

# SYSTEMS AND METHODS TO MANUFACTURE FUNCTIONAL PHOTONIC CRYSTAL APERTURE WITH NANO-POST ARRAY FOR SELECTIVE CURRENT CARRIER INJECTION

Tech ID: 34071 / UC Case 2025-151-0

## PATENT STATUS

Patent Pending

## BRIEF DESCRIPTION

The challenge of efficiently injecting electrical current carriers into photonic crystal (PhC) optical devices while maintaining high optical confinement and index contrast is a significant hurdle in integrated photonics. Current electrical control schemes typically rely on high-index conductive semiconductor heterostructures, which compromise the device's optical properties, complicate fabrication, or are limited to small apertures. This invention, developed by UC Berkeley researchers, is an electrical injection platform for PhC apertures that directly injects carriers into individual unit-cells of the PhC while achieving maximum optical confinement by maintaining the highest possible refractive index contrast between the gain semiconductor and air.

## SUGGESTED USES

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Integrated photonic circuits: Enabling electrically controlled light sources and modulators in high-density integrated systems.

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High-efficiency PhC lasers: Providing a method for electrical excitation of PhC lasers, demonstrated with room-temperature lasing at telecommunication wavelengths.

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Quantum photonic devices: Allowing precise and minimally invasive electrical control of quantum photonic states.

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Topological optoelectronic devices: Satisfying the need for direct, subwavelength-resolution carrier injection into extended optical modes in devices with strict symmetric constraints.

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Optical sensors: Integrating electrical control for tuning and modulating PhC-based sensors.

## ADVANTAGES

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Maximum Optical Confinement: Maintains the highest possible refractive index contrast (semiconductor/air), preserving the high-quality optical properties of suspended, optically pumped PhC devices.

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Decoupled Control: dedicated electrical injection path does not interfere with the optical confinement, effectively separating the control of photons and electrons/holes.

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## CONTACT

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## INVENTORS

» Kanté, Boubacar

## OTHER INFORMATION

### CATEGORIZED AS

- » **Optics and Photonics**
  - » All Optics and Photonics
- » **Nanotechnology**
  - » Electronics
- » **Semiconductors**
  - » Design and Fabrication

### RELATED CASES

2025-151-0

Scalability to Large Apertures: Unlike previous lateral injection schemes, this direct injection method is compatible with the electrical excitation of large PhC apertures.

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Preservation of Symmetry: The design preserve the critical symmetries of the PhC structure.

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Simplified Fabrication: The platform is manufactured on a monolithic semiconductor structure.

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Subwavelength Resolution Injection: Enables precise, minimally invasive electrical control by selectively injecting carriers into extended optical modes with subwavelength resolution, preventing the excitation of unwanted modes.

RELATED MATERIALS



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