Light Force Devices for Integrated Photonic Circuits

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Description:

Light can exert a force through two separate mechanisms: radiation pressure, which exerts a force in the direction of the light, and a gradient force, which acts in a transverse direction. Yale researchers have demonstrated for the first time that the transverse gradient force can be harnessed in integrated silicon photonic circuits. A free standing optical waveguide is driven by the gradient optical force generated by asymmetrically engineering the lightwave mode in the waveguide. Due to the strong confinement of light in the submicron waveguide, the optical force is significantly enhanced at small dimensions, with the level of actuation comparable to electrostatic and piezoelectric methods. This device paves the way for optically-actuated nanomechanical devices operating under a new physical principal - waveguide light force - that is fundamentally different from conventional approaches.

The Yale researchers are currently testing a wide range of devices that utilize the optical gradient force. These include switches/fuses, scanning probes, tunable couplers, tunable phase shifters, tunable filters, synchronized oscillators and photonic transistors. Arrays of such devices can be fabricated along a photonic bus with the goal of large-scale integration of nanomechanical systems for all-optical switching, optomechanical signal processing, radio-frequency photonics, and tunable nanophotonics.

Advantages: Optically-actuated nanomechanical devices offer higher speed and bandwidth than electronics while avoiding parasitic crosstalk found in electrical systems. Devices are nondissipative for very low power operation. Devices are silicon-based and CMOS-compatible, allowing mass production, batch measurement, and integration between devices. A range of devices possible with nanosecond mechanical response times. Devices can be online programmable and reconfigurable.

Fields of Application: Optical signal processing, RF signal processing, reconfigurable photonics, chemical/biological sensing, optomechanical computing.

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Publications:


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