effective index of 1.6×10^{-4} which shifts the initial resonance by 0.097 nm, thereby yielding a modulation extinction ratio on the bus of at least 6 dB. The on- and off-state capacitances of the device are 3.6 and 6.9 fF, respectively, and the switching energy is estimated to be 8.5 fJ or 4.3 fJ/bit with a modulation response time of about 1 ps as limited by the RC time constant. For a modulator scaled to operate at the 1.3 μm wavelength, the switching energy is estimated to be 2.5 fJ/bit.

A final comment concerns alternative resonators for SOI modulator devices. Very recently, a new high-Q inline SOI waveguide resonator known as the silicon nanobeam has been reported [9–11]. This straight strip-waveguide cavity contains a 1D photonic crystal lattice that tapers in-and-out of the resonant region without a point defect. The nanobeam is equivalent in many respects to the circular resonators discussed in this paper, except that this cavity is inside the input/output waveguide instead of being external to it. To create an ultracompact one-waveguide MOS depletion modulator, we believe that the results obtained here can be applied immediately to an HfO_2-gated nanobeam. Specifically, if the nanobeam has cross-section dimensions of 230 nm × 400 nm for TE_0 guiding at $\lambda = 1.55$ μm, then the same *p*-dopings and the same gate dielectric-and-electrode layer thicknesses derived here for the micro-donut would be used in the nanobeam over an 8 μm active length. Our MOS structure also applies to the inline Fabry Perot cavity in Fig. 1(a) of [12].

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