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and
Department of Electronic Engineering
The Chinese University of Hong Kong

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Location : Rm 418, Ho Sin Hang Engineering Building,
The Chinese University of Hong Kong

Title: Silicon-based planar lightwave circuits
Speaker: Dr. Daoxin Dai,
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Abstract: Silicon-on-insulator (SOI) structures are highly promising for future low-cost planar lightwave circuits (PLCs) due to the excellent optical properties and the compatibility with silicon CMOS integrated circuit technology. In this talk some optimal designs and analyses for silicon waveguides, devices, and modules are presented. First, the characteristics of SOI rib waveguides and silicon nanowires, such as the bending loss and the birefringence, are analyzed by using a finite-difference method. An appropriately designed multimode bent waveguide for reducing effectively the bending loss of the fundamental mode is realized. The slab height and the rib width of an SOI rib waveguide are normalized with the total height of the silicon layer and a general relation between these two normalized parameters for a nonbirefringent SOI rib waveguide is established. Secondly, the issue of multimode effect in Si-based PLCs and devices such as arrayed-waveguide gratings (AWGs), etched diffraction gratings, and multimode interference couplers is discussed in detail. Two kinds of taper structures are proposed for reducing the multimode effects. Thirdly, two kinds of effective and accurate methods are developed for the simulation of an AWG demultiplexer. The first model is based on Kirchhoff-Huygens diffraction formula. To improve the computational speed, this model is reduced to a two-dimensional one effectively. Furthermore, a reciprocity theory is introduced for the optimal design of a special structure used for flattening the spectral response of an AWG demultiplexer. The second simulation method combines a beam propagation method and the Kirchhoff-Huygens diffraction formula, which improves the computational efficiency. Recently Si nano wires are very attractive for realizing high integration density. In this talk some analyses and designs on Si nano wires and devices are presented, such as bending losses, coupling lengths, etc. A bi-level taper is introduced to improve the coupling efficiency between a Si nano wire and a fiber. A novel layout for a nano AWG is also introduced. Finally two designs for silicon-based monolithic optical power, which includes 40-channel AWG (de)multiplexers and an array of photodetector. The first design consists of two AWG (de)multiplexer. The FPRs of these two AWGs are overlapped to reduce the chip size. For the second design, only one AWG is needed and a loopback path is used, which makes the chip more compact. This response of the Si-based photodetector is enhanced by using a Helium ion-implant.

Daoxin Dai was born in Jiangxi, China, in 1979. He received the B.Eng. degree in the department of optical engineering of Zhejiang University in 2000, and received his Ph.D degree in 2005 from the same department. Currently, he is working as a postdoctoral Fellow in the Chinese University of Hong Kong, and he will go to Zhejiang University as a research staff next year. His research activities are in the modeling and fabrication of planar lightwave circuits. Dr. Dai has first-authored about 15 international journal papers, and has been granted five patents on optical waveguide and devices. ddxopt@yahoo.com.cn

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*** ALL are welcome to attend ***