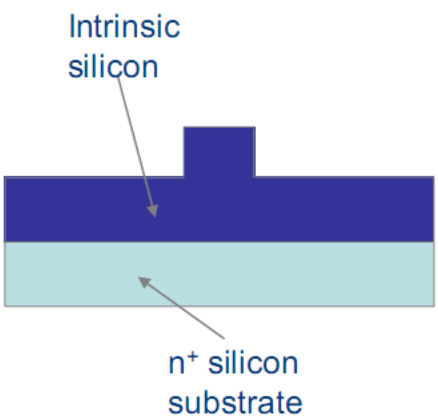
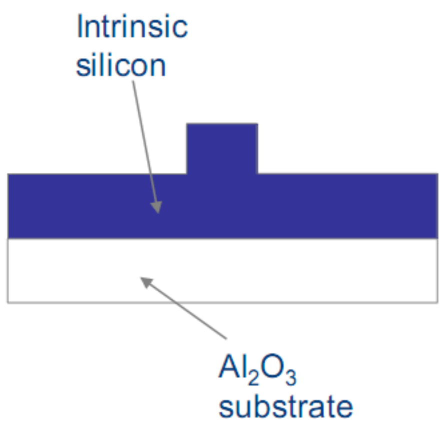
Options for Silicon waveguides:

Silicon on doped silicon



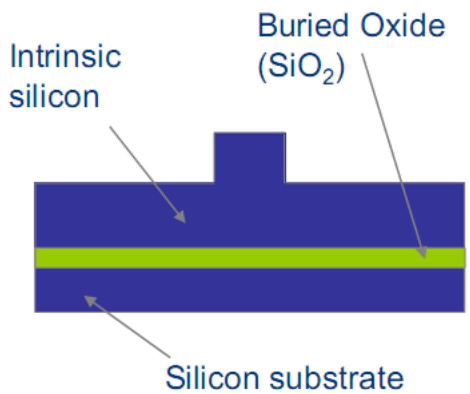
First reported by Soref & Lorenzo Electron. Lett., 21, 1985. & *IEEE J. Quantum Elect.*, QE-22, 1986.

Silicon on sapphire



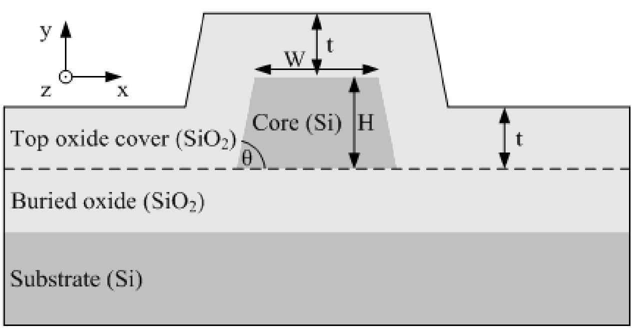
First reported by Albares & Soref *Proc. SPIE, 704*, 1987.

Silicon on Insulator (SOI)

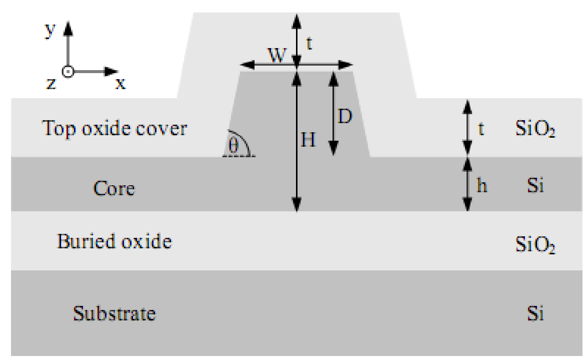


First reported by Soref & Lorenzo, *OSA Integrated Guided Wave Optics '89, 1989.*

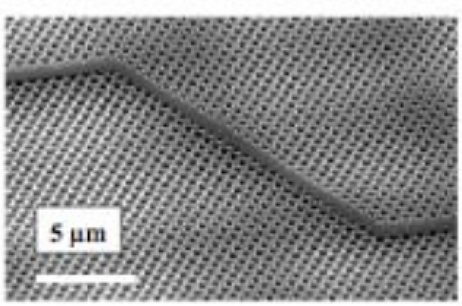
The Most Popular Waveguides:



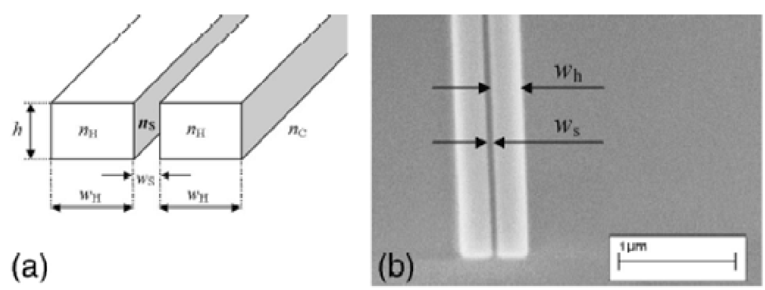
Strip waveguide (SM: 200×500 nm; 2-3 dB/cm loss)



Rib/ridge waveguide (H=200-400 nm to several microns; 0.1 dB/cm loss)



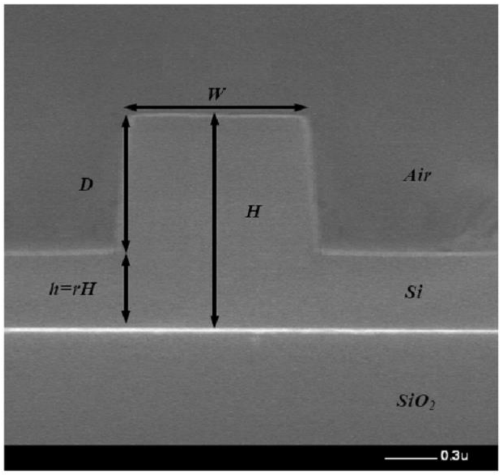
Photonic crystal waveguide (L=100 μm; 3-4 dB/cm loss)



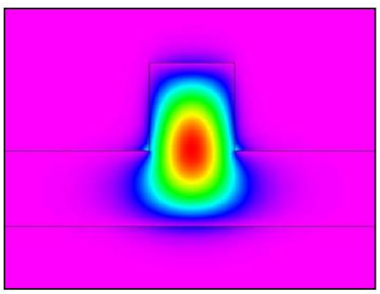
Slot waveguide (non-linear effects, sensors)

SOI Rib Waveguides:

i- Large Rib WGs:

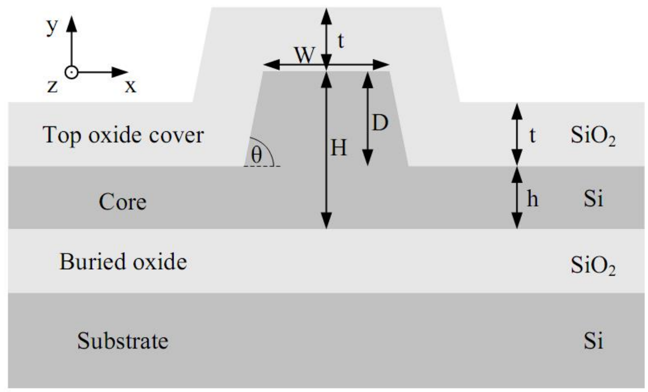


SOI rib waveguide



$$\frac{W}{H} \leq 0.3 + \frac{r}{\sqrt{1-r^2}} \qquad (\text{for } 0.5 \leq r < 1)$$

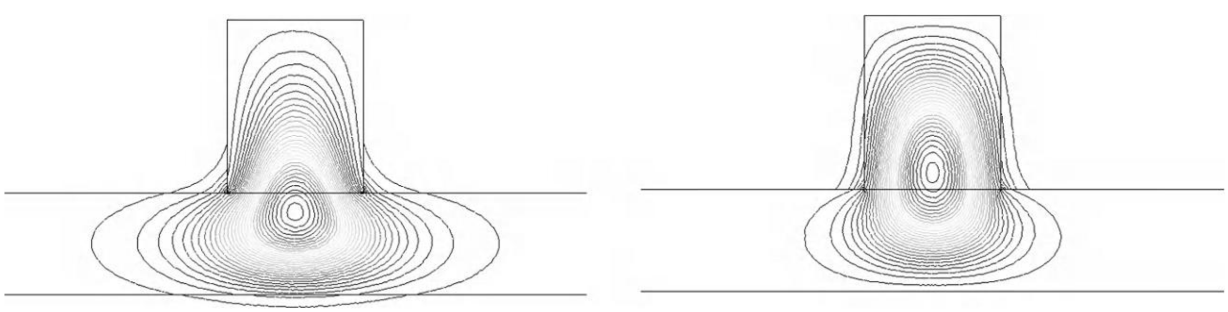
Soref's formula for single mode condition for large rib waveguides



Rib waveguide (H=400 nm to several microns; 0.1 dB/cm loss)

ii- Small Rib WGs

Smaller WG ➔ Stronger polarization dependent behavior



(*a*) (*b*)

Figure 2.7 (*a*) TE and (*b*) TM mode shapes for a rib waveguide in SOI with $H = 1.35$ μm, $D = 0.85$ μm, and $W = 0.70$ μm [21]

Characteristic curves extracted from simulation of specific Rib waveguide structures: (*assuming* λ = 1550*nm*)

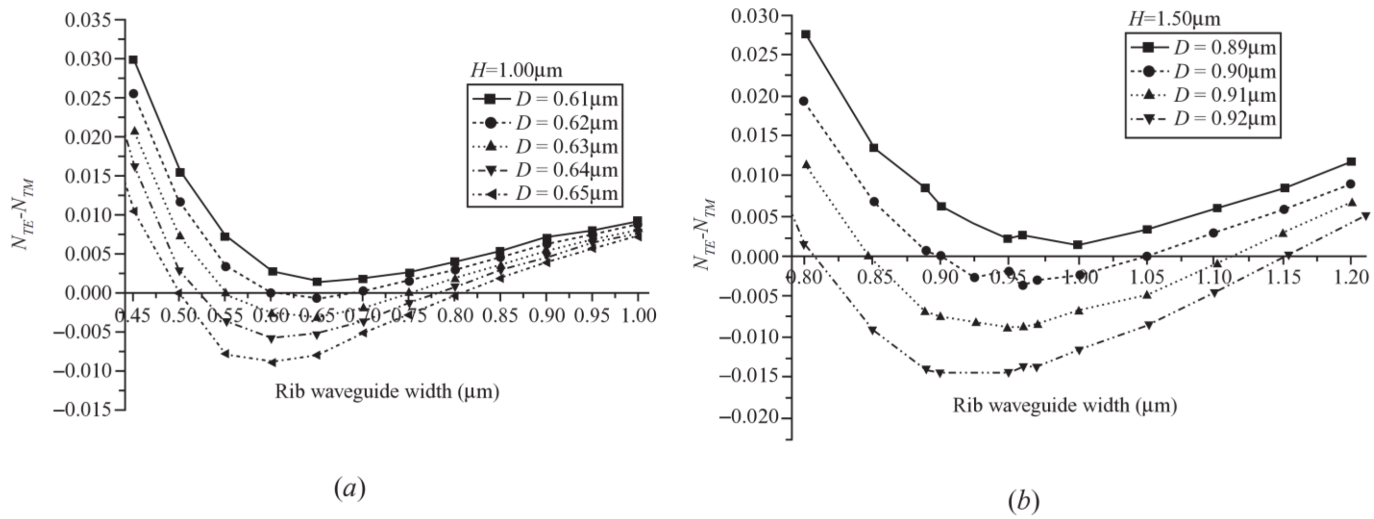


Figure 2.8 Effective-index difference calculation between quasi-TE and quasi-TM polarized modes using the FEM, for waveguide heights of (*a*) 1.00 μm; (*b*) 1.50 μm [9]

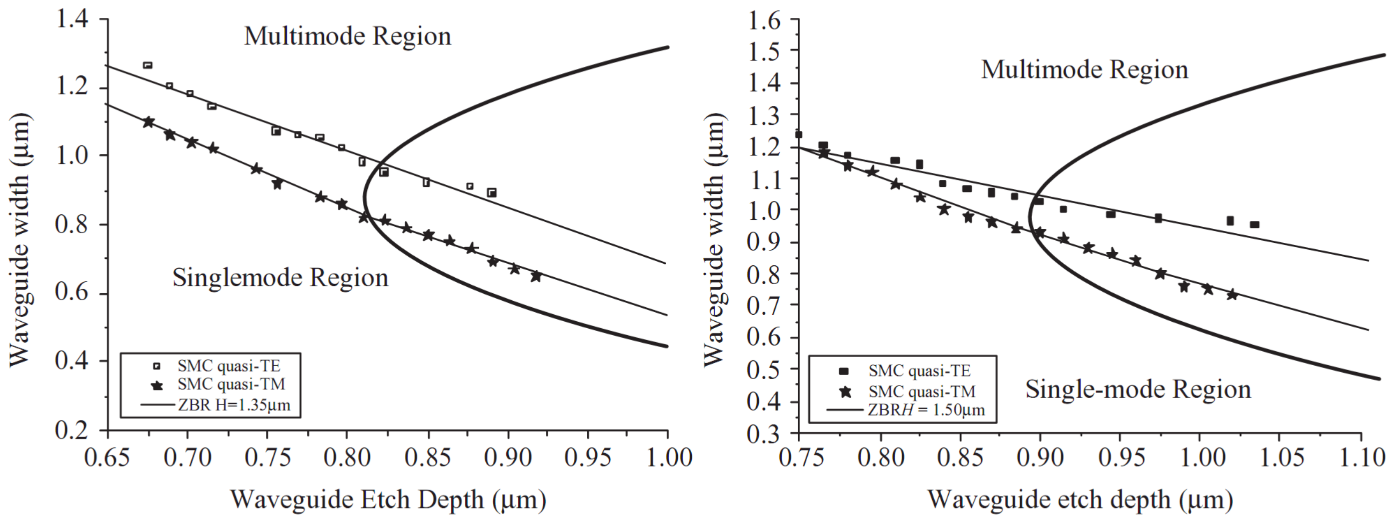


Figure 2.9 The single mode condition and the polarisation independence locus plotted on the same graph, for rib waveguides with height of: (*a*) 1.35 μm; (*b*) 1.5 μm [9]

Sub-micron optical waveguides for silicon photonics formed via the Local Oxidation of Silicon (LOCOS):

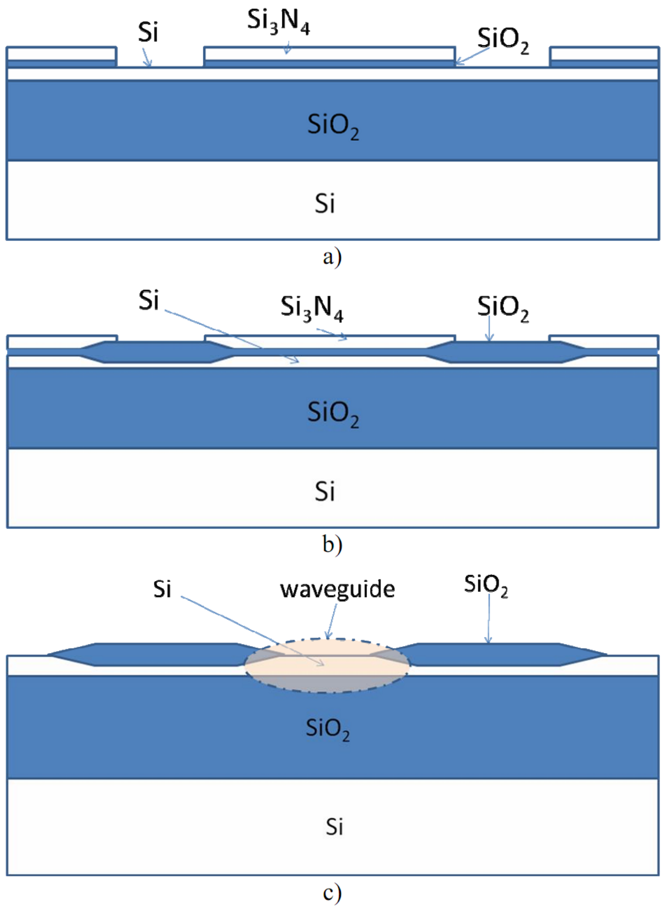


Fig: 1 LOCOS waveguides fabrication process: a) mask formation,b) oxidation through mask, c) mask removal to reveal waveguide

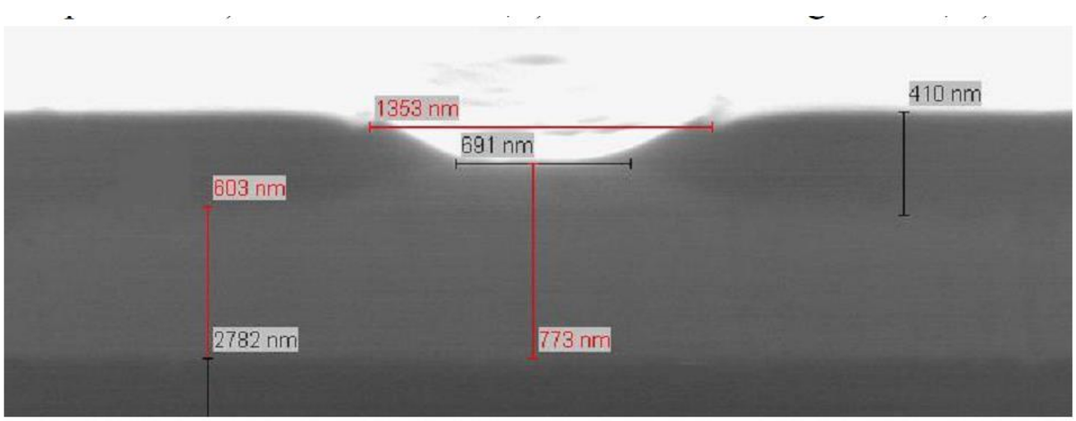


Fig: 2 SEM of the measured waveguides

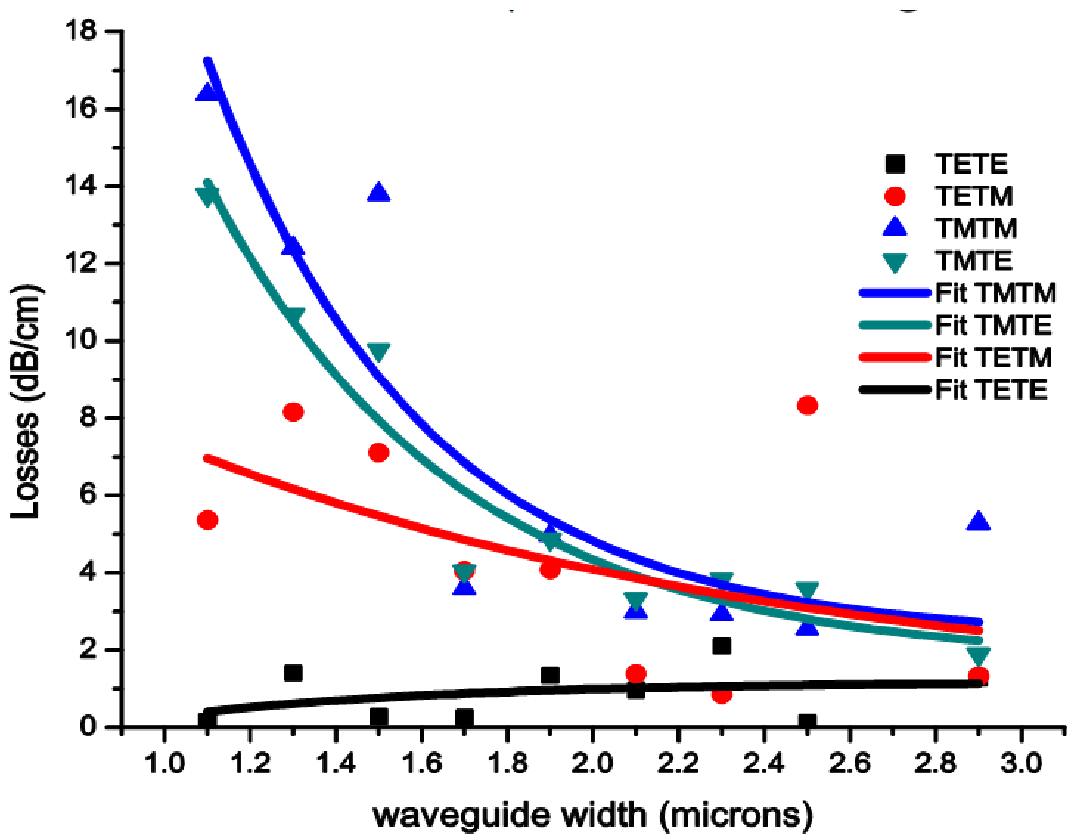


Fig: 4 Polarisation dependent loss with waveguide width.

Low loss etchless silicon photonic waveguides:

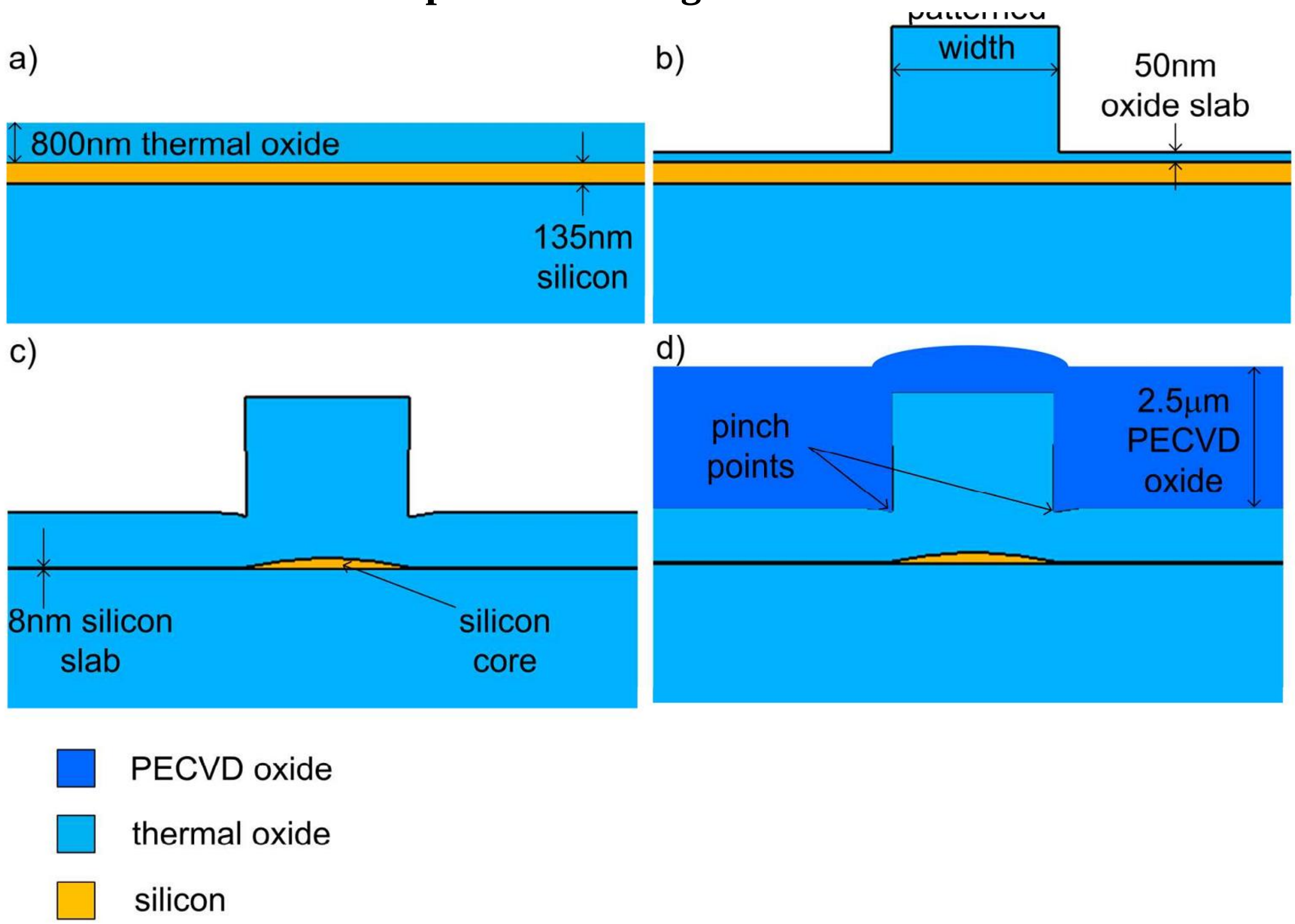


Fig. 1. Fabrication process for the etchless waveguides. a) 800 nm of thermal oxide are grown on an SOI wafer with a 3 μm buried oxide. b) Waveguides are patterned with e-beam lithography and the oxide is etched. c) Waveguide core is defined using thermal oxidation. d) PECVD oxide is deposited as an overcladding.

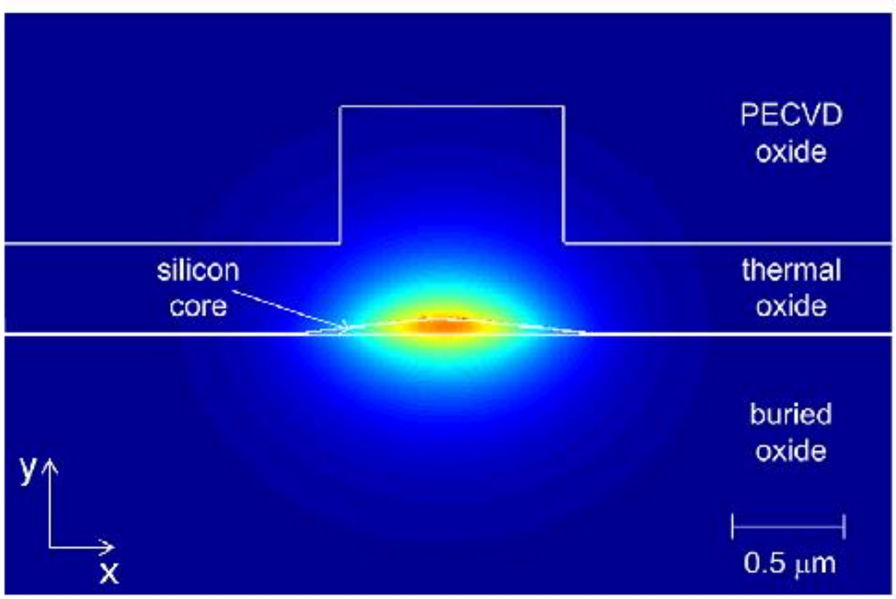


Fig. 2. TE mode profile for 1 μm wide etchless waveguide with cladding profile.

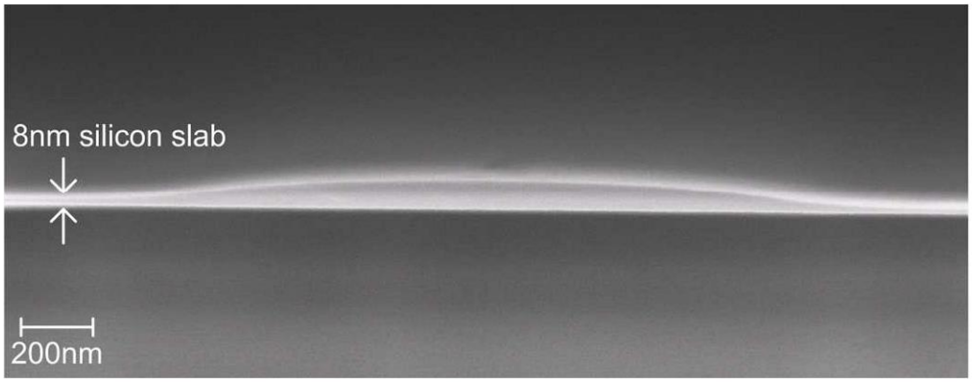


Fig. 3. Cross-section SEM image of an etchless waveguide.

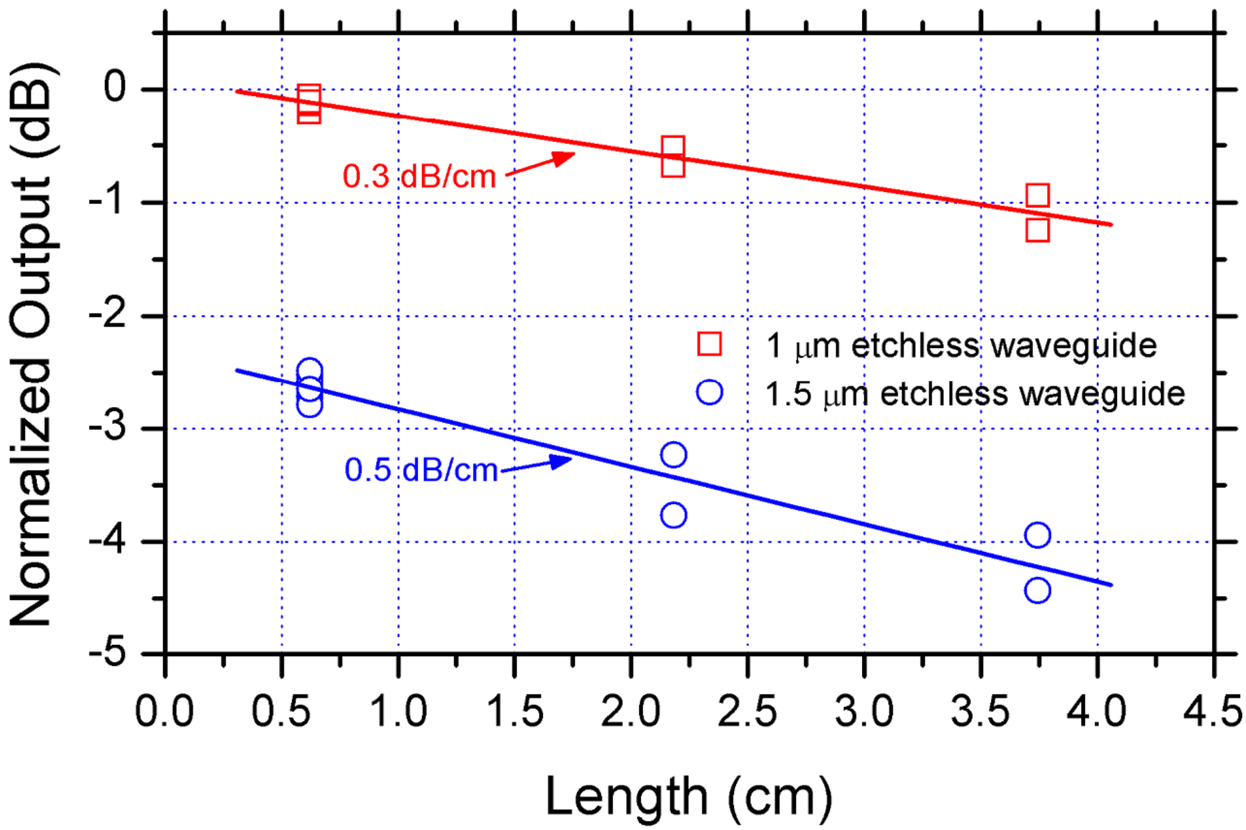


Fig. 5. Measurement results for etchless waveguides. We measured losses of 0.3 dB/cm for a 1 μm waveguide and 0.5 dB/cm for a 1.5 μm waveguide for the TE mode. Each marker denotes a measurement for a different waveguide on the same chip. The solid lines are the linear fit to the experimental data. The output is normalized relative to -16.1 dBm.

Low-loss silicon-on-insulator shallow-ridge TE and TM waveguides formed using thermal oxidation:

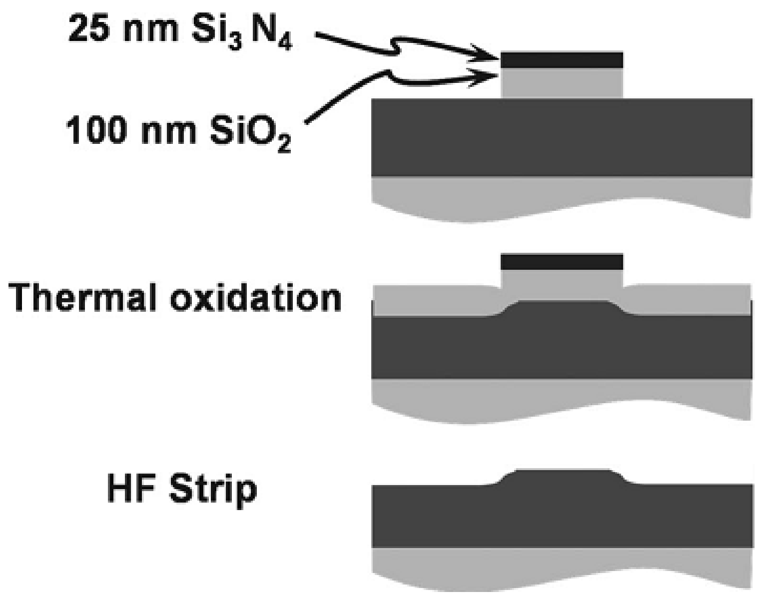


Fig. 4. Processing steps for ridge waveguide fabrication.

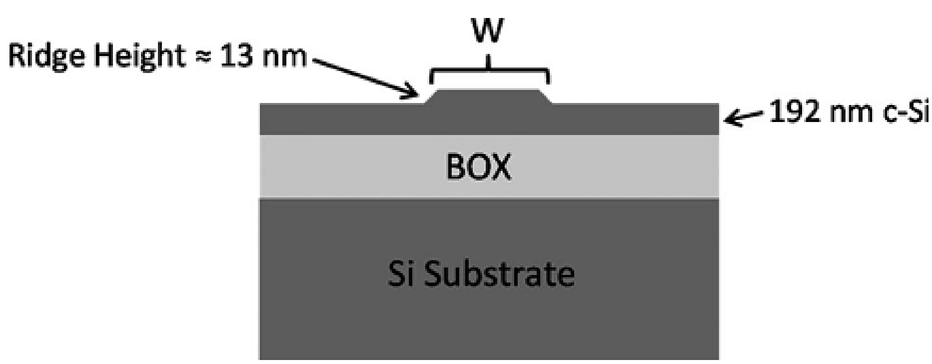


Fig. 3. Quasi-planar ridge SOI waveguide geometry. BOX thickness is $2\,\mu$m.

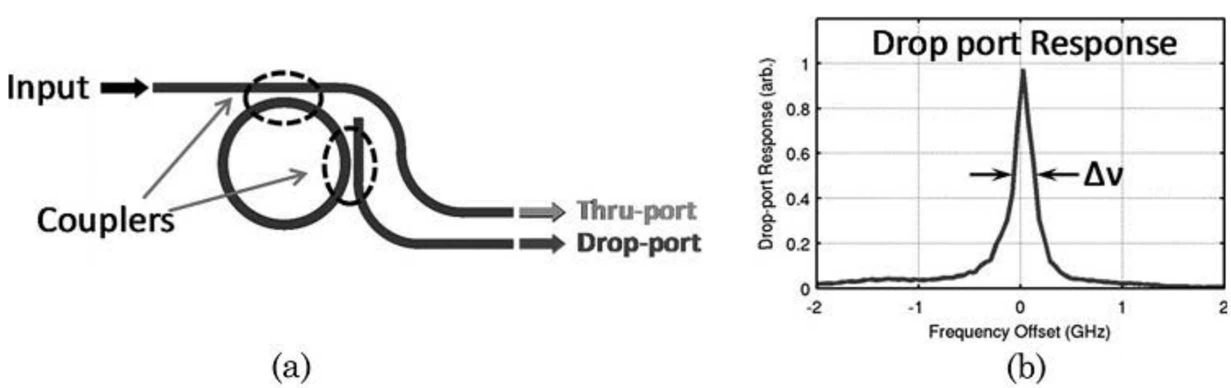


Fig. 6. (a) Ring resonator with add-drop ports and (b) an exemplary drop-port response.

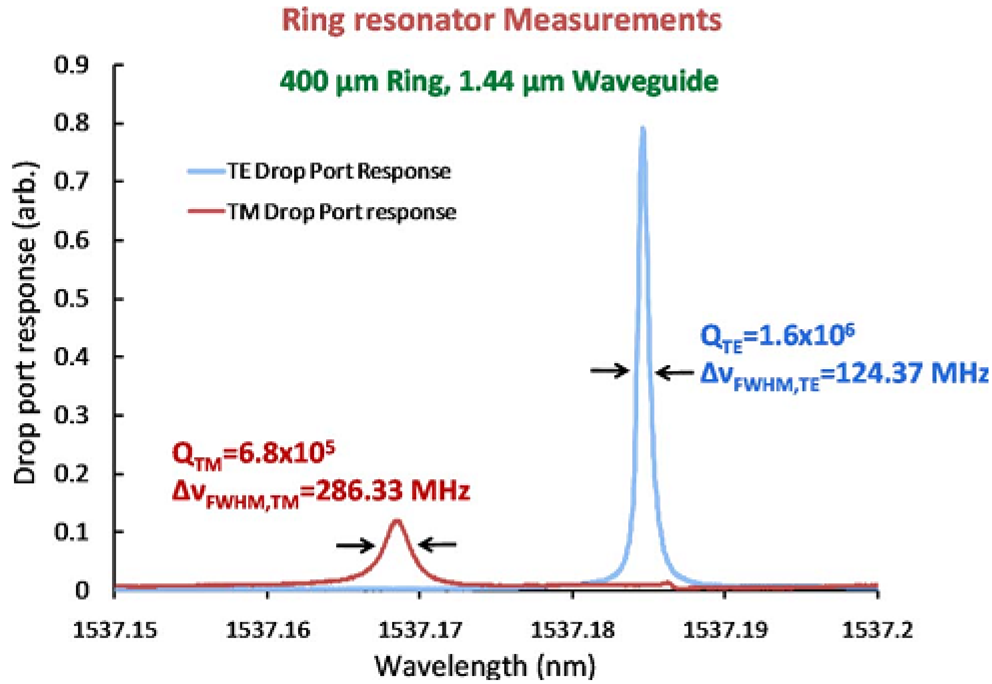


Fig. 7. (Color online) Drop-port responses for the TE and TM modes for a $400\,\mu$m radius ring resonator with "magic width" waveguide of $1.44\,\mu$m.