ME PhD Thesis Defense

Fabrication and Characterization of Optomechanical Devices

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ABSTRACT

Silicon photonics is a promising platform for photonic devices and circuits, largely driven by advanced complementary metal-oxide-semiconductor (CMOS) processing technology. An extremely crucial component for a photonic device is the optical waveguide, which guides optical signals. A key development in this research area was the availability of high-quality silicon-on-insulator (SOI) wafers. SOI offers the possibility of highly integrated and scaled photonic devices, due to strong optical confinement as a result of high-index contrast between silicon and silicon-oxide layer. SOI waveguides have wide applications ranging from telecommunication, optical interconnection, to chemical and biosensing.

In this work, we have presented a conceptual design for sensing applications. A 220 nm thin silicon microcantilever acts as an optical waveguide, end-coupled to another microcantilever waveguide. The sensitivity of this device is dependent on vertical misalignment and the transversal gap between the coupled microcantilever waveguides. We have fabricated SOI-based end-coupled waveguides with 50 nm vertical misalignment and varying transversal gap as shown in figure 1. The insertion loss is measured across the end-coupled microcantilever waveguides having gaps ranging from 200 nm to 600 nm. The gaps were created by milling SOI microbeams using focused ion beam (FIB). The effect of ion beam milling on these structures has also been investigated. This device is designed to operate as a single sensor for two different parameters, namely, refractive index change arising from molecular binding and strain induced by temperature changes, which usually requires individual sensor elements dedicated to each parameter. Our design overcomes this multiplexing challenge by utilizing a suspended Bragg grating with a single defect which respond differently to refractive index changes and geometric changes due to strain. Hence, the signal from this device effectively contains two channels each carrying unique information about the molecular binding event. We have fabricated such suspended Bragg grated waveguide devices with defect mode and characterized their performance.

ABOUT THE SPEAKER

Mr. Prem Prakash Singh is currently working as an Assistant Professor in University of Allahabad, U.P from July 2017 onwards. He has joined the PhD Program in Department of Mechanical Engineering, IISc in 2009 under the guidance of Prof. Rudra Pratap and Prof. Manoj Varma. He has research interest in the area of MEMS and Silicon Photonics. During PhD, he was an international visiting student at University of Western Australia, Perth for six months in 2012. He is a recipient of CSIR-JRF award in Physics subject.

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