

Short Course Description

Course Title

Photonic Integrated Circuits

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Photonic Integrated Circuits (PICs) are optical chips that contain a number of distinct optical components interconnected by monolithically integrated optical pathways. PICs have emerged as a critical technology for optical communications subsystems to achieve increasingly aggressive targets in density and cost. By replacing the meticulously-aligned fiber connections between individually-packaged optical components with highly efficient and stable lithographically-produced waveguide connections, PICs offer the potential for dramatic improvements in cost, size, power, and reliability.

The materials of choice for PICs have historically been InP and associated epitaxially-grown III-V compounds, which offer an uncompromised suite of high-performance lasers, detectors, modulators, amplifiers, low-loss waveguides and filter functions based upon resonators, multi-path interference, and gratings. More recently, Si has also emerged as an attractive candidate for a number of key active and passive functions, offering both the sophistication and precision of CMOS process technology and the lure of integration with CMOS electronics.

This course will review the key design issues of both InP and Si PICs, focusing on the optimization of passive and active guided wave components, fabrication methods for achieving compatibility with minimum process steps, and challenges associated with different materials and process requirements in the InP and Si materials systems.

The course will richly illustrate PIC performance with examples drawn from the research literature, as well as today's commercially deployed PIC's ranging from relatively simple integrated laser-modulator devices to highly complex fully-integrated wavelength-division-multiplexed transmit and receive subsystems. It will also examine the significant body of PIC research exploring additional functionality in the all-optical domain.

Benefits and Learning Objectives

This course should enable participants to:

- Compare the merits of PICs to conventional discrete solutions and identify where PICs may be warranted.

- Explain the different design approaches and fabrication challenges for PICs.
- Describe the relative benefits and limitations of PICs in the InP and Si systems.
- Discuss and summarize the state of the art and future trends in photonic integration technology.

Intended Audience

This course is intended for practicing engineers, students, managers, and investors interested in learning more about photonic integration technology. Some familiarity with optical communications is desirable, but this course should be understandable by anyone with an undergraduate background in electrical engineering, physics, or materials science.

Instructor Biography

Thomas Koch is a joint Professor of ECE and Physics at Lehigh University, and holds the endowed chair of Director, Center for Optical Technologies. He previously held vice president positions at SDL, Lucent, and Agere Systems, and is widely known for his extensive contributions to photonic integrated circuit technologies. He has received the IEEE Eric E. Sumner Award, the IEEE LEOS Distinguished Lecturer and William Streifer Scientific Achievement Awards, is a Fellow of Bell Labs, the OSA, and the IEEE, and a member of the National Academy of Engineering.

