Metal and dielectric nanostructure-based optical circulators and isolators to direct light through optical circuits

_A key step to harnessing the potential of optical integrated circuits is developing methods to reliably transmit light while preventing unwanted reflections. This technology proposes a method to construct optical isolators, which preferentially transmit light in one direction, and optical circulators, which direct light through only one of a number of ports, using nanostructures that enable light to flow in one direction more readily than in the opposite direction._

**Metasurface for controlling guided light waves: CMOS compatible and less bulky than conventional devices**

Current isolators and circulators rely upon the Faraday Effect or magnetic materials for their operation and are often bulky and difficult to integrate into circuits. In contrast, the nanostructures used in this technology are readily compatible with CMOS processing techniques. Furthermore, these nanostructures also have a small footprint with dimensions only an order of magnitude larger than the free wavelength of the light directed and can be designed to accommodate a wide range of the electromagnetic spectrum.

Numerical simulation has shown this technology to provide an on-off extinction ration of 100 to 1, and implementation of changes to the polarization have been experimentally shown.

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**Applications:**

- Optical isolators, modulators, and polarization rotators for transmission of light through optical circuits
- Detectors and perfect absorbers for integrated photonic circuits
- Highly efficient on-chip nonlinear optical components
- Connector components for optical telecommunications
- Heat assisted magnetic recording
Advantages:

• Smaller footprint than conventional isolators and circulators that use magnetic effects to direct lasers.
• Broadband operation
• Compatible with conventional CMOS processing techniques.
• Effective on wavelengths ranging from just a few microns (near-infrared) to over one millimeter (radio).

Patent Information:

Patent Pending (US 20160195676)

Tech Ventures Reference: IR CU13369

Related Publications:

• N. Yu, M. Kim, Z.Li. Controlling light propagation in optical waveguides using one dimensional phased antenna arrays. CLEO Conference Paper, June 8-13, 2014


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