



Quantum Dot Photonic Integrated Circuits

Tech ID: 29480 / UC Case 2018-609-0

BRIEF DESCRIPTION

A PIC based on quantum dots, grown on Si that allows lasers, modulators, and photodetectors to be integrated.

BACKGROUND

Photonic integrated circuits (PICs) are traditionally based on quantum well lasers, quantum well modulators, and bulk photodetectors. However, quantum dot lasers offer many advantages such as a lower threshold, higher temperature operation, and lower diffusion length which enables smaller devices with more integration. A PIC based on quantum dot lasers would incorporate each of these advantages and enable a superior device.

DESCRIPTION

Researchers at the University of California, Santa Barbara propose a PIC based on quantum dots, grown on Si that allows lasers, modulators, and photodetectors to be integrated. The use of quantum dots would enable higher device performance, better reliability, and system-level performance over conventional quantum well technology. The advantage of quantum dot modulators is the 3D confinement of electrons and holes which enhances that exciton enhancement. The more rapid change in absorption with wavelength makes quantum confinement stark effect modulators work better. Quantum dot photodetectors leads to higher bandwidth efficiency products. These quantum dot based PICs have demonstrated superior performance, improved reliability, and have vastly improved laser lifetimes.

ADVANTAGES

- ▶ Laser lifetime extended at elevated temperature (60°) operation
- ▶ Improved performance
- ▶ Increased reliability

APPLICATIONS

- ▶ Photonic Integrated Circuits

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,355,213	07/08/2025	2018-608
United States Of America	Issued Patent	11,693,178	07/04/2023	2018-609
United States Of America	Issued Patent	11,435,524	09/06/2022	2018-609

CONTACT

Pasquale S. Ferrari  
[ferrari@tia.ucsb.edu](mailto:ferrari@tia.ucsb.edu)  
tel: .

INVENTORS

- ▶ [Bowers, John E.](#)
- ▶ [Gossard, Arthur C.](#)
- ▶ Jung, Daehwan
- ▶ Norman, Justin
- ▶ Shang, Chen
- ▶ Wan, Yating

OTHER INFORMATION

KEYWORDS

indadvmat, materials, PIC,  
quantum dot lasers

CATEGORIZED AS

- ▶ [Materials & Chemicals](#)
- ▶ [Other](#)

RELATED CASES

2018-609-0, 2018-608-0, 2017-  
045-0, 2016-912-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Bonding of Heterogeneous Material for Improved Yield and Performance of Photonic Integrated Circuits
- ▶ Epitaxial Laser Integration on Silicon Based Substrates
- ▶ Integrated Reconfigurable Circulator
- ▶ Magneto-Optic Modulator
- ▶ Integrated Dielectric Waveguide and Semiconductor Layer
- ▶ Orthogonal Mode Laser Gyro
- ▶ Monolithically Integrated Laser-Nonlinear Photonic Devices
- ▶ Misfit Dislocation Free Quantum Dot Lasers

