GUEST EDITORIAL

MICRO-OPTICS FOR PHOTONIC NETWORKS

It is with great pleasure that I introduce this special section of JM^3 devoted to the subject of micro-optics for photonic networks. The *Journal of Microlithography, Microfabrication, and Microsystems* provides a forum for researchers to present the latest developments for micro-optical components and optical microsystems. Optical communications provide one area of application for these devices, and serves as the focal point for this special section of JM^3.

While the optical communications industry has undergone a serious downturn in recent times, there is little doubt that optics will play a growing role in the evolution and expansion of network technology. Optics already play a key role in long haul telecommunications, and have begun making serious inroads into shorter range networks. Micro-optical components and systems for very short reach (VSR) data communications, board-to-board, chip-to-chip, and even within-chip optical interconnections have also been demonstrated. These types of applications are driving the need for miniaturization, cost reduction, and increased performance for photonics modules. As the distance scale for optical communications shrinks, the required manufacturing volumes also rapidly increase. These factors necessitate the development and application of innovative, scaleable technologies for micro-optical fabrication and integration. For all of these reasons, this promises to be an exciting area for research and development for many years to come.

Realization of all of the devices and systems discussed in these papers depend heavily on techniques of microfabrication and integration that are a primary focus of JM^3. Photolithography, etching, deposition, and other wafer-level fabrication techniques are commonly used throughout the creation of these devices. However, while many of the core techniques are similar to those used for microelectronics manufacturing, some of the technical requirements can be quite different depending on the type of device. Material requirements are driven by optical considerations rather than electrical. Optical devices may require the creation of 'large' structures (such as for optical waveguides), 'small' structures (such as for photonic crystals), or a range of feature sizes in the same component (such as for diffractive optics). Similarly, the creation of binary, multi-level, or analog surface topographies may be required. In all cases, however, the accurate realization of the necessary device geometries is important for the performance of the device.

There are five papers in this special section. These papers cover various aspects of micro-optics for photonic networks, with topics ranging from optical waveguides to photonic crystals and free-space optical modules. Planar optical waveguides have emerged as a key technology for photonic devices and networks, providing a means for optical signal routing, splitting, and other functions. Research in the area of photonic c incredible range of applications of these devices for manipulating light. Free-space micro-optics, including diffractive and refractive devices, also provide many useful means for manipulating light in photonic networks.

One important issue in dense wavelength division multiplexing (DWDM) networks is the need to actively monitor the actual signals in the various optical channels in a compact, efficient, cost-effective manner. In the first paper, Thiele et al. report on an approach to solving this problem that integrates replicated grating couplers with optical waveguides for active monitoring of multiple DWDM optical channels.

As discussed earlier, photonic crystals provide an exciting research area for a wide range of optical applications. One use of these devices creates an optical analog to an electrical circuit for compact routing of optical signals. In the paper by Pustai et al., the authors present their work on the analysis and characterization of two-dimensional optical routing with photonic crystal directional couplers consisting of air holes in silicon. The case of three-dimensional optical signal routing is discussed by Sharkawy et al. through the implementation of optical vias for in-plane and out of plane coupling in three-dimensional photonic crystal optical networks.

Free space components represent another approach for implementation of optical functionality in photonic networks. In the paper by Glebov et al., the authors combine ideas from both guided-wave and free-space propagation in their work on the use of integrated microlens arrays in silica on silicon for DWDM applications. In the final paper of this special section, Lohokare et al. report on the hybrid integration of diffractive micro-optics with avalanche photodetectors for increased performance of optical receivers in free-space photonic networks.

I hope that you enjoy this collection of articles. Suggestions for improvements and new topical areas are welcomed.

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 1537-1646/2003/$15.00