2017 AIM Summer Academy

Fundamentals of Integrated Photonics: Principles, Practice and Applications

MIT, July 24-28, 2017

AIM Summer Academy teaches the design fundamentals for integrated photonics from three distinct perspectives: device physics, circuit layout, and manufacturing variation. The program offers a holistic methodology for conceptualizing a photonic integrated circuit (PIC) for a systems application, and plan a circuit design that closely references the standardized process design kits used in current chip fabrication process flows. The program is arranged for participants with no prerequisite expertise in photonics theory or practice, while challenging them to readily engage, at a conceptual level, with an application-specific circuit design that tackles leading edge manufacturing and application challenges. The curriculum is distributed over a four-day period, with an optional closure at the 3-day milestone.

Day 1 of Summer Academy introduces attendees to the scaling drivers that are accelerating the adoption of PICs for four diverse applications, and the fundamentals of materials, optical properties, waveguides and system performance budgets. The day concludes with a review of the passive devices necessary for building a PIC transceiver. Day 2 continues this device introduction with an in-depth study of the modulator and detector for a transceiver; on-chip light source solutions will be briefly surveyed. The day concludes with a detailed description of the process flow for manufacturing a multi-layer PIC comprised of a heterogeneous set of materials with disparate thermal, mechanical, optical, and electrical properties. Day 3 formally introduces the Process Design Kit (PDK) as an enabling new methodology for fabless manufacture of a PIC, and how compact modeling of a Mach-Zehnder Interferometer versus a ring modulator reveal diverging device performance metrics, that are well-suited to different PIC applications. The description of devices is reconceived from static elements into dynamic components—comprised of both an optical layer and electrical layer for real-time feedback control. Day 4 addresses the fabrication constraints of foundry facilities that follow this device design and process flow, by describing a manufacturing methodology that incorporates design variation assessment into the PDK, and by describing control Statistical Process Control implementation for high yield manufacturing.

Two laboratory demonstrations present introductory insights into the test and packaging tools and process flows for high volume manufacturing of PIC chips. Invited representatives from five major Electronic-Photonics Design Automation (EPDA) vendors will offer targeted demonstrations on Days 1-4 that model the device, circuit, and manufacturing principles taught during lecture sessions. Throughout the week, attendees incorporate their daily insights into the conceptual design of an application-specific PIC, and present their team's analyses and solutions on Day 5.

AIM Summer Academy is gateway course that prepares attendees for taking subsequent in-depth online learning modules. A two-sequence edX course on PIC design for test in collaboration with the AIM Photonics 300mm MPW facility in Albany, NY will launch in early 2018. Attendees will also be prepared for engagement with the AIM Photonics Package, Assembly and Test facility in Rochester, NY.