Insight Medical Publishing

Nanoscience & Nanotechnology Research

2020

Vol.4 No.2

Nano-mechanical energy-efficient optical diode with high nonreciprocal transmission ratio

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Abstract

Nano-structure passive optical diodes are highly desirable for on-chip optical signal processing, such as optical computing and logic gates. Recently, the high-power consumption (~10 dBm) and low nonreciprocal transmission ratios (NTRs) (<30 dB) of the most demonstrated optical diodes limit their practical applications for optical signal processing. Therefore, to pursue high reliability and low system cost, it is still highly desirable to realize optical diodes with low-power consumption and high NTRs. In our experiment, we demonstrate a passive nano-mechanical optical diode based on cascaded opto-mechanical microring resonators (MRRs). Due to the enhanced inelastic interaction between the photons and the nano-mechanical MRR, the opto-mechanical devices could be effectively driven by the optical force. Therefore, the forward and backward transmissions of the integrated optical diode could be flexibly manipulated based on the nonlinear opto-mechanical effect, which could be effectively excited by ultra-low input powers. With injecting an ultra-low optical power of -3.1 dBm, a high NTR of 45.3 dB and a relatively broad operation bandwidth are achieved. The proposed optical diode provides a complementary metal-oxide semiconductor (CMOS) compatible solution for on-chip nonreciprocal transmission with dominant advantages of high NTRs, low-power consumption, a relatively broad 30-dB bandwidth and compact footprint, which has significant applications for on-chip optical computing and logic gates.

Biography:

Li Liu is an associate professor in China University of Geosciences. Now he is researching in Massachusetts Institute of Technology as a research scholar. He received the B.E. degree and PhD degree in optoelectronics engineering from the Huazhong University of Science and Technology, Wuhan, China. He is the director of the opto-electronic device team in China University of Geosciences. He is currently working on the applications of nano-mechanical devices. As the first author, he has published more than 20 papers about nanotechnology.

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Annual Congress on Smart Materials ; May 11-12, 2020; Amsterdam, Netherlands

Abstract Citation: Li Liu, *Nano-mechanical energy-efficient optical diode with high nonreciprocal transmission ratio*, Smart Materials 2020, Annual Congress on Smart Materials; May 11-12, 2020; Amsterdam, Netherlands