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Glass Integrated Optics and Optical Fiber Devices: A Critical Review, edited by S. Iraj Najafi,
Proc. of SPIE Vol. 10275 (Vol. CR53), 1027501 · © (1994) 2017 SPIE
CCC code: 0277-786X/17/$18 · doi: 10.1117/12.2284730

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Preface

Two distinctly different types of guiding structures are used to make glass waveguide devices: optical fibers and integrated optical waveguides.

There has been remarkable progress in optical fiber devices. Optical fibers have been used to study and demonstrate a number of important phenomena such as optical amplification, soliton propagation, and pulse break-up. All-fiber devices have been produced using readily available optical fibers.

Glass integrated optics was rather slow starting, but outstanding progress has been achieved during the past decade or so. High performance integrated optical devices and circuits have been fabricated.[1-3]

Different techniques are used to make glass integrated optical devices. Ion-exchange is the most popular. This technique is simple and can be used to make reproducible and low-cost devices. Recently, a flame hydrolysis technique has attracted attention, probably because the resultant waveguides can be fused to optical fiber, which improves environmental stability of the chip and eliminates back reflection in the fiber-chip interface. Plasma deposition offers the possibility of doping waveguides to achieve nonlinear devices. The sol-gel method is flexible and can be used to make waveguides with different dopants (e.g., rare earths, semiconductors, photosensitive elements). It is also attractive for fabrication of hybrid circuits. Figure 1 depicts a hybrid 1.3 μm/1.55 μm amplifier/splitter.[2] Ion implantation also has been employed to make glass waveguides. In addition, we have used Ge implantation to make waveguides. A simple photoresist mask has been used to produce channel waveguides. However, the waveguides had rather high propagation losses. In addition, the fabrication process is very costly and is not suitable for device fabrication.

Accurate theoretical tools have been developed to design glass integrated optical devices.[4-6] New and complex devices have been proposed, analyzed, and demonstrated. In particular, waveguides with grating have attracted a lot of attention.[7,8] Figures 2 and 3 depict two examples of such devices. In Figure 2 we propose a new rare-earth-doped glass waveguide laser. The grating with variable width is used to diffract a symmetric laser beam perpendicular to the waveguide surface. In Figure 3 we suggest a narrow band wavelength division multi/demultiplexer.[9]

This critical review includes papers, authored by recognized experts, discussing optical fibers and the progress and future potential of glass integrated optical devices.

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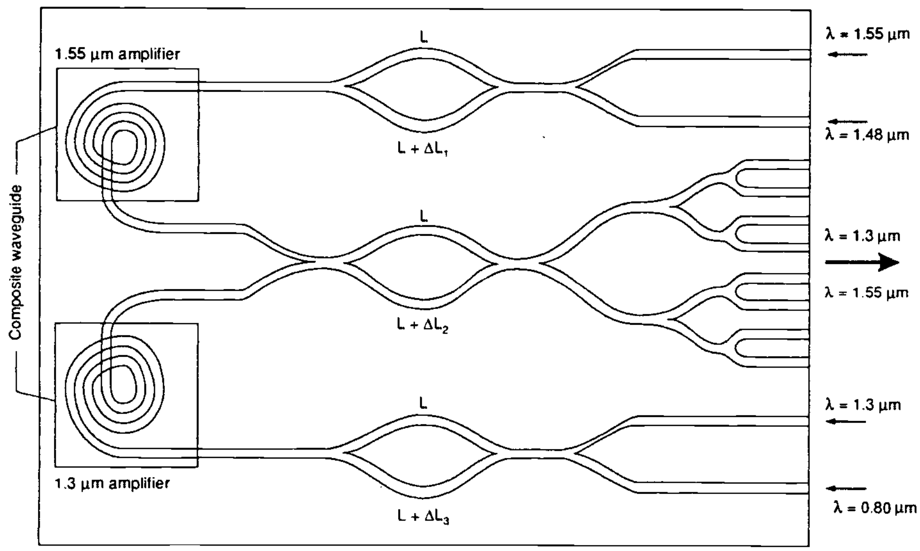

Fig. 1. 1.3 μm/1.55 μm glass integrated optical amplifier/splitter circuit.[2] The composite waveguides can be achieved using rare-earth-doped sol-gel glasses.

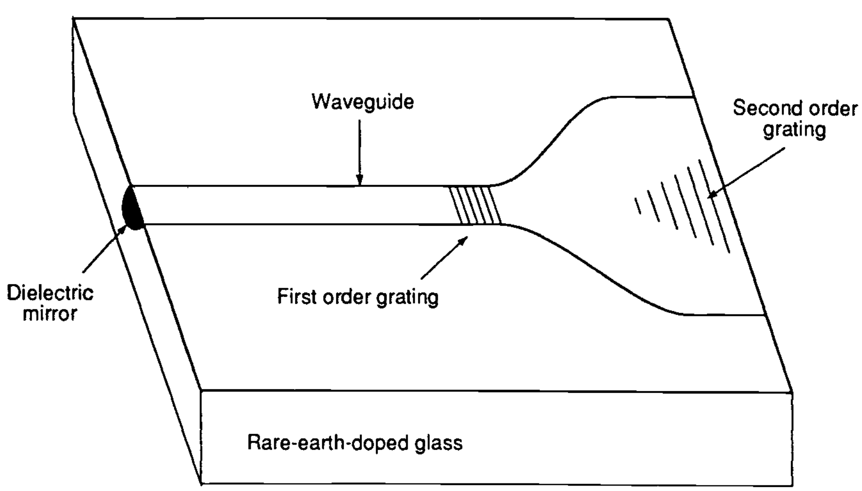

Fig. 2. Rare-earth-doped glass integrated optical symmetric beam surface emitting laser.

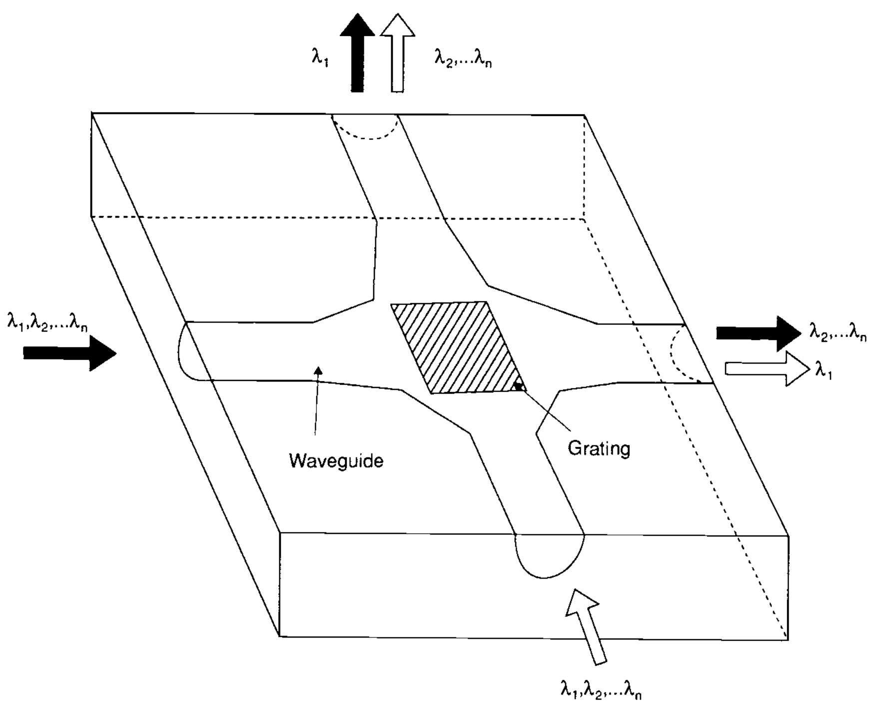

Fig. 3. Integrated optical narrow-band wavelength division multi/demultiplexer.[9]

References

1. S. I. Najafi, *Introduction to Glass Integrated Optics*, Artech House, Boston, 1992.
2. S. I. Najafi and Seppo Honkanen, "Gradient Index Optics," in *CRC Handbook of Photonics*, Editor: M. Gupta, in press.
3. S. Honkanen, A. Tervonen, and S. I. Najafi, "Passive integrated optical components for PONs," *invited paper*, Conf. on Europ. Fiber Optics Communications and Networks, June 1994.
4. Ionex software by Optonex Ltd.
5. P. Auger and S. I. Najafi, "New method to design directional coupler dual wavelength multi/demultiplexer with bends at both extremities," submitted for publication.
6. S. I. Najafi, S. Honkanen, and A. Tervonen, "Recent progress in glass integrated optical circuits," *invited paper*, Conf. on Integrated Optics and Microstructures (SPIE's Annual Meeting), San Diego, July 1994.

7. S. I. Najafi and M. Fallahi, "Circular grating lasers," *invited paper,* International Symposium on Integrated Optics, Lindau, April 1994.
8. S. I. Najafi, "Circular gratings and applications in integrated optics/optoelectronics," in *Nonlinear Optics for High Speed Electronics and Optical Frequency Conversion,* N. Peygambarian et al., Editors, Proc. SPIE 2145, pp. 46–57 (1994).
9. P. Lefebvre, S. I. Najafi, and M. Kavehrad, "Compact narrow-band integrated optical wavelength division multi/demultiplexer," submitted for publication.

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June 1994