SUBWAVELENGTH SILICON PHOTONICS

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Received 30 May 2011; accepted 7 June 2011.

Abstract

With the goal of developing photonic components that are compatible with silicon microelectronic integrated circuits, silicon photonics has been the subject of intense research activity [1]. Silicon is an excellent material for confining and manipulating light at the sub-micrometer scale. Silicon optoelectronic integrated devices have the potential to be miniaturized and mass-produced at affordable cost for many applications, including telecommunications, optical interconnects, medical screening, and biological and chemical sensing.

We review recent advances in silicon photonics research at the National Research Council Canada. A new type of optical waveguide is presented, exploiting subwavelength grating (SWG) effect. We demonstrate subwavelength grating waveguides made of silicon, including practical components operating at telecom wavelengths: input couplers, waveguide crossings and spectrometer chips [2-4]. SWG technique avoids loss and wavelength resonances due to diffraction effects and allows for single-mode operation with direct control of the mode confinement by changing the refractive index of a waveguide core over a range as broad as 1.6 – 3.5 simply by lithographic patterning. The light can be launched to these waveguides with a coupling loss as small as 0.5 dB and with minimal wavelength dependence, using coupling structures similar to that shown in Fig. 1. The subwavelength grating waveguides can cross each other with minimal loss and negligible crosstalk which allows massive photonic circuit connectivity to overcome the limits of electrical interconnects. These results suggest that the SWG waveguides could become key elements for future integrated photonic circuits.

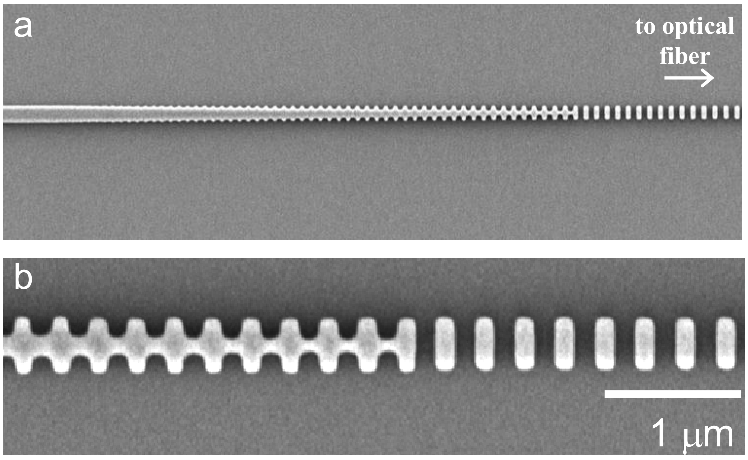

Fig.1: *Subwavelength grating fibre-chip coupler for silicon waveguides.*

References:

[1] P. Cheben, R. Soref, D. Lockwood and G. Reed, Editors, *Special Issue in Silicon Photonics,* in *Advances in Optical Technologies* (2008).

[2] P. Cheben et al.: *Optics Letters*, **35,** 2526 (2010).

[3] P. J. Bock et al.: *Optics Express*, **35,** 20251 (2010).

[4] J. H. Schmid et al.: *Optics and Photonics News, Special Issue Optics in 2010*, 24 (2010).

[5] A. Densmore et al.: *IEEE Photonics Technology Letters*, **18,** 2520 (2006).