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Deeply Subwavelength All-Dielectric Nanophotonics in Silicon

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All-dielectric silicon waveguide for subdiffraction optical confinement

Market Overview

This technology increases the energy efficiency of optoelectronic applications by increasing the optical confinement and energy density in the longitudinal and transverse planes. This increases of the efficacy of devices such as LIDAR, free-space communications, and optical manipulations. The global market for optoelectronics is growing at a CAGR of 18.3% from 2016 to 2023. The growth in this market is driven from the high demand for bandwidth and current power constraints. This invention would increase power output and bandwidth all while lowering the necessary power needed.

Technical Summary

This technology has two features that enhance the energy densities of optical wavelengths in both the longitudinal and transverse dimensions. The inventor introduced a new pathway for enhancing optical confinement in the transverse plane of a waveguide using orthogonal boundary conditions of Maxwell's equations, and optionally in the longitudinal dimension of a waveguide using "periodic spatial refocusing" (PSR). This unique approach can achieve extreme light confinement and ultra-high energy densities and offers record low mode areas to be realized in a theoretically lossless all-dielectric platform for the first time. Applying these principles to specific types of active opto-electronic devices is predicted to enable up to ~10-1000x energy efficiency scaling.

Application

All-dielectric silicon nanophotonic for increased optical confinement and lower power usage

Development Stage

Proof of Concept Prototype

Advantages

- All-dielectric design, allowing for significantly lower losses compared to plasmonic approaches
- Ultra-low waveguide mode areas, yielding increased optical energy densities with favor improved device performance with lower power requirements
- First-time realization of optical devices achieving the optical confinement and enhanced light-matter interactions

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Provisional	United States	62/844,815	NA	2019-022	Dr. Judson Ryckman

About the Inventors

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Dr. Judson Ryckman received the B.E. and Ph.D. degrees in electrical engineering in 2008 and 2013, respectively, from Vanderbilt University. Through his dissertation work, entitled ‘Porous and Phase Change Nanomaterials for Photonic Applications’, he has tackled problems in photonics spanning areas in nanofabrication, sensing, and integrated optics. Dr. Ryckman serves on the committee of technical conferences such as IEEE Optical Interconnects and is a reviewer for numerous journals published by IEEE and OSA. Dr. Ryckman’s research interests lie in the development and application of photonic platforms to solve problems in areas of sensing, biomedicine, food-safety, and computing/communications.

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