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A 3D Tapered Nanophotonic Waveguide to Fiber Edge Coupler

High-efficiency fiber-to-chip coupler boosting performance for photonics, quantum, and optical networks.

Researchers at Purdue University have developed a grayscale lithography technique to actualize efficiently coupled 3D tapered waveguide-to-fiber couplers (TWCs). Minimizing coupling losses in optical fibers makes communicating information over quantum networks more efficient. Better efficiency has been partially achieved with grating couplers, edge couplers, and adiabatic couplers. However, these strategies remain sensitive to wavelength, polarization, coupler geometry, and misalignment, which significantly limits many potential quantum applications. Purdue researchers developed a 3D TWC design that can achieve highly efficient flat-cleaved fiber-to-silicon nitride photonic waveguide coupling, potentially up to 95% polarization-insensitive fiber coupling efficiency and micron-size misalignment tolerance. Beyond the high-efficiency fiber-nanophotonic circuit coupling, this technology shows potential to be applied to waveguide crossing, interplanar coupling, chip-to-chip coupling, etc.

Technology Validation: Fabricated 3D TWCs on a functional nanophotonic circuit demonstrated 85% coupling efficiency with potential for more.

Advantages:

-Wide bandwidth

-Efficient

-Misalignment tolerance

Applications:

-Photon coupling

-Electronics

-Fiber optics

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