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Silicon integrated nanophotonics for on-chip interconnects[1]

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Current trend in microelectronics industry is to increase the parallelism in computation by multi-threading, by building large scale multi-chip systems and, more recently, by increasing the number of cores on a single chip. With such increase of parallelization the interconnect bandwidth between the racks, chips or different cores is becoming a limiting factor for the design of high performance computer systems. The on-chip ultrahigh-bandwidth silicon-based photonic network might provide an attractive solution to this bandwidth bottleneck. We will review recent results on silicon nanophotonic circuits based on photonic wires and photonic crystals. Strong light confinement at the diffraction limit enables dramatic scaling of the device area and allows unprecedented control over optical signals. Silicon nanophotonic devices have immense capacity for low-loss, high-bandwidth data processing that might enable the design of ultra-compact on-chip optical networks. In particular we will show recent results on design and characterization of various ultra-compact (<0.03mm2) silicon nanophotonic circuits as optical delay lines, electro-optic modulators, broadband optical switches, wavelength filters, etc.

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