

High-speed all-optical switching in silicon-on-insulator nanophotonic devices

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Abstract

Silicon-on-insulator (SOI) technology is a promising platform to realize cost-efficient integrated photonic on-chip components. High photonic integration capabilities are made possible by the high refractive-index contrast between silicon and typical cladding materials, and the natural vertical confinement of optical waves given by the buried oxide layer. Integration of photonic and electronic functions on the same substrate is feasible by transferring established CMOS-compatible processing technologies.

In this talk I will present an overview of the progress made in our institute in the exciting field of integrated SOI waveguide photonics, with a strong emphasis on high-speed all-optical switching applications. Nonlinear optical effects can be easily exploited for active functionality if short optical pulses are launched into high-confinement silicon waveguides. Based on cross-phase modulation, sub-picosecond optical switching is demonstrated on the SOI chip. In addition, microring resonators appear specifically attractive for photonic switching, since their spectral transmission characteristics are very sensitive to minimal modifications of the optical phase. I will present recent results about all-optical switching in an SOI microring resonator induced by the photoinjection of an electron-hole plasma. To enhance modulation speed an effective approach to reduce the free carrier lifetime in SOI components will be shown.

Biosketch

Michael Först studied physics at the RWTH Aachen University and received his Ph.D. degree in 2001. His work focussed on the femtosecond time-resolved investigation of coherent charge carrier and crystal lattice dynamics in semiconductor and optical data storage materials. From 2001-2004 he lead the femtosecond spectroscopy research group at the Institute of Semiconductor Electronics, also taking responsibility of activities in optical coherence tomography for biomedical imaging. In late 2004 he took the position as Oberingenieur at the same institution. Since then, he additionally engaged in the development of ultrafast measurement techniques has been leading research on the fundamentals optical and electrical data storage technologies as well as silicon-based light emitting diodes and integrated photonic components.

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