Team unveils new path for dense photonic integration

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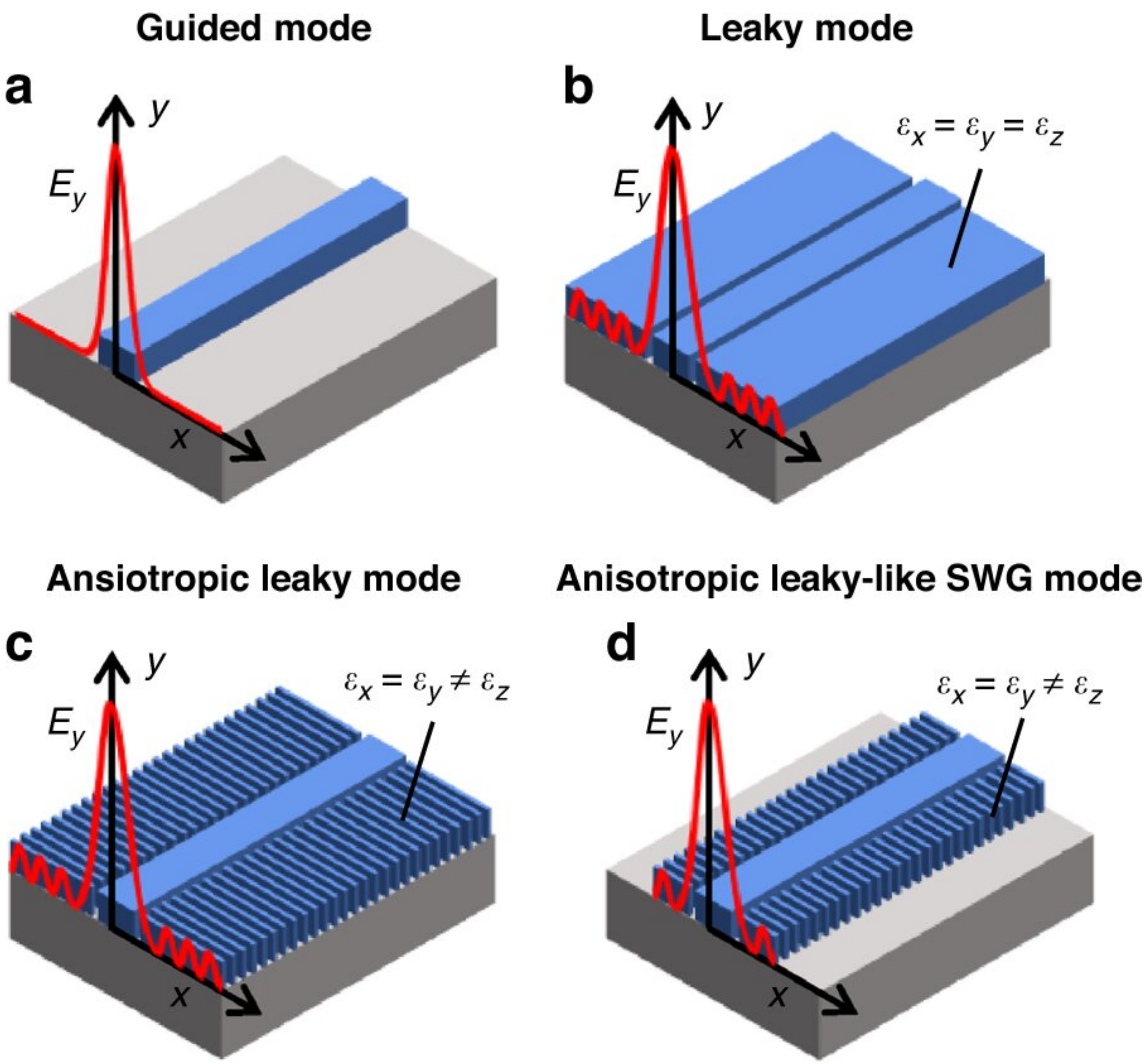

Waveguide configuration with subwavelength gratings (SWGs). Waveguide schematics under evaluation (blue: Si and gray: SiO_2). The red lines illustrate the fundamental TM_0 modes (E_y). **a** A typical strip waveguide supporting a guided mode with exponentially decaying evanescent fields. **b** Placing infinite slabs adjacent to the strip results in leaky mode with a radiative loss into the slabs. **c** A perpendicular array of infinite SWGs can replace the slab, supporting a leaky mode, but SWGs provide anisotropic field oscillations. **d** By truncating the SWGs, the mode will be guided without radiative losses while preserving its leaky-like oscillations in the anisotropic SWG claddings. When coupled with other waveguides, this leaky-like anisotropic oscillation exhibits a non-conventional anisotropic perturbation and can result in zero crosstalk. Credit: *Light: Science & Applications* (2023). DOI: 10.1038/s41377-023-01184-5

Integrated optical semiconductor (hereinafter referred to as optical semiconductor) technology is a next-generation technology for which many researches and investments are being made worldwide because it can make complex optical systems such as LiDAR and quantum sensors and computers into a single small chip.

In existing semiconductor technology, the goal was to achieve units of 5 nanometers or 2 nanometers, but increasing the degree of integration in optical semiconductor devices can be said to be a key technology that determines performance, price, and energy efficiency.

A research team led by Professor Sangsik Kim of the Department of Electrical and Electronic Engineering discovered a new optical coupling mechanism that can increase the degree of integration of optical semiconductor devices by more than 100 times.

The number of elements that can be configured per chip is called the degree of integration. However, it is very difficult to increase the degree of integration of optical semiconductor devices, because crosstalk occurs between photons in adjacent devices due to the wave nature of light.

In previous studies, it was possible to reduce crosstalk of light only in specific polarizations, but in this study, the research team developed a method to increase the degree of integration even under polarization conditions, which were previously considered impossible, by discovering a new light coupling mechanism.

This study, led by Professor Sangsik Kim as a corresponding author and conducted with students he taught at Texas Tech University, was published in *Light: Science & Applications* on June 2.

Professor Sangsik Kim said, "The interesting thing about this study is that it paradoxically eliminated the confusion through leaky waves (light tends to spread sideways), which was previously thought to increase the crosstalk." He added, "If the optical coupling method using the leaky wave revealed in this study is applied, it will be possible to develop various optical semiconductor devices that are smaller and that has less noise."

More information: Md Faiyaz Kabir et al, Anisotropic leaky-like perturbation with subwavelength gratings enables zero crosstalk, *Light: Science & Applications* (2023). DOI: 10.1038/s41377-023-01184-5

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