RESNICK INSTITUTE
science + energy + sustainability

LIGHT-MATERIAL INTERACTIONS IN ENERGY CONVERSION
DOE Energy Frontier Research Center
California Institute of Technology
Lawrence Berkeley National Laboratory
University of Illinois at Urbana-Champaign

RESNICK INSTITUTE + LMI-EFRC SEMINAR

John E. Bowers , Ph.D.
Director
Institute for Energy Efficiency
Univ. of California Santa Barbara
Kavli Chair in Nanotechnology

John E. Bowers

Low Power Hybrid Silicon Sources and Low Loss Silica Waveguides for Optical Interconnects

Energy efficiency is important for communications and interconnects. Data centers consume about 2% of the overall electricity worldwide, with about 20% of this power spent on interconnects. A more energy efficient solution for interconnects is needed. Optics and photonic integration offer a promising alternative to electronic interconnects due to superior speed and large parallelism and hence potentially vastly reduced energy consumption. Silicon-on-insulator (SOI) based photonics is an attractive technology for interconnect applications due to its compatibility with CMOS electronics and with the CMOS fabrication infrastructure, which is vastly more standardized and mature than any other photonic technology. This allows for cost-effective and ubiquitous implementation of such technology. The indirect bandgap of silicon and silicon-compatible materials like germanium does not allow for efficient optical sources and hence the integration of III/V based materials, such as indium-phosphide, is necessary to meet the required energy footprint. I will review recent work on single-frequency lasers and high speed modulators realized in the hybrid silicon platform. In this platform III/V epitaxial layer-stacks are transferred to an SOI photonic circuit by means of wafer bonding. Hereafter the active elements are lithographically defined. Arrays of single-frequency lasers enable high-capacity wavelength-division multiplexed interconnects.

I will also describe our progress toward fiber-like losses with a planar silica waveguide technology. By using thin (40 nm) silicon nitride on silica waveguide technology, we have demonstrated low loss of 0.045 dB/m, which makes it feasible to put hundreds of nano-seconds of delay and planar resonator structures with quality factors greater than 30 million on a chip. By grouping these structures with the passive and active building blocks of a planar integration platform, complex photonic integrated circuits can be fabricated on a silicon substrate.

CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

THURSDAY MAY 10, 2012 3:00 - 4:00 p.m.

101 Guggenheim Lab, Lees-Kubota Hall

Refreshments at 2:45 in the lobby

resnick.caltech.edu + lmi.caltech.edu

RESNICKINSTITUTE
science + energy + sustainability

LIGHT-MATERIAL INTERACTIONS IN ENERGY CONVERSION
DOE Energy Frontier Research Center
California Institute of Technology
Lawrence Berkeley National Laboratory
University of Illinois at Urbana-Champaign

RESNICK INSTITUTE + LMI-EFRC SEMINAR

John E. Bowers , Ph.D.
Director
Institute for Energy Efficiency
Univ. of California Santa Barbara
Kavli Chair in Nanotechnology

John E. Bowers

Biography

John Bowers holds the Fred Kavli Chair in Nanotechnology, and is the Director of the Institute for Energy Efficiency and a Professor in the Departments of Electrical and Computer Engineering and Materials at UCSB. He is a cofounder of Aurrion, Aerius Photonics and Calient Networks. Dr. Bowers received his M.S. and Ph.D. degrees from Stanford University and worked for AT&T Bell Laboratories and Honeywell before joining UC Santa Barbara. Dr. Bowers is a member of the National Academy of Engineering, a fellow of the IEEE, OSA and the American Physical Society. He is a recipient of the OSA Tyndall Award, the OSA Holonyak Prize, the IEEE LEOS William Streifer Award and the South Coast Business and Technology Entrepreneur of the Year Award. He and coworkers received the EE Times Annual Creativity in Electronics (ACE) Award for Most Promising Technology for the hybrid silicon laser in 2007.

CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

THURSDAY MAY 10, 2012 3:00 - 4:00 p.m.
101 Guggenheim Lab, Lees-Kubota Hall
Refreshments at 2:45 in the lobby

resnick.caltech.edu + lmi.caltech.edu