

## A Vertical Grating Coupler with High Efficiency and Broadband Operation

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**Abstract :** A Silicon-on-insulator (SOI) perfectly vertical fibre-to-chip grating coupler is proposed and designed based on engineered subwavelength structures. The high directionality of the coupler is achieved by implementing step gratings to realize asymmetric diffraction and by applying effective index variation with auxiliary ultra-subwavelength gratings. The proposed structure is numerically analysed by using two-dimensional Finite Difference Time Domain (2D FDTD) method and achieves 96% (-0.2 dB) coupling efficiency and 39 nm 1-dB bandwidth. This highly efficient GC is necessary for applications where coupling efficiency between the optical fibre and nanophotonics waveguide is critically important, for instance, experiments of the quantum photonics integrated circuits. Such efficient and broadband perfectly vertical grating couplers are also significantly advantageous in highly dense photonic packaging.

**Keywords :** diffraction grating, FDTD, grating couplers, nanophotonic

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