UNIVERSITY OF DELAWARE - TECHNOLOGY LICENSING OPPORTUNITY | UD 26-007

Integrated Doped Resistive Heater for Controlling Volatile Phase-Change Material

This innovative side-contact heating architecture eliminates the historical conflict between optical performance and thermal efficiency when manipulating volatile phase-change materials. By delivering precise, nanosecond-scale local thermal control via standard CMOS workflows, it provides hardware developers with a low-power, high-density platform to drive next-generation optical networks and AI chips.

TECHNOLOGY OVERVIEW

Next-generation integrated photonics heavily rely on phase-change materials (PCMs) to enable reconfigurable devices for neuromorphic computing, optical memory, and advanced telecommunications. Unlike non-volatile variants that permanently maintain their state, volatile PCMs are highly valued for high-speed applications because they automatically reset when a stimulus is removed, though they require continuous and highly precise thermal stimulation to sustain their active phase. Existing thermal control methods, such as focused laser pulses, direct current injection, and global substrate heaters, are fundamentally ill-equipped for these demands, suffering from massive energy inefficiencies, material delamination, and severe thermal stress. Furthermore, traditional top-contact heater configurations physically sit inside the optical path, inducing significant signal insertion losses and complicating standard silicon fabrication workflows.

University of Delaware Researchers have developed an advanced technology that introduces an integrated resistive heater architecture engineered specifically to control volatile PCMs within silicon photonic systems without obstructing light propagation. The platform features heavily doped silicon rib regions positioned laterally adjacent to the silicon waveguide core, acting as localized, high-precision Joule heaters. When a voltage is applied, these lateral ribs precisely raise the temperature of the volatile PCM layer above its phase-transition threshold via tailored geometric thermal gradients. By shifting the heater completely to the side of the waveguide, this CMOS-compatible approach preserves optical mode integrity and minimizes signal absorption. Simultaneously, its tight thermal confinement delivers rapid, nanosecond-scale heating and cooling cycles while blocking thermal crosstalk, enabling dense and reliable component packaging.

Click Here to View Published Papers/Patents

KEY BENEFITS

Preserved Signal Integrity: Lateral positioning keeps the heater out of the optical path, preventing unwanted absorption and insertion losses.

Ultra-Low Power & High Density: Confines Joule heating to the target zone, reducing power consumption and preventing thermal crosstalk between adjacent components.

Nanosecond-Scale Switching: Enables high-speed, fully reversible phase transitions via concentrated heating and rapid thermal cooling cycles.

CMOS-Compatible Fabrication: Eliminates manufacturing complexity by integrating into standard silicon photonics foundry workflows using everyday doped silicon structures.

Enhanced Device Lifespan: Avoids direct current injection and bulk thermal shocks, protecting the phase-change material from structural degradation and mechanical stress.

WHAT WE ARE SEEKING : Licensing opportunities • Strategic partnerships • Industry feedback

UNIVERSITY OF DELAWARE
ECONOMIC INNOVATION & PARTNERSHIPS

302-831-4005

techtransfer@udel.edu