High-speed energy-efficient electro-optic switch developed

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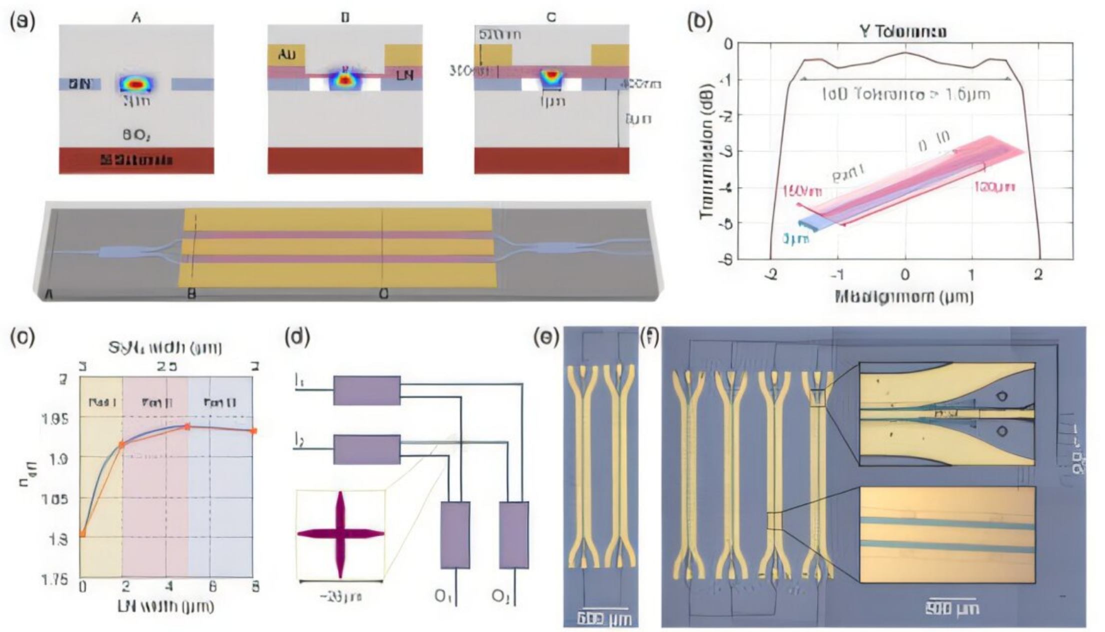

Fig. 1. (a) Schematic of the 1×2 optical switch element based on the LN-Si_3N_4 hybrid waveguide. (b) Misalignment tolerance of the evanescent coupler in the Y direction. (c) Effective index of the LN-Si_3N_4 hybrid waveguide vs waveguide width. (d) Schematic structure of the 2×2 cascaded switch architecture. (e, f) Optical micrographs of (e) 1×2 and 2×2 optical switch elements and (f) 2×2 cascaded optical switches.

(a) Schematic of the 1x2 optical switch element based on the Ln-Si3N4 hybrid waveguide. (b) Missalignment tolerance of the evanescent coupler in the Y direction. (c) Effective index of the Ln-Si3N4 hybrid waveguide vs. waveguide width. (d) Schematic structure of the 2x2 cascaded switch architecture. (e,f) Optical micrographs of 1x2 and 2x2 optical switch elements and 2x2 cascaded optical switches. Credit: Jinwei Su, Shanghai Jiao Tong University

Researchers have developed a high-speed electro-optic switch that is energy-efficient, has low crosstalk and works across a broad bandwidth. Made using a scalable, chip-friendly process, this switch could enhance data capacity in optical networks and data centers by improving signal routing and switching.

Jinwei Su from the Shanghai Jiao Tong University in China will present this research at Optical Fiber Communications Conference and Exhibition (OFC), the global event for optical communications and networking, which will take place 30 March–3 April 2025 at the Moscone Center in San Francisco.

As artificial intelligence and cloud computing rapidly advance, the demand for high-capacity data exchange continues to rise. Optical switching, with its broad bandwidth and low latency, is emerging as one of the most promising solutions to address this challenge. To achieve nanosecond-scale optical switching, the researchers fabricated a 2×2 cascaded electro-optic switch by micro-transfer printing pre-etched thin-film lithium niobate (TFLN) onto silicon nitride.

The 2×2 cascaded electro-optic switch consists of four 1×2 Mach-Zehnder interferometer structures formed by silicon nitride waveguides with a TFLN coupon integrated onto the interferometer arms via micro-transfer printing to create hybrid phase shifters. This design takes advantage of the superior modulation capabilities of TFLN and the exceptional passive properties of silicon nitride, ensuring optimal performance for the optical switch.

Tests of the switches showed a broad 3-dB bandwidth exceeding 100 nm, an insertion loss of about 1.3 dB at a 1550-nm wavelength and low crosstalk below -45 dB. In addition, the TFLN enabled high-speed switching with a response time of less than 3 ns while consuming little power.

"Building on our study, our next steps will focus on further reducing insertion loss through optimized coupler design and ensuring backend compatibility with commercially available ultra-low-loss silicon nitride platforms," said Su.

"Additionally, we plan to develop large-area coupon-based massive micro-transfer printing to integrate multiple elements in a single process. These improvements will thereby scale our switch design toward practical, commercial applications in next-generation optical communication systems."

OFC will feature over 650 high-impact, peer-reviewed scientific presentations, including this one, during the five-day technical conference in San Francisco.

Provided by Optica

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