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Design of a strip silicon waveguide and its optical characteristics

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Abstract

Due to the significant advancements in silicon photonics, this paper presents a design of a strip silicon waveguide using COMSOL software, and its optical characteristics are simulated. The results show that this waveguide has two propagating modes, Transverse Electric (TE) mode and one Transverse Magnetic (TM) mode. The electric field profiles for these modes are illustrated at specific wavelengths. In addition, the effective refractive index, waveguide dispersion, and effective mode area have been investigated. For the proposed structure, the effective refractive index of the TM mode is always greater than that of the TE mode. Both modes have a zero dispersion wavelength over the examined wavelength range, occurring around 2.5 μm for the TM mode and approximately 2.12 μm for the TE mode. Our findings show that the effective mode area of both modes is on the order of 0.1 μm^2 and does not increase much with increasing wavelength. Furthermore, the effective mode area for the TE mode first increases and then decreases. Finally, by utilizing the equations governing the supercontinuum generation process in silicon waveguides, this process is studied in the proposed waveguide. The simulation results indicate that, depending on the characteristics of the injected pulse, the output from the waveguide achieves a spectral broadening of one octave.

Keywords: Strip silicon waveguide, Dispersion, Electric field profile, Effective mode index, Effective mode area

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