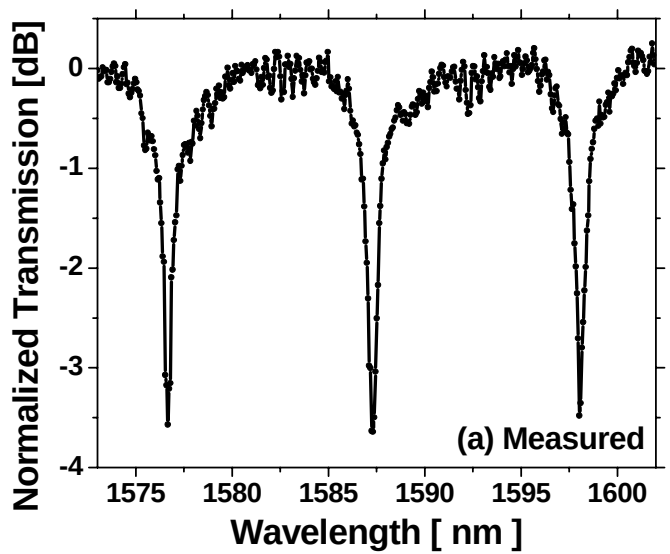


Buried heterostructure technology

Single mode waveguides

Coupling to single resonator mode

Low loss couplers to fiber



In Collaboration with Princeton Lightwaves

2nd Order Tunable Filters

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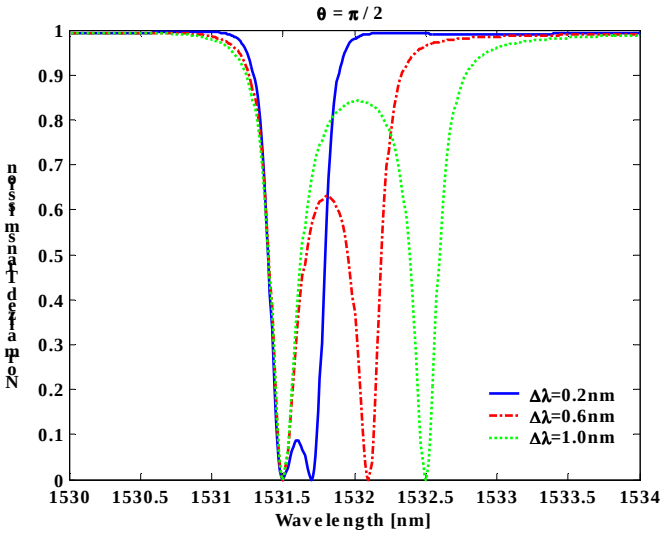

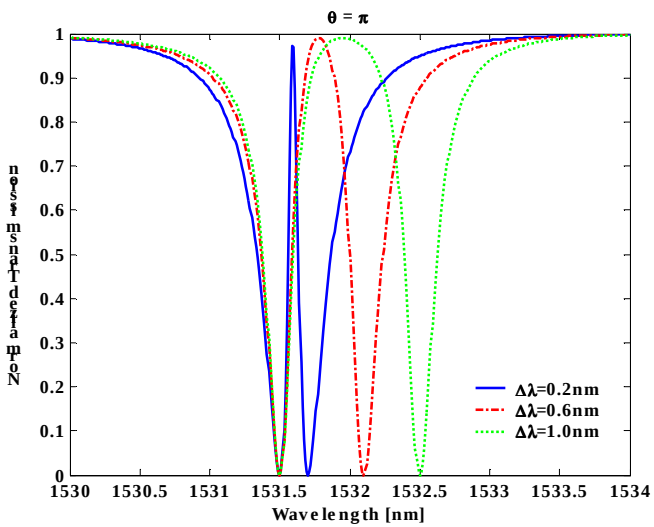

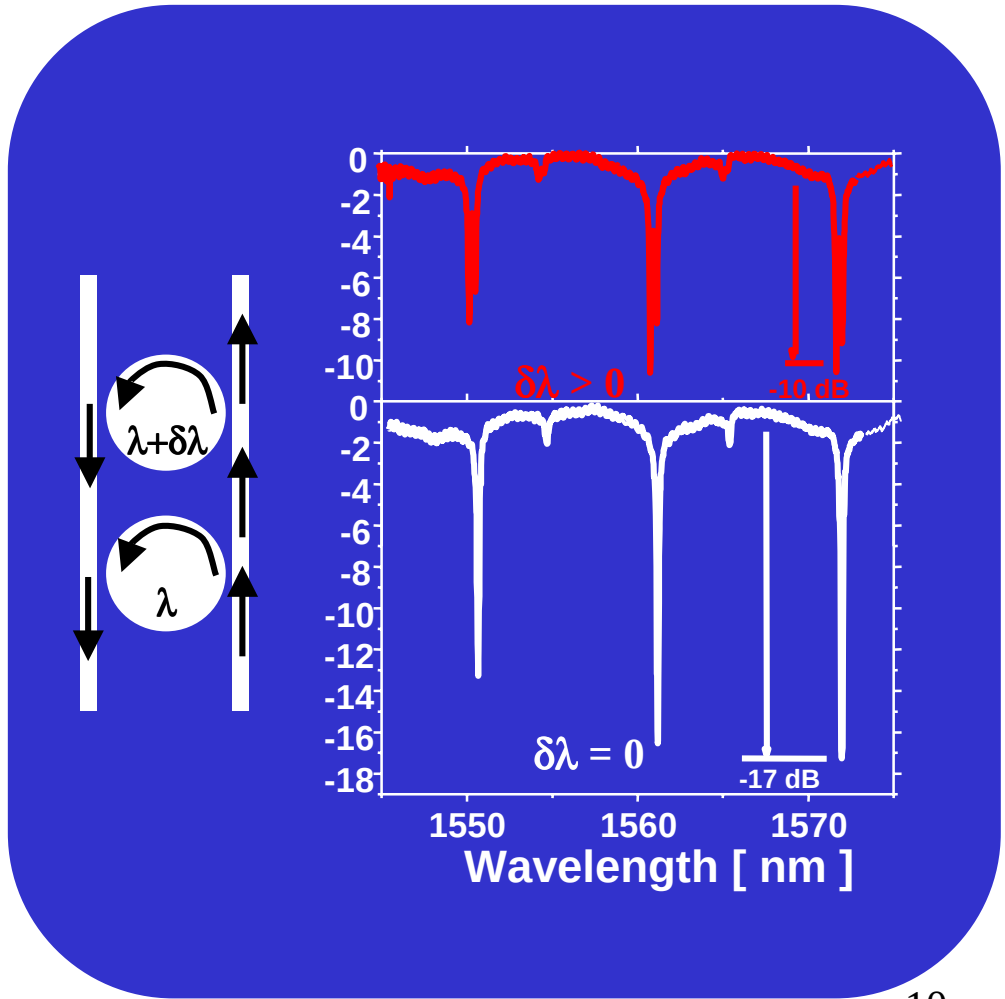

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