Introduction to the Issue on Optical Modulators—Technologies and Applications

WE ARE pleased to introduce the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS (JSTQE) Issue on Optical Modulators—Technologies and Applications. The last decade has seen a convergence of photonics, computing, and interconnect technology, and the optical modulator has been central to these developments. In particular silicon photonics-based devices have emerged as a leading candidate for many short-reach applications, but they do not yet compete for some more traditional applications such as long-haul communications, or applications for deposited photonic circuit technologies. Consequentially, the evolution of optical modulators is fascinating, and the relative performance of devices fabricated in different technologies, as well as the cost of these solutions, will determine the dominance or otherwise of a given technology in a given application area.

This issue focuses on recent work on modulators fabricated primarily in silicon, lithium niobate, III–V semiconductors, and polymers, and includes fundamental device work to parametric optimization for specific applications. This issue contains 24 papers, including 10 invited and 14 contributed papers, authored by some of the leading research scientists in the world. The papers cover the broad scope of research representative of this rapidly evolving field.

1) *Silicon photonics* In these papers, the operation, analysis, and performance of silicon-based modulators are discussed. The typical performance parameters of interest are modulation bandwidth, ease of fabrication, energy consumption (Joules per bit), cost, ease of integration, and scalability. Silicon photonics devices have emerged as the leading candidates for short-reach interconnect, including intrachip devices, but are also considered as a leading candidate for mass markets such as fiber to the home, lab on a chip, and consumer device interconnects.
2) *Lithium niobate* The technology, which is involved in the fabrication of lithium niobate modulators, is already mature, and such devices are widely implemented in optical telecommunications networks and elsewhere. This is reflected in the contributions to this issue where, with the exception of the discussion of using ferroelectric domain engineering in the performance enhancement of lithium niobate integrated optical devices, the majority of papers are relevant to smart use of lithium niobate modulators in optical signal processing applications.
3) *III–V semiconductors* These semiconductors provide a basis for compact and efficient modulators with very high performance to be realized, as well as facilitating monolithic integration with other photonic functions to create high-functionality optical circuits. With high-volume production already well established, current research continues to expand the capabilities of III–V platforms and offers exciting prospects for the future. Papers published in this issue provide insights into the design, fabrication, and performance characteristics of modulators and photonic integrated circuits based on GaAs and InP, thereby providing a reference for the present state of the art, as well as addressing specific applications in the telecommunications and microwave photonics fields.
4) *Polymer-based modulators* Polymers have long held the promise for modulator technology of increased speed and reduced power consumption. The past several years have seen significant advances in using polymers for modulator, interconnect, and signal processing applications. The papers on this issue deal with many different challenges, including fabrication in a hybrid material system, different types of optical wave modulation, material robustness, photonic integrated circuits, and optical interconnect demonstrations.

We hope you will find that this JSTQE issue on optical modulators stimulating, exciting, and a useful reference text. Furthermore, we believe that this issue will serve as a benchmark for the technology, and will stimulate further advances in this rapidly growing field.

ACKNOWLEDGMENT

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GRAHAM REED, *Primary Guest Editor*
Optoelectronic Research Centre
University of Southampton
Southampton, Hampshire, SO17 1BJ, U.K.

SAKELLARIS MAILIS, *Guest Editor*
Optoelectronic Research Centre
University of Southampton
Southampton, SO17 1 BJ, U.K.

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MICHAEL J. WALE, *Guest Editor*
Oclaro Technology Limited
Towcester, Northamptonshire, NN12 8EQ, U.K.

ALAN WILLNER, *Guest Editor*
Ming Hsieh Department of Electrical Engineering
University of Southern California
Los Angeles, CA 90089-2565, USA

Graham Reed received B.Sc. and Ph.D. degrees from the University of Surrey, Guildford, U.K., in 1983 and 1987, respectively.

He is a Professor of Silicon Photonics at the University of Southampton, Southampton, U.K. In April 2012, he joined Southampton from the University of Surrey, where he was a Professor of Optoelectronics, and the Head of the Department of Electronic Engineering from 2006 to 2012. He is a pioneer in the field of silicon photonics, and acknowledged for initiating this research field in the U.K. He established his Silicon Photonics Research Group in 1989. The first Silicon Photonics company in the world, Bookham Technology (now Oclaro), was founded by Reed's Ph.D. student, Dr. A. Rickman, and adopted the research developed in Reed's Group. The Group has provided a series of world leading results, and are particularly well known for their work on silicon optical modulators. They have developed efficient modulators for low-power transceiver applications, as well as reporting the first device operating at 50 Gb/s, and have pioneered numerous other silicon photonics devices and processes, such as novel multiplexers, couplers, carrier lifetime modification, and slow light structures. He has published more than 300 papers.

Dr. Reed is a regular invited speaker at the major conferences around the world. He has served on numerous international conference committees, has also chaired many others. He is a Chartered Enginer. He is a Fellow of the institution of Engineering and Technology.

Sakellaris Mailis received the Ph.D. degree in optical signal processing with photorefractive materials from the Foundation for Research and Technology Hellas, University of Crete, Crete, Greece, where he studied physics.

He is a Principal Research Fellow at the Optoelectronics Research Centre (ORC), University of Southampton. His research interests include the areas of nonlinear and integrated optics, laser-processing of materials, and in particular ferroelectric domain engineering, where he has contributed numerous scientific publications. At the ORC he is leading the Lthium Niobate Group where he has pioneered research on laser-assisted processes for ferroelectric domain engineering, microstructuring, and fabrication of optical waveguides.

Michael Wale (M'92) Mike received the B.A., M.A., and D.Phil. degrees in physics from the University of Oxford, Oxford, U.K.

He is the Director or Active Products Research at Oclaro, based at Caswell, Northamptonshire, U.K. Since moving into industry in the early 1980s, he has been involved in many different aspects of research, development, and manufacturing of photonic devices and systems, with particular emphasis on photonic integrated circuit technology. Alongside his role at Oclaro, where he has responsibility for strategic technology activities, he is a Professor of Photonic Integration/Industrial Aspects, Eindhoven University of Technology, The Netherlands and an Honorary Professor at the University of Nottingham, Nottingham, U.K.

Dr. Wale is a member of the Executive Board of the European Technology Platform, Photonics21, and the Chairman of its Working Group on Design and Manufacturing of Optical Components and Systems. He is a member of the Optical Society of America and is the author/coauthor of approximately 150 publications.

Alan E. Willner (F'04) received the B.A. degree in physics from Yeshiva University, New York, NY, USA, in 1982, and the Ph.D. degree in electrical engineering from Columbia University, New York, in 1988. He received an Honorary Degree (*Honoris Causa*) from Yeshiva University in 2012.

He was at AT&T Bell Labs and Bellcore, and is currently the Steven and Kathryn Sample Chair in Engineering at the University of Southern California, Los Angeles, CA, USA. He has coauthored more than 1000 publications, including one book, six edited books, and 24 patents.

Dr. Willner is an International Fellow of the U.K. Royal Academy of Engineering and a Fellow of the American Association for the Advancement of Science, the Optical Society of America, and The International Society for Optics and Photonics. His professional activities include Cochair of the U.S. National Academies Study on Optics and Photonics, President of the IEEE Photonics Society, Editor-in-Chief of the IEEE/OSA JOURNAL OF LIGHTWAVE TECHNOLOGY, Editor-in-Chief of *OSA Optics Letters*, Editor-in-Chief of the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, Cochair of the OSA Science and Engineering Council, General Cochair of the Conference on Lasers and Electro-Optics (CLEO), Chair of the IEEE TAB Ethics and Conflict Resolution Committee, the General Chair of the IEEE Photonics Society Annual Meeting, and Program Cochair of the OSA Annual Meeting. He received the National Science Foundation (NSF) Presidential Faculty Fellows Award from the White House, IEEE Eric Sumner Award, Guggenheim Foundation Fellowship, Packard Foundation Fellowship, NSF National Young Investigator Award, Fulbright Foundation Senior Scholars Award, OSA Forman Engineering Excellence Award, IEEE Photonics Society Engineering Achievement Award, IEEE Photonics Society Distinguished Traveling Lecturer Award, SPIE President's Award, OSA Leadership Award, USC University-Wide Associates Award for Creativity in Research, and Eddy Award from Pennwell for Best Contributed Technical Article.