中国科学院半导体研究所

黄昆半导体科学技术论坛

第 398 期讲座

报告题目： Heterogeneous Integration of III–V modulators into Silicon Photonics

报 告 人： Frank Peters (University College Cork)

个人简介： Frank Peters is a professor in the School of Physics at University College Cork, Ireland. He is also the head of the Integrated Photonics group at the Tyndall National Institute, which is part of the Irish Photonic Integration Centre (I-PIC). He completed a Ph.D. from McMaster University in 1991. From 1991-1993, he was a Research Engineer in the ECE Department at the University of California, Santa Barbara working on Vertical Cavity Lasers and optical modulators. Between 1993 until 2001 he worked as a Research Scientist at W. L. Gore and Associates and Agilent Technologies developing and integrating photonic devices into datacom and telecom applications. From 2001-2005 Frank worked at Infinera in the development of high speed photonic integrated circuits, and then moved to Ireland in 2005.

Frank has authored more than 300 papers and holds over 50 patents all concerned with thermal, optical, electrical and systems issues relating to the design and use of photonic devices and high speed photonic integrated circuits. He has been part of three start-ups and received the SFI Industry Partnership Award 2023 for IPIC’s partnership with Rockley Photonics. His primary research interests are in using interesting physics to solve photonics problems in the following areas: Photonics Integrated Circuits (PICs); Monolithic and Hybrid Integration; High Speed Photonic Devices; Physics of Optical Waveguides; Semiconductor Lasers; Planar Optical Devices; Computational Modelling; Photonics Systems; Implementation of advanced modulation schemes in PICs; Automation and characterisation of Photonic Devices.

报告摘要： Silicon based photonic integrated circuits (PICs) have revolutionized the foundational technologies used in high-speed optical communications, largely displacing the earlier III-V based transceivers PICs. The worldwide communication network continues to grow due to increasing requirements of datacenters, artificial intelligence, and other existing and emerging technologies. Looking into the future, there is a need for improved optical modulators that can work with silicon photonics, which are superior to existing modulators made from group IV semiconductors [1].

Numerous options for integrating alternate materials into silicon photonics have been demonstrated and are being explored. These options include two main types of materials, electro-optic and III-V, as well as different integration methods. Electro-optic materials have been preferred as they enable advanced modulation formats (e.g. QAM) using Mach Zehnder modulators. This topic will focus on a lesser explored, alternative option; the integration of high-speed III-V based optical modulators into silicon photonics using micro transfer printing (MTP) [2]. The topic will cover two main areas. First, the challenges of achieving high-speed using MTP will be addressed, and second there will be a discussion on efficiently generating advanced modulation formats using the MTP technologies.

[1]Shekhar, S., Bogaerts, W., Chrostowski, L. et al. Roadmapping the next generation of silicon photonics. Nat Commun 15, 751 (2024). https://doi.org/10.1038/s41467-024-44750-0

[2] J.Zhang, et al. "III-V-on-Si photonic integrated circuits realized using micro-transfer-printing." APL Photonics 4, 110803 (2019): 529-533. https://doi.org/10.1063/1.5120004

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