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Silicon Photonics: An Affordable Solution for Communications at Terabit Data Rates[1]

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Over the past 20 years, laser sources, filters, modulators and detectors have followed the example of lithographic miniaturization provided by the silicon microelectronics industry. Optical devices with sizes smaller than the wavelength of light have evolved, and can be integrated into compact photonic systems. More recently, with the introduction of silicon on insulator (SOI) wafers and with the capability to pattern silicon with 100nm resolution, it has become possible to build high quality optical devices within silicon fabrication lines. Using the very same procedures as silicon electronics inexpensive optical and electronic components can thereby be constructed side by side on 8 inch wafers. This capability enables tuning and switching of complex optical systems with on-chip electronics, as well as data communications at Terabit/second bit-rates, all available at the less than 10 dollars per square centimeter cost traditional in the silicon fabrication industry. By integration of nonlinear optical materials with silicon and the fabrication of high index contrast structures that concentrate light to approximately 1 GW per square centimeter fields, it is also possible to fabricate very fast optical modulators and switches that can operate at THz frequencies. In this presentation, we review the present capabilities of "silicon photonics" and examine the prospect for inexpensive silicon photonic devices to switch, generate and detect THz frequencies.

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