Athermal Silicon Photonics With CMOS Compatibility

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ABSTRACT

The high thermo-optic coefficient of silicon is associated with thermal instability in silicon based photonic devices. Researchers at the University of California, Davis have developed a method that allows for complete compensation and athermalization of silicon photonic devices using techniques that are compatible with complementary metal-oxide-semiconductor (CMOS) fabrication.

FULL DESCRIPTION

Silicon is a widely used material in the field of photonics despite its very strong temperature dependence as measured by its high thermo-optic coefficient. Thus, the optical characteristics of silicon photonic devices can vary strongly with changes in temperature. Silicon photonic waveguides, the structures used to guide electromagnetic waves in integrated optical circuits, typically consist of a silicon core, an under-cladding layer and an over-cladding layer.

Various approaches to solve the problem of temperature dependence in silicon waveguides have been demonstrated such as use of polymer materials in the cladding layers. Polymer materials have strong negative thermo-optic coefficients making them suitable for passive athermalization of silicon waveguides; however, they have been shown to have issues with moisture absorption, chemical absorption, photo-degradation, thermal-degradation and mechanical brittleness all leading to instability. In addition, polymer materials are not compatible with CMOS fabrication and integration. Other approaches including use of additional inferometers or waveguide structures have been demonstrated, but these methods significantly increase the size of devices and show significant wavelength dependence.

Researchers at the University of California, Davis have developed a technology that allows for complete compensation and athermalization of silicon photonic devices using techniques that are compatible with CMOS fabrication. This new method uses titanium dioxide (TiO_2) deposition, a standard step in CMOS fabrication, to eliminate temperature dependence of silicon photonic devices. The technology can be used in any silicon photonic devices such as lasers, modulators, arrayed waveguide gratings and Mach-Zehnder interferometers.

APPLICATIONS

- Optical cladding material for use in silicon photonic devices

FEATURES/BENEFITS

- Compatible with standard CMOS fabrication and integration processes
- Can be used in any silicon photonic device
- Does not significantly change the size of the device

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,696,487	07/04/2017	2014-685

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OTHER INFORMATION

KEYWORDS

thermal, athermal, silicon, Si, photonics, CMOS, complementary metal-oxide-semiconductor, complete compensation, titanium dioxide, TiO2, optical cladding

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Energy**
  - Lighting
- **Engineering**
  - Robotics and Automation

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- Development of a CMOS-Compatible, Nano-photonic, Laser
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- Compressive High-Speed Optical Transceiver
- All-Optical Regenerators
- Silicon Based Chirped Grating Emitter for Uniform Power Emission
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