



BILKENT UNIVERSITY

unam - INSTITUTE of MATERIALS SCIENCE & NANOTECHNOLOGY

FACULTY OF SCIENCE

**MATERIALS SCIENCE and NANOTECHNOLOGY
GRADUATE PROGRAM SEMINAR**

**“Silicon Nanowire Waveguide Optical Switch Using
Physical Contact”**

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Utilization of optical fiber over long distances for geographically dispersed users and applications have increased the need for better optical telecommunication devices. Optical switches are the primary components for realization of switch networks in the telecom field such as add-drop multiplexers, cross connects, and others. A novel submicron silicon waveguide optical switch using physical contact will be mentioned in this seminar. The switch is composed of an identical input and output waveguides, and a movable waveguide driven by a miniature electrostatic comb actuator. The movable waveguide closes the gap between input and output waveguides. Due to physical contact of silicon nanowire waveguides, light propagates from input waveguide to output waveguide through the movable waveguide. Optical property of the switch is studied by three dimensional Finite-Difference Time-Domain (FDTD) Analysis. Fabrication platform for the switch was silicon-on-insulator wafer for monolithic device integration. Electron beam lithography and Fast Atom-Beam (FAB) dry etching were utilized in the nanofabrication of sensitive switch region. The switch was compact, about $40 \times 60 \mu\text{m}^2$ in-size, and performed medium speed, 109 kHz specifically, high extinction ratio, 15 dB with an opt up to 40 to 50 dB with larger actuation strokes, and wavelength-independent property. The concept of optical switching on the nanowire waveguides in the field of silicon photonics in particular, nano-realm in general, is still novel and promising for future optical switching at telecommunication wavelengths and sensing applications in the Evanescent Wave Region (EWR), corresponding to submicron distances about the waveguides.

Dr. Bulgan received Bachelor of Science in Mechanical Engineering from Istanbul Technical University, Istanbul, Turkey in 1996. During his master’s study at the University of Wisconsin-Madison, WI, USA, between 1997 and 1999, he has developed a multi-tier client/server architecture to enable the Internet-based Computer Aided Design (CAD), which later lead to the establishment of a start-up called “inter3d.com LLC.” Between 2001 and 2005, he served as a lecturer in the Department of Mechanical Engineering at Izmir Institute of Technology, Urla, Turkey. He received the doctoral degree as a Japanese Government Fellow, in the Department of Nanomechanics, Tohoku University, Japan in 2008. In his doctoral study, Dr. Bulgan has introduced a NEMS-actuated optical switch using physical contact of silicon nanowire waveguides. Currently, Dr. Bulgan is an assistant professor at the Mechanical Engineering Department, Ozyegin University, Istanbul. His current research interests lie in Optical Microelectromechanical Systems (Optical MEMS), Silicon Nanophotonics for Optical Switching and Near-Field Displacement Sensing, and MEMS-Embedded Computer-Integrated-Manufacturing.

Date : October 8, 2010 (Friday)

Time : 15:40

Place : Faculty of Science Building, A Block, Seminar Room (SA 240)

Tea will be served after the seminar