Introduction to the Issue on Microoptoelectromechanical Systems (MOEMS)

THIS ISSUE of IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS (IEEE JSTQE) summarizes the state-of-the-art advances in the emerging field of microoptoelectromechanical systems (MOEMS or optical MEMS). MOEMS generally refers to the optical and optoelectronic systems that include one or more micromechanical elements. In contrast to conventional optomechanical systems that employ bulk mechanical parts, the micromechanical elements in MOEMS are batch fabricated by the micromachining [also known as microelectromechanical systems (MEMS)] techniques. They are smaller, lighter, faster, and cheaper than their bulk counterparts, and can often be monolithically integrated with the optical components.

The ability to integrate moveable optomechanical parts and microactuators has opened up many new opportunities for optoelectronic systems. A small displacement (or rotation) can produce a large effect in optical systems. With MOEMS, sophisticated optomechanical devices can now be integrated on a single chip of silicon. Their applications include telecommunication, display, scanning, data storage, signal processing, and sensing. This issue explores various issues of MOEMS, including advances in devices, processing and integration technologies, system design, packaging, and modeling. The fabrication technologies reported in this issue encompass surface-micromachining and bulk-micromachining processes on semiconductor (both silicon and III–V) substrates as well as optical fibers.

The topics covered in this issue are organized into six sections: free-space optical switches, waveguide and fiber-optic switches, optical scanners, micromirror array devices, optical sensors, and packaging and modeling for MOEMS. The free-space switch usually employs microactuated moveable mirrors to reflect or steer input optical beams. In this issue, Lin *et al.* present a surface-micromachined matrix optical switch with electrostatic actuation. The scalability of the MEMS matrix switch for large-scale networks is also analyzed theoretically. An electromagnetically actuated MEMS switch with latching capability is reported by Toshiyoshi *et al*. Giles *et al.* report a continuously variable attenuator based on a MEMS reflection optical gate. Yasseen *et al.* report a 1×8 rotary optical switch driven by electrostatic micromotor. Monolithic integration of a MEMS modulator with a photodiode is also reported (Waters *et al.*).

The guided-wave MEMS optical switch usually comprises a moveable waveguide or optical fiber. Two papers in this issue discuss 1×2 switches with moveable fibers: Nagaoka reports a 1×2 switch with magnetic actuation and latching, and Hoffmann *et al*. use thermal actuators to move a fiber between two V-grooves. Two papers in this issue report on evanescently coupled MEMS waveguide switches: Chollet *et al.* demonstrate a 2×2 switch with variable gap between waveguides, and Veldhuis *et al.* describe an ON/OFF switch by replacing one waveguide with absorbing element. Two types of optical scanners are reported in this issue: Hagelin and Solgaard present a surface-micromachined polysilicon mirrors for display applications (102 by 119 pixels demonstrated), and Yaseen *et al.* report a diffraction grating scanner powered by a polysilicon micromotors.

A micromirror array is a unique device enabled by the MOEMS technology. It has applications in display, adaptive optics, and spectral analysis. Two papers in this issue address the adaptive optics applications: Bifano *et al.* report a deformable mirror device, and Cowan *et al.* present a segmented mirrors, both are made by surface-micromachining technology. Lim *et al.* report a new micromirror array with vertical spring for display applications. A Hadamard transform spectrometer employing a linear micromirror array as a switchable entrance mask is reported by Diehl *et al.* In the area of optical sensors, Le Dantec *et al.* report a tunable filter based on InP–air microcavities, and Tohyama *et al.* describe a fiber-optic tactile sensor. The packaging of MOEMS devices is discussed by Oh *et al.*, and the modeling of MOEMS waveguide devices is reported by Khalil *et al.*

This is the first Special Issue on MOEMS in IEEE JSTQE. We hope this issue will provide the readers with an overview of the MOEMS technology as well as detailed reports of the technical advances. Lastly, we would like to thank all the authors for contributing to this issue and the reviewers for setting a high standard for the papers and bringing this issue to press on time.

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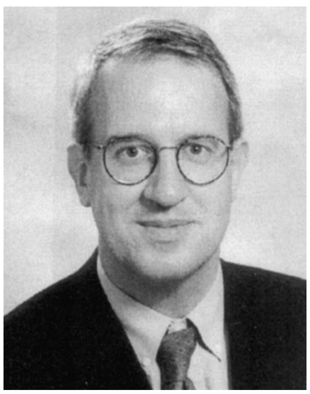

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