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Novel spot size converter for coupling standard single mode fibers to SOI waveguides

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Abstract

We have designed and numerically simulated a novel spot size converter for coupling standard single mode fibers with 10.4μm mode field diameter to 500nm × 220nm SOI waveguides. Simulations based on the eigenmode expansion method show a coupling loss of 0.4dB at 1550nm for the TE mode at perfect alignment. The alignment tolerance on the plane normal to the fiber axis is evaluated at ±2.2μm for ≤1dB excess loss, which is comparable to the alignment tolerance between two butt-coupled standard single mode fibers. The converter is based on a cross-like arrangement of SiO_xN_y waveguides immersed in a 12μm-thick SiO_2 cladding region deposited on top of the SOI chip. The waveguides are designed to collectively support a single degenerate mode for TE and TM polarizations. This guided mode features a large overlap to the LP01 mode of standard telecom fibers. Along the spot size converter length (450μm), the mode is first gradually confined in a single SiO_xN_y waveguide by tapering its width. Then, the mode is adiabatically coupled to a SOI waveguide underneath the structure through a SOI inverted taper. The shapes of SiO_xN_y and SOI tapers are optimized to minimize coupling loss and structure length, and to ensure adiabatic mode evolution along the structure, thus improving the design robustness to fabrication process errors. A tolerance analysis based on conservative microfabrication capabilities suggests that coupling loss penalty from fabrication errors can be maintained below 0.3dB. The proposed spot size converter is fully compliant to industry standard microfabrication processes available at INO.

Topics

Single mode fibers ; Waveguides ; Fabrication ; Microfabrication ; Simulations ; Indium oxide ; Cladding ;Telecommunications ; Tolerancing

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