

Silicon Photonics Research Centre of Excellence @IIT Madras

Bijoy Krishna Das

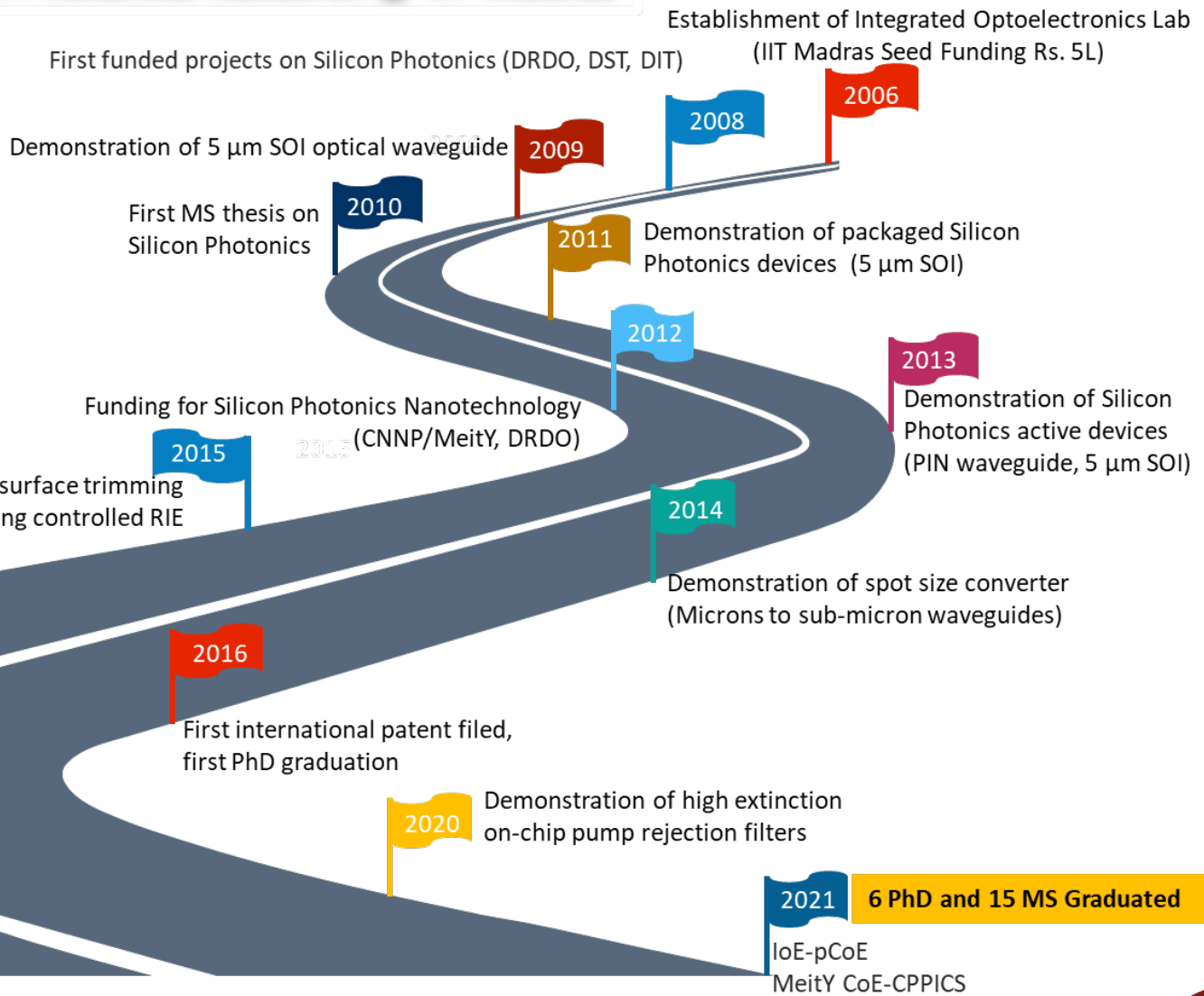
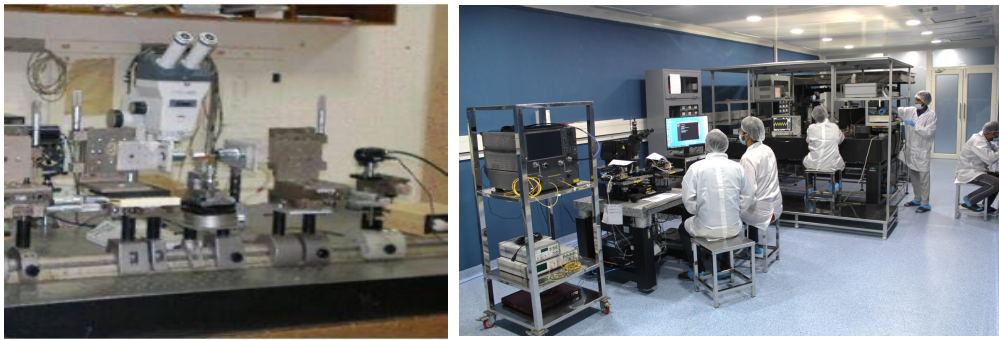
Professor, Department of Electrical Engineering

IIT Madras, Chennai 600036, India

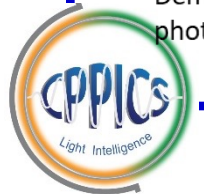


18 Years of Silicon Photonics Research @ IIT Madras

2006 → 2024



Status in 2024: 4 Research Associates, 15 PhD and 5 PG Research Scholars and 7 Project Staff



18 Years of Silicon Photonics Research @ IIT Madras

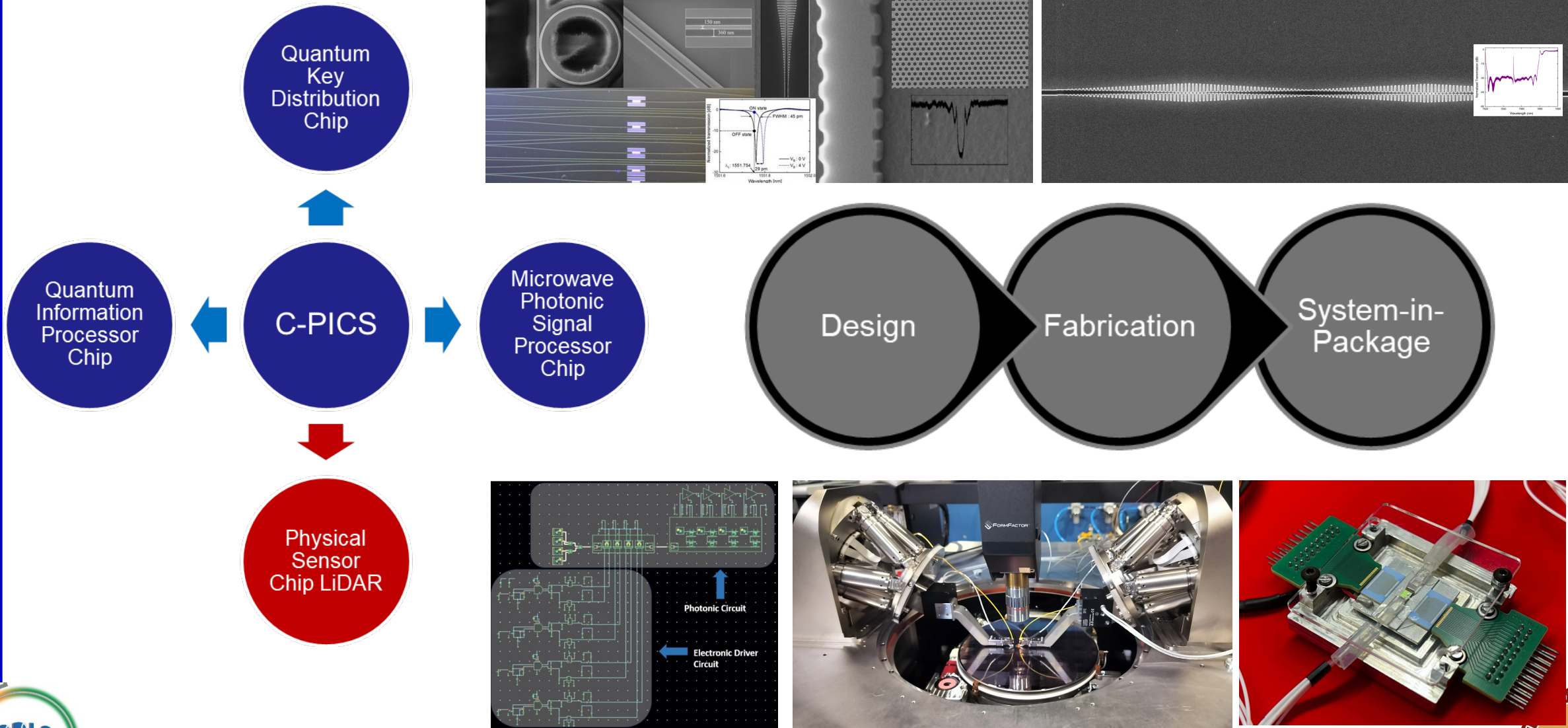
Silicon Photonics Centre of Excellence @ IIT Madras (Since January 2021)



Inaugurated by the Hon'ble Secretary S. Krishnan on 20 October 2023

EU-India Semiconductor Workshop: October 09, 2024: Brussel, Belgium

CoE-CPPICS: Silicon Photonics Product Research Development and Manufacturing Model



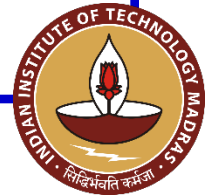
izmo

izmo micro: custom SiP & IC Packaging for high-density, high-performance systems

Wide range of packaging options to accommodate diverse design specifications and functional requirements, including complex mixed-technology assemblies.



EPDA for ADS

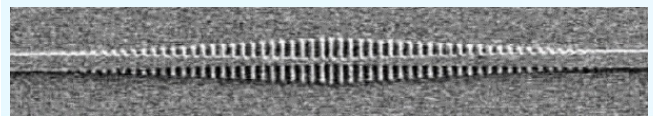
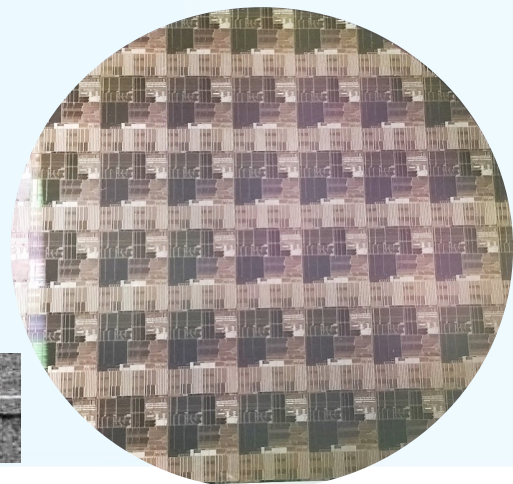


Where we stand now in terms of experimental demonstration?

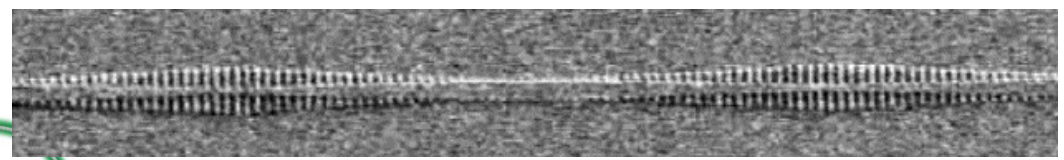
Home > The 25th European Conference on Integrated Optics > Conference paper

Silicon Photonic Wafer-Scale Yield of Single Mode Resonator with Broadband DBR Mirrors

Conference paper | First Online: 16 June 2024
pp 565-570 | Cite this conference paper



Arnab Goswami, Pratyasha Priyadarshini, Gan Yih Loong, Ng Chew Yan, Deleep Nair, Anjan Chakravorty & Bijoy Krishna Das

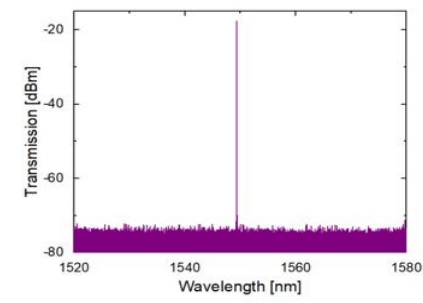
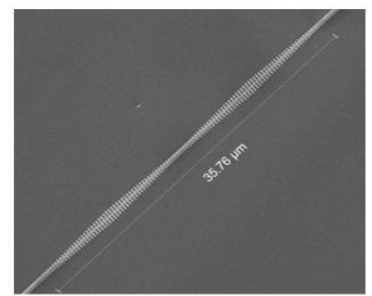
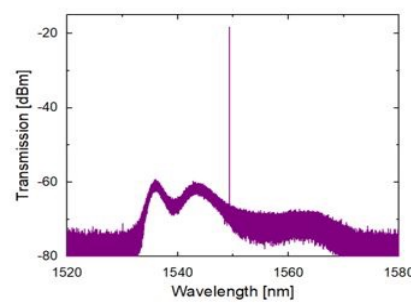


Research Article | Vol. 32, No. 16 / 29 Jul 2024 / Optics Express 27409
Optics EXPRESS

Distributed Bragg reflector based ASE noise removal pump wavelength filters for futuristic chip-scale quantum photonic circuits

PRATYASHA PRIYADARSHINI, ARNAB GOSWAMI, ASHITOSH VELAMURI, AND BIJOY KRISHNA DAS

Center for Programmable Photonic Integrated Circuits and Systems, Department of Electrical Engineering, Indian Institute of Technology, Chennai 600036, India



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Where we stand now in terms of experimental demonstration?

Conferences > 2024 8th IEEE Electron Device...

A Robust and Low-cost Fiber-optic Array Attachment Solution for Silicon Photonics Chips with Large Number of Input/output Channels

Publisher: IEEE

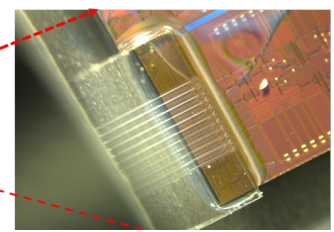
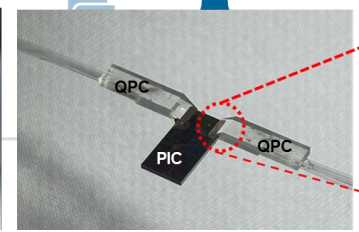
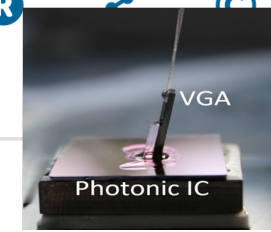
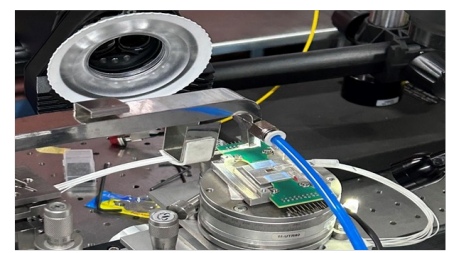
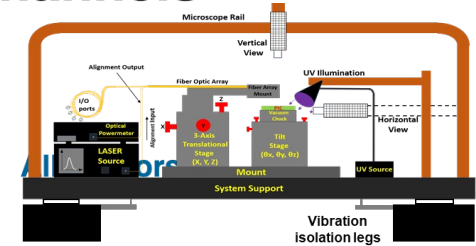
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PDF

A. Gayen ; N. Nallusamy ; G. Ezhilarasu ; S. Hassan ; S Vinoth ; K. Piyush ; A. Goswami ; B.K. Das

70 Full Text Views

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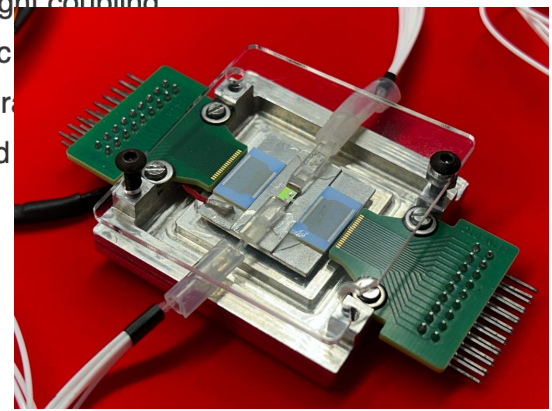
Abstract

Abstract:

A programmable photonic integrated circuit can have a large number of input/output waveguide light coupling ports. We have developed a robust and low-cost solution for attaching different types of fiber-optic to silicon photonics chips. In our first attempt, we achieved light coupling of upto 25% through a grating coupler which is very close to its theoretical value of about 35%. The coupling efficiency remained even after six months from its packaging date.

Published in: 2024 8th IEEE Electron Devices Technology & Manufacturing Conference (EDTM)

- Document Sections
- I. Introduction
- II. Fiber Array to PIC Attachment System
- III. Process Steps and



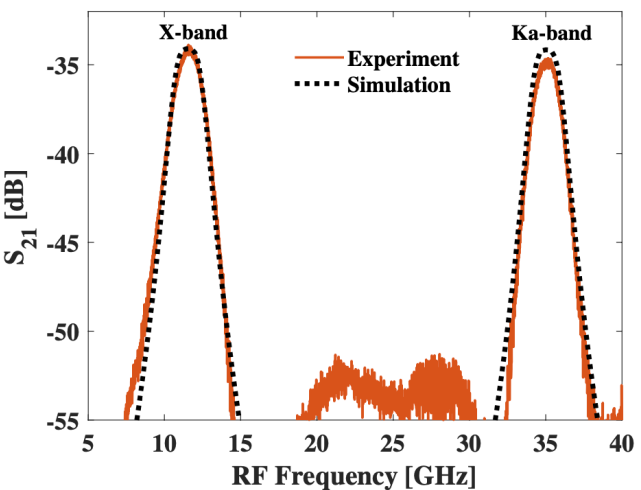
Where we stand now in terms of experimental demonstration?

Reconfigurable Multiband Microwave Filters using Programmable Photonic Integrated Circuit

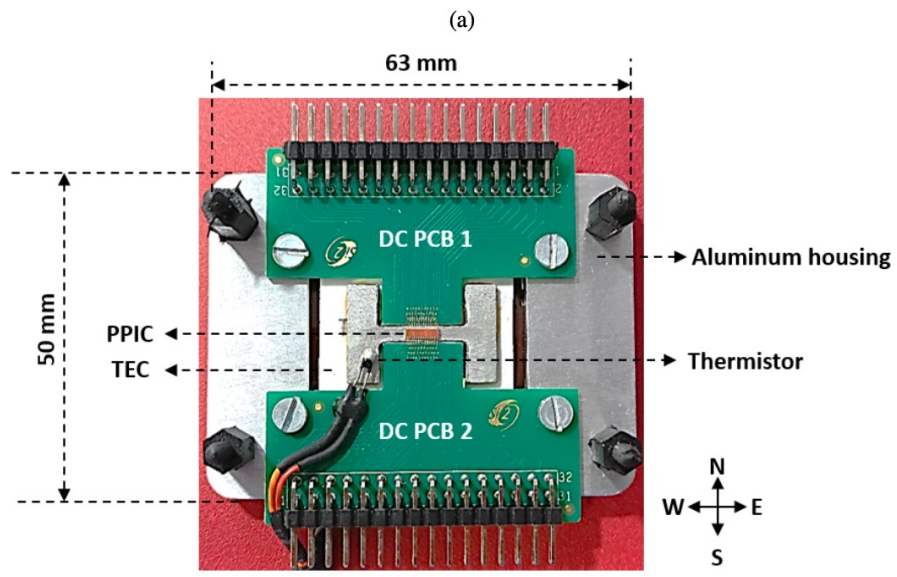
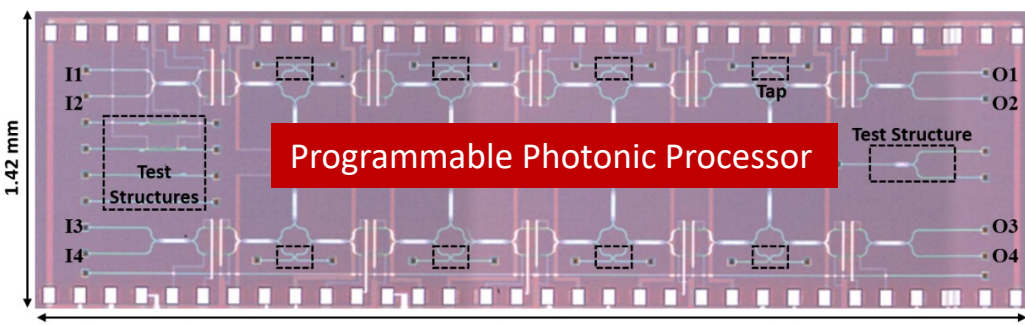
ASHITOSH VELAMURI¹, KUMAR PIYUSH¹, YASH RAJ¹, ARNAB GOSWAMI¹, ANANDHA PADMANABHAN², NITIN GHODGAONKAR², DINANATH SONI², JANAKIRAMAN VIRARAGHAVAN¹, AND BIJOY KRISHNA DAS^{1,*}

¹Centre for Programmable Photonic Integrated Circuits and Systems
 Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai - 600 036, India
²IZMO Microsystems, Bengaluru - 560 066, India
 *bkdas@ee.iitm.ac.in

Abstract: A program of 14 tunable balance photonic technology filters. The photonic an external 16-channel integrated into both the packaged chip is stabili ambience temperature microring resonators o ranges (23.25 GHz, 11.



rated circuit comprised tigated using a silicon d microwave photonic rable operations using no-optic phase shifters iting temperature of the void any interference of ble into three different for three free-spectral nd microwave photonic



<https://doi.org/10.1364/opticaopen.26045947.v2>



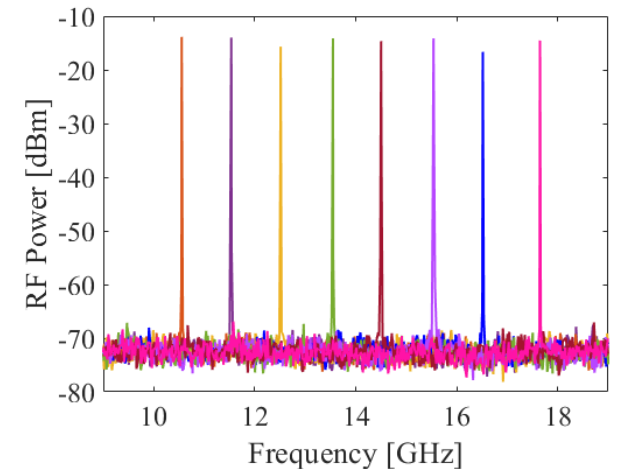
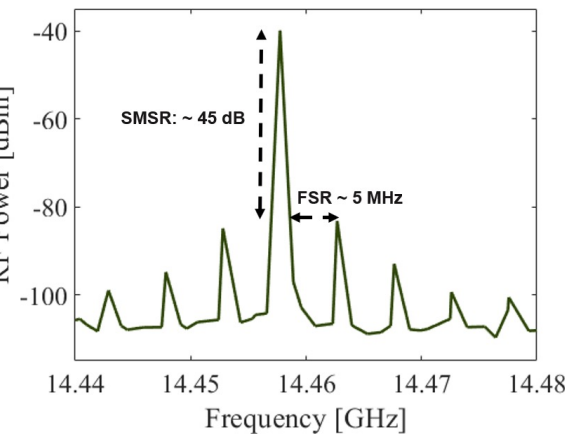
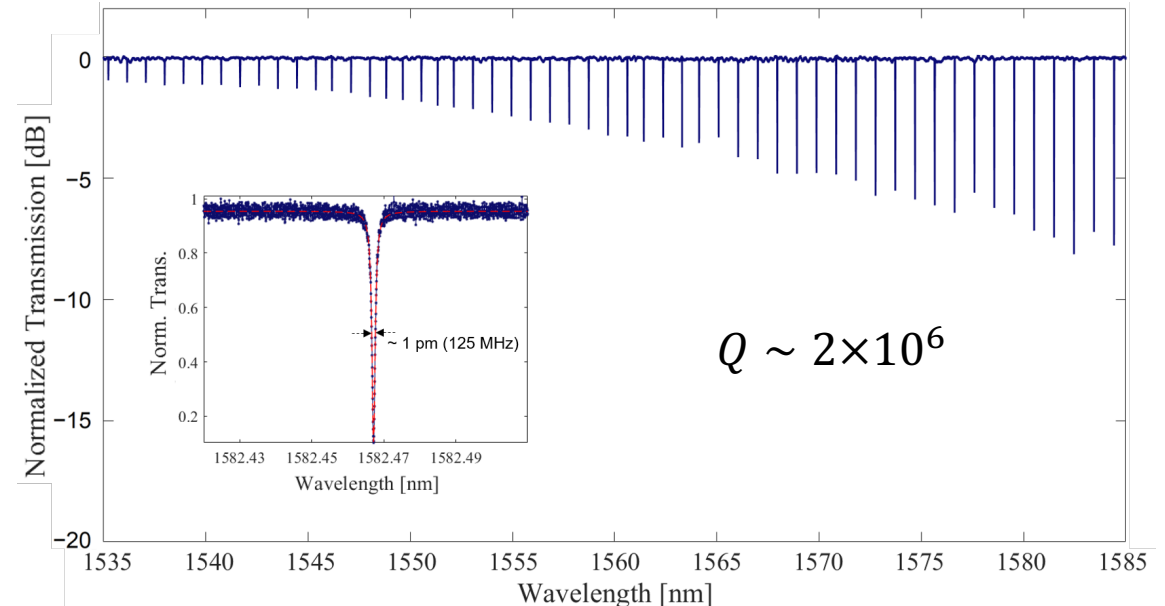
Where we stand now in terms of experimental demonstration?

1 **High-Q Microring Resonators with Bimodal SiN**
 2 **Waveguides: Microwave Photonic Applications**

3 **ANUSHKA TIWARI, ASHITOSH VELAMURI, RAM MOHAN RAO**
 4 **BOYAPATI, ARNAB GOSWAMI, ENAKSHI BHATTACHARYA, AND BIJOY**
 5 **KRISHNA DAS***

6 *Centre for Programmable Photonic Integrated Circuits and Systems*
 7 *Department of Electrical Engineering, Indian Institute of Technology, Chennai 600036, India*
 8 **Corresponding author: bkdas@ee.iitm.ac.in*

9 **Abstract:** A high-Q microring resonator in all-pass configuration using a low-loss bimodal SiN
 10 waveguide design has been demonstrated and explored for microwave photonic applications. We
 11 have recorded a Q-value as high as $\sim 2 \times 10^6$ from such a device design by exciting fundamental
 12 mode into the bimodal bus and ring waveguides which was fabricated using in-house conventional
 13 silicon photonics process technology. Our experimental results show that an equivalent
 14 design with a singlemode waveguide and fabricated with same fabrication process techn
 15 exhibit nearly 7 times lower Q-value ($\sim 2.5 \times 10^5$). The cavity loss is reduced because
 16 fact that the fundamental guided mode in a bimodal waveguide experiences lower scat
 17 and bend-induced radiation losses (~ 0.1 dB/cm); scattering losses occurs mainly due
 18 waveguide sidewall roughness which in fact fabrication process dependent. Such a devi
 19 been used further to demonstrate a widely tunable narrow-bandpass microwave photonic
 20 The experimental results exhibit a narrowband filter with a 3-dB bandwidth as low as 290
 21 with broad tunability from 5-45 GHz and the side-band rejection of ~ 30 dB has been rec
 22 Furthermore, the device was used to demonstrate widely tunable microwave oscillator
 23 signal-to-sidemode suppression ratio of up to 45-dB. Though both filter and oscillator c
 24 tuned up to 60 GHz, we are limited to characterize it due to the phase modulator bandwid
 25 GHz) and the RF amplifier bandwidth (20 GHz).



<https://doi.org/10.1364/opticaopen.26304610.v1>



Where we stand now in terms of experimental demonstration?

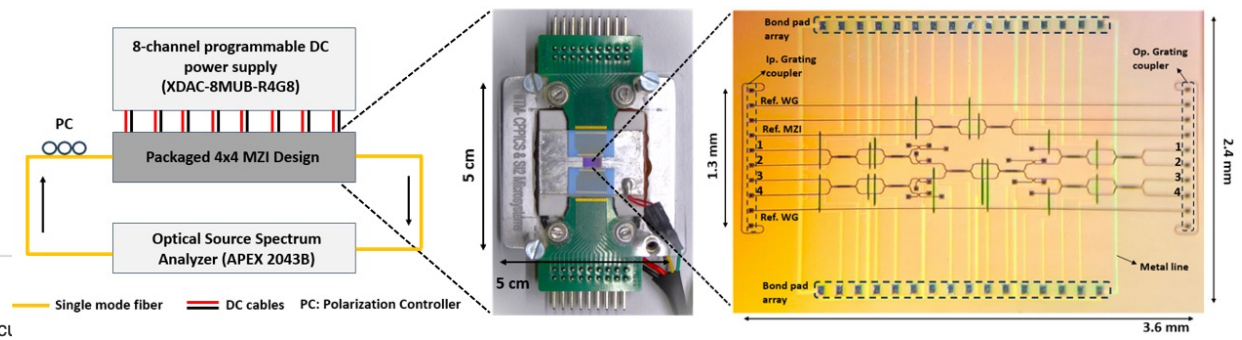
Conferences > 2024 Conference on Lasers and...

Estimation of Local Phase Errors in Silicon Photonic MZI Mesh from Passive Measurements

Publisher: IEEE Cite This PDF

Kumar Piyush ; Yash Raj ; Akash Shekhar ; Ashitosh Velamuri ; Arnab Goswami ; Naveen Raj Murugesan All Authors

25 Full Text Views



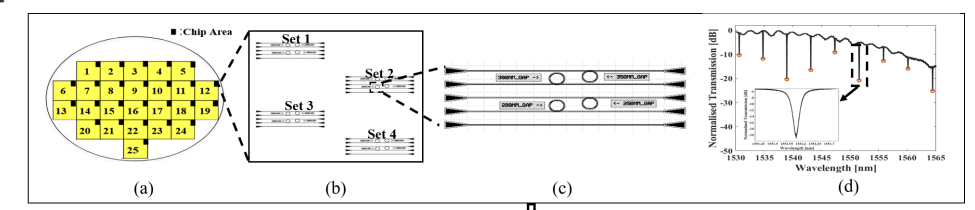
Abstract
 An algorithm is developed to extract component-level phase errors of photonic integrated circuit passive transmission characteristics. This algorithm successfully reduces the optical crosstalk from -10dB to -20dB.

Extraction of Silicon Photonic Wafer-Scale Process Variability Using ML-Enhanced Algorithm

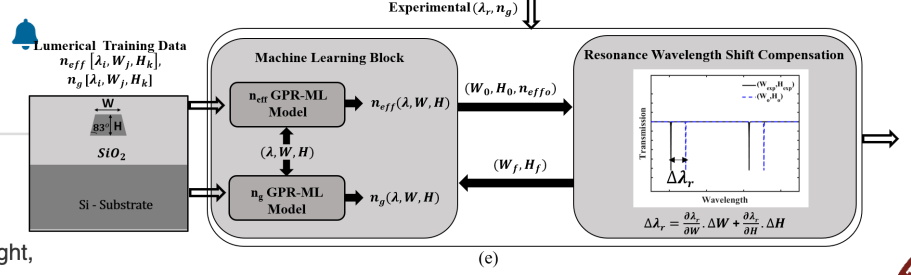
Publisher: IEEE Cite This PDF

Shruti Pandey ; Tarun Arumugham ; Anjana James ; Ashitosh Velamuri ; Arnab Goswami ; Gan Yih Loong All Authors

6 Full Text Views



Abstract
 An experimental investigation has been conducted to extract the silicon photonic wafer-scale fabrication process variability using a machine-learning enhanced algorithm to predict sub-nanometer scale width, height, and effective index variations ($\Delta n \sim 10^{-5}$) for a single-mode waveguide.



Team CoE-CPPICS: Admin & Technical Staff and Research Scholars

POSTDOCTORAL RESEARCH ASSOCIATE



Diptasree
(PhD, IIT Madras)



Nagarajan
(PhD, Shastra Univ.)



Shamsul
(PhD, IIT Dhanbad)



Gautham
(PhD, UCLA)



CTO: Arnab



Sindhura



Saranath



Satish

RESEARCH SCHOLARS



Suvarna



Ram



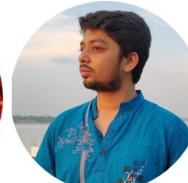
Ashitosh



Anushka



Pawan



Ankan



Sarad



Akash



Rajendran



Venkatesh



Piyush



Riddhi



Yash



Anjana



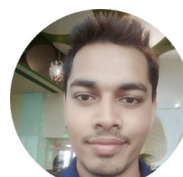
Pranita



Shruti



Mayukh



Dibyanchal



Vinoth



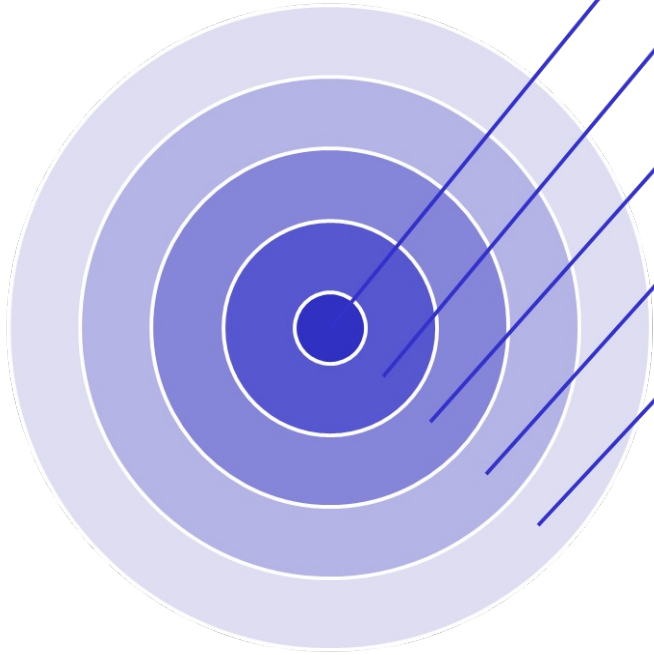
Prakash



Chief Investigator



Chief Technology Officer



In-house process development



Device design, simulation, fabrication & testing



Modelling, circuit design and foundry tapeout



Wafer/die/board-level testing & programming



System-in-Package prototypes and products



Co-Investigators:
Amitava DasGupta, Anil Prabhakar, Anjan Chakravorty, Deleep Nair, Deepa Venkitesh, Enakshi Bhattacharya, Janakiraman Viraraghavan, Nandita DasGupta, Saurabh Saxena, Sudharsanan Srinivasan, Sankaran Aniruddhan, Natarajan Venkatachalam



CoE-CPPICS: Silicon Photonics Product Research Development and Manufacturing Model

Industry Advisory Board for Guidance and Supports

























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Thank you

