Active and Passive Components for Optical Networks

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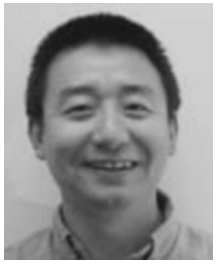
Optics has been behind various enabling technologies to cope with the ever-increasing bandwidth demands at internet backbone level. Dense-wavelength-division-multiplexing (DWDM) allows concurrent transmissions of many channels of wide bandwidth data through a single fiber. The success of erbium-doped fiber amplifiers (EDFA) pushes the data regeneration distance longer and longer. The emerging massively parallel optical switches are revolutionizing all-optical communication networks. We are witnessing an era of renaissance of optics due to the communication infrastructure upgrade frenzy. High speed optics, once so prohibitively expensive that only long-haul communications was feasible, is being applied to ever-shorter distances, penetrating from metro-area to access and intra-computer interconnect networks. Bulk free-space optics is being miniaturized and integrated to serve critical missions to keep the pace of bandwidth booms. At the same time, the pace of developing wider bandwidth and more cost-effective solutions to sustain the explosive growth of bandwidth presents huge challenges and opportunities for optical scientists and engineers.

We are choosing this forum to present a special section dedicated to Active and Passive Components for Optical Networks with one main objective: to update on some of the latest research and development results in these areas which are critically important to wide bandwidth optical networking applications. Innovative and affordable component concepts are the emphasis of the special section.

The organization of the presentation adopts the cluster format, grouping papers in similar areas together. The presentation sequence is as follows. An invited paper from Eldada kicks off the special section with an overview of recent advances in telecom and datacom optical component developments. The first cluster behind the overview devotes to transmitters, modulators and receivers. Here we showcase some of the latest research works. The first paper in the cluster, from Michalzik et al., discusses the applications of short-wavelength vertical-cavity-surface-emitting lasers. The emphasis of this work is in optical interconnect and local access networks where communications distances are short. The next paper, by Liu et al., deals mainly with the wide-bandwidth multiple quantum-well based modulators and photo-detectors. The last paper of the cluster, by Wang et al., shows research results in photo-detectors, too. However, its focus is on Si-based resonant-cavity-enhanced photo-detectors. The next cluster of the special section is devoted to optical network amplifiers with two papers presenting latest results. The first one, by Liu et al., is in the area of L-band EDFA's, and the second one, by Zhang et al., discusses about a new generation of narrow-band amplifier, called amplets aimed to applications of sub-system level optical power and dispersion management. The next cluster contains five papers in areas of filters and switches for DWDM-based network applications. First, Zhao et al. demonstrates a grating-based wavelength demultiplexer which can potentially address cost concerns of the DWDM components. Then, Popelek and Li show a multiple-purpose optical filter architecture that can be used for WDM-based add/drop and wavelength routing applications. Following that paper, Sun et al. discuss their innovative approach of using a polymeric electro-optic switch array suitable to planar light-wave integration to perform wide-band optical array switching. The next paper, by Ren et al., investigates experimentally dispersion compensation performance based on manipulating transmission properties of a fiber Bragg grating. Last but not least, Jeong and Lee show their theoretical analysis of a new type of fiber grating: liquid-crystal fiber grating for its suitability of fabricating long-period fiber gratings for dynamic gain flattening. The last cluster of the special section contains two papers dealing with radio-frequency (RF) oriented network applications. The first of the two, by Li et al., demonstrates a RF mixer based on a photodetector fabricated using a metal-semiconductor-metal structure. Such RF mixer is a critical component to optical RF networks using sub-carrier modulations. The second paper, by Shi et al. (also the last paper of the entire special section), discusses another mission—critical components in RF communications, a true-time-delay device.

The paper presents a survey of current as well as promising technologies to implement the desired time-delay functions.

Active and passive components will continue to play important roles of building future optical networks of all levels. We hope this special section will serve to stimulate research and development interests in related areas going forward.



Dr. Suning Tang holds a PhD degree of electrical engineering in optoelectronic interconnects from the University of Texas at Austin, Texas, 1994, a MSc degree of applied physics in fiber optics from the Weizmann Institute of Science, Israel, and a BSc degree of electrical engineering in laser devices from Nanjing Institute of Technology, China. Prior to joining Digilens as a photonic engineering director, Dr. Tang worked as the vice president of switching technology of the Lightwaves 2020, Inc., Santa Clara, California, in 2000. Dr. Tang had been the co-founder and the chief scientist of the Radiant Research, Inc., Austin, Texas, from 1995 to 2000. He had worked for Crystal Semiconductors (Cirrus Logic) and Advanced Photonics Technologies from 1991 to 1995. Dr. Tang's research in polymer-based optoelectronic interconnects was selected by ''Optics & Photonics News'' as one of the principal advances in the field of optics over 1994. His work in the past 15 years includes optical interconnects, WDM devices, fiber optic devices, optical modulators/switches, optical control of microwave signals, and semiconductor photonic devices. He was the principal investigator for more than 25 awarded research programs sponsored by Department of Defense and private industries during the period of 1996–2000. Dr. Tang has served as a conference chairman for many international conferences in the area of optoelectronic interconnects and fiber-optic communications. He was member of executive organizing committee of Photonics West 2001. Dr. Tang has over 100 publications in refereed journals and conferences, and several patents. Dr. Tang is a member of SPIE, OSA and IEEE.

Yao Li received the BE degree in instrumentation engineering from the Beijing Polytechnic University, Beijing, China, in 1982. He received his MS and PhD degrees in electrical engineering from the City College of New York (CUNY) in 1984 and 1987, respectively. From 1987 to 1992, he was first an assistant professor and later a tenured associate professor of electrical engineering at CCNY. He spent eight years at the NEC Research Institute, Princeton, New Jersey as a research scientist and lab director, working on enabling technologies for optical information procession and optical interconnections. Since August of 2000, he has been with Phaethon Communications, Fremont, California, developing critical optical technologies and components for the next generation DWDM fiber optic networks. He is the author or coauthor of more than 100 refereed journal papers and numerous conference papers. He has received 18 U.S. patents with others pending. Dr. Li is a fellow of SPIE and OSA, and a senior member of IEEE.