effective second order nonlinear polarization by maximizing the FF and SH mode overlap.

In a second part we show that the use of side-coupled integrated spaced sequence of resonators (SCISSOR) can lead to an adaptation of the Fresnel phase-matching to the case of highly confining waveguides. As it is the case for bulk media, this method allows resonant or not QPM. This property can be used to control the spectral bandwidth of the phase-matching curve.

Compact spectrometer modeling based on wavelength-scale stationary wave Fourier transform in integrated optic

A. Morand, G. Custillon, P. M. Benech, Minatec (France); E. P. Le Coarer, Univ. Joseph Fourier (France); G. Leblond, S. Blaize, Univ. de Technologie de Troyes (France)

Recently, a new generation of high-resolution ultra-compact spectrometers has been investigated in integrated optics. Its principle is to sample an interferogram obtained by a stationary waves in an optical waveguide with no moving components. Then a Fourier transform of this intensity pattern gives the spectral response of the optical source used. The sampling is obtained thanks to metallic nanowires set uppon the surface of the waveguide. Only a small part of the light, proportional to the light under the metallic element is scattered outside. Then this radiated part is detected on a camera through an optical objective. In this paper, this device is modelized using an Aperiodic Fourier Modal Method allowing to simulate a long SOI waveguide composed of very small metallic elements described by a complex refractive index. We demonstrate that it is possible to obtain the spectral response with this method. Instead of using a classical objective-camera set up, we also modelize an entire compact device composed of a linear photo-detector array above the waveguide separated by a peculiar gap. This gap is chosen in order to image the interferogram without damaging the initial interferogram. Spectral resolution close to 4 nm is obtained with 1 mm waveguide length. In each case, the interferogram is now undersampled. In order to detect the scattering of each point, the distance between each nanowire must be sufficient to respect the spatial resolution of the optical set-up or the pitch of the photo-detector array. Its effect on the Fourier transform will be discussed.

Study and simulation for the sharp-corner of silicon-on-insulator waveguides

D. Sun, T. Hall, Univ. of Ottawa (Canada)

Planar lightwave circuit (PLC) technology is widely accepted for manufacturing photonic components. Silicon-on-insulator (SOI) waveguides have attracted much research for implementing the highly integrated PLC-based devices. Newly developed state-of-the-art can make the transmission loss of silicon waveguides much lower (<0.01dB/cm) when waveguide size is around 1.5 mm, so it is feasible to manufacture photonic wires and highly integrated photonic chips. Like the electronic products, the photonic wires and sharp-curves/corners are two critic aspects for implementing the highly-integrated photonic devices. So far, however, there have not been many publications for these subjects though they are the entry steps for qualified highly integrated photonic products. In this work, starting with the guided-mode conversion process and principle of transportation waves, we propose three types of right corner mirrors of SOI waveguides with a waveguide reflecting interface (RI) and build the theoretical model of equivalent reflecting interface (ERI) with time domain. Then we simulate the conversion efficiencies with FDTD method and further testify the simulation results with commercial FDTD software tool. The device parameters used in simulation includes the refractive indices of silicon/silica of 3.45/1.45 and the refractive index of the optimal material for filling the corner mirror is 1.48. Finally, we analyze the simulation results and conclude that the conversion efficiency of a right corner is determined by several parameters including the geometrical structure, index-difference and side-wall roughness of waveguides, and the distance between the ERI and the practical RI. For the right-corner structure, the optimal conversion efficiency can be achieved more than 95%, namely the access loss is 0.22 dB, but for the angle of 120°, the access loss is less than 0.1 dB. For some important PLC components, the deflection angle of 120° is good for implementing compact design. Therefore, both the new structure of corner mirror and its ERI model are very conducive for the silicon highly integrated photonic devices.

6996-23, Session 5

Bending and transition losses and mode and polarization conversions in bent optical waveguides

A. B. M. Rahman, D. Leung, The City Univ. (United Kingdom); S. S. A. Obyaya, Univ. of Leeds (United Kingdom); K. T. V. Grattan, The City Univ. (United Kingdom)

Rigorous, full-vectorial and computationally efficient finite element-based modal solution, junction analysis and BPM approaches have been developed and used to study bending loss, transition loss and polarization conversion in a bent semiconductor optical waveguide. It has been shown that a reduction in the bending radius increases the modal loss and the associated transition loss also increases as the mode shape modifies significantly in a bent waveguide. Higher order modes are also generated at the junction interface and this causes mode beating and periodic variation of the spot-size along the curved waveguides. By introducing an appropriate offset and by using waveguides with unequal width, such a transition loss and associated mode beating can be reduced.

In a bent waveguide the non-dominant field component is relatively large compared to the same in a straight waveguide and its shape is also similar to that of the dominant field, so the overlap integral between two vector modal fields of the quasi-TE and TM modes is significantly higher. It is also shown that when the bending radius is reduced to design a compact PIC, the associated polarization conversion also increases significantly. On the other hand, by reducing the bending radius a polarization rotator can be designed but it is also shown here that such a device could lose a significant amount of the input power in the bend section, if not designed properly. By using several cascaded bent sections with periodic phase reversal, a low-loss polarization rotator may also be designed. Numerically simulated results for the bending loss, transition loss, mode beating, polarization conversion and offset optimization for compact bent designs will be reported.

6996-24, Session 6

Nested-ring Mach-Zehnder interferometer in silicon-on-insulator

S. Darmawan, L. Yosef Mario, Nanyang Technological Univ. (Singapore); P. Dumon, R. G. Baets, Univ. Gent (Belgium); M. Chin, Nanyang Technological Univ. (Singapore)

For the first time, we realized a novel device, namely a nested-ring Mach-Zehnder interferometer (NRMZI) on Silicon-on-insulator platform, based on deep UV lithography. The nested-ring (NRR) is realized by connecting the drop and through port of a dual-bus ring-resonator with a U-shaped waveguide. The key design parameters of NRR are: (1) The length of the U shaped connector and (2) the coupling coefficients (k) between the two loops. Incorporating the NRR into a balanced MZI can produce an interesting box-like spectral characteristic due to the double-Fano resonance induced by the split-resonances.

We show experimentally that the devices have two possible modes of operations depending on the ring-bus coupling coefficient (k): (1) When (k) is small, the inner-loop resonance dominates leading to drop-like, through-like, or asymmetric Fano- resonance output, depending on the offset phase arising from the MZI arm imbalance; (2) when (k) is relatively large, the outer loop resonance dominates giving rise to double Fano resonances and a box-like transmission profile with sharp roll-off. For the small-(k) case, the microring has a higher Q, hence the device is more sensitive to slight MZI arm imbalance as compared to the device with larger (k)(lower Q). This sensitivity to offset phase implies that it is desirable to have active bias control at the lower MZI arm (or in the NRR) in order to balance the MZI for better performance, or to tune the imbalance to achieve a variable output profile.

6996-25, Session 6

Broadband and highly efficient grating couplers for silicon-based horizontal slot waveguides

J. V. Galan-Conejos, P. Sanchis-Kilders, J. Blasco-Solves, J. Marti-Sendra, Univ. Politécnica de Valencia (Spain)

Optical nonlinear effects have been widely studied in III-V semiconductor photonics. However, nonlinear performance in silicon photonics is still inefficient. An alternative silicon-based waveguide configuration, which is known as slot waveguide, has been recently proposed to improve the nonlinear performance in a very efficient way. In the slot waveguide, the fundamental mode light is highly confined in a very small region, which is called slot, of a low index contrast material between

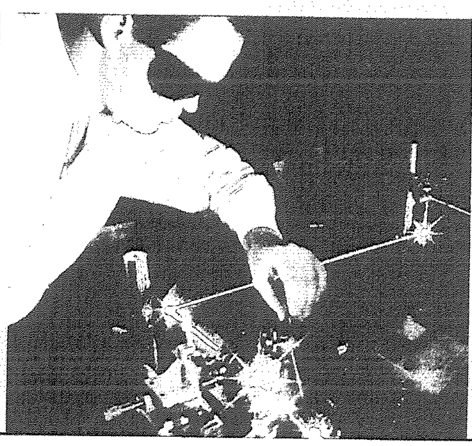
Technical Programme

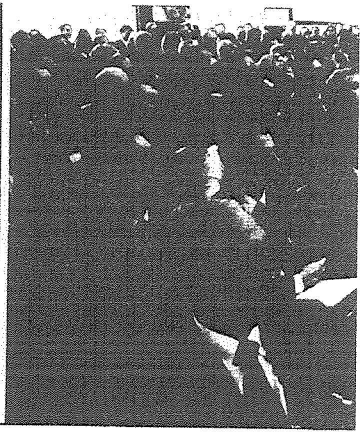
SPIE *Europe*

Photonics Europe

Conferences: 7–10 April 2008
Exhibition: 8–10 April 2008
Industry Perspectives Programme: 8–10 April 2008

Palais de la Musique et des Congrès
Strasbourg, France





SPIE *Europe*