Integrated Optical Switches Realized on Silicon-Silicon Nitride Multi-layer Waveguide Platform

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Abstract— Optical switches are essential components in all-optical signal processing. They can replace traditional optical-electrical-optical conversion with reduced volume, weight, and power consumption. We report our recent progress on large-scale silicon optical switch fabrics. A 32×32 optical switch is implemented with a switch-and-select topology architecture on a multilayer 3D SiN-Si waveguide platform. As waveguide crossings are formed by spatially separated waveguides, the insertion loss and crosstalk are reduced considerably, compared to planar waveguide crossings. The average fiber-to-fiber insertion loss is around 13 dB and the crosstalk is less than −20 dB. A wavelength-selective 8×8 double-microring resonator (MRR) optical switch is also realized by 3D SiN-Si waveguides. The resonances of all SiN MRR switching elements are well aligned for the as-fabricated chip, owing to the high fabrication error tolerance of SiN MRRs. The fiber-to-fiber insertion loss of the microring switch is between 6.1 dB and 9.2 dB, crosstalk is lower than −22.5 dB, and the optical bandwidth is up to 70 GHz. The 8×8 MRR switch exhibits superior switching performances and is ready to be scaled up to a higher port count.

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