017

All-optical flip-flop employing a DFB-SOA optical

Wouter D'Oosterlinck
Supervisor(s): Geert Morthier and Roel Baets

All-optical flip-flops are key elements to come to all-optical packet switched networks. Like their electronic counterpart they have the ability to operate in one of two stable states at any time. To switch between the different states only a small set or reset pulse should be required. Here we present an implementation of an all-optical flip-flop based on the optical feedback between a semiconductor optical amplifier (SOA) and a distributed feedback (DFB) laser diode. The two stable states correspond to the situations where either the input signal is the dominant one inside the SOA or where the laser signal coming from the DFB laser diode is dominant. With this device excellent flip-flop characteristics have already been obtained, which will be shown in the following article.

018

Optical Biosensor based on Silicon-on-Insulator Microring Resonators for Specific Protein Binding Detection

Katrien De Vos
Supervisor(s): Peter Bienstman and Roel Baets

Optical label-free biosensors to detect biomolecular interaction attempt to overcome the drawbacks of commercialized systems relying on the detection of labeled biomolecules. We propose an integrated Silicon-on-Insulator optical biosensor based on resonant microring cavities in order to combine fast sample preparation, real time quantitative measurements of low analyte concentrations with a high throughput fabrication method. The shift of resonance wavelength that occurs when the dielectric surroundings of a cavity is changed, can be used for sensing. An SOI optical microring resonator with a radius of 5 micron is capable of detecting bulk refractive index changes of 10-4. We use the avidin/biotin high affinity couple to demonstrate good repeatability and the detection of avidin concentrations down to 50 ng/ml. Further miniaturization allows for detection of extremely low analyte concentrations while lining up the microrings in arrays allows for cheap label-free multiparameter analyses.

019

A Nanophotonic NEMS-modulator in Silicon-on-Insulator

Joris Roels, Iwijn De Vlaminck, Dries Van Thourhout, Liesbeth Lagae, Dirk Taillaert and Roel Baets
Supervisor(s): Dries Van Thourhout

The bandwidth of a single optical fiber offers a tremendous potential data transmission capacity (Tb/s) in optical communication networks. Switching the signals at the network nodes however is a limiting factor for the actual network capacity. Since switching is performed in the electrical domain (slow) optical-electrical conversions are required at every node. In order to avoid these conversions and achieve fast all optical switching in communication networks, a compact, low cost, integrated optical switch is needed. Nanophotonic integrated circuits in silicon-on-insulator (high-index contrast) are well-suited for this purpose. Nevertheless it is hard to obtain a strong light modulation effect in silicon. In this paper we demonstrate light modulation by moving a nanophotonic waveguide (NEMS = nano-electromechanical system). A 20% power modulation effect was measured and we discuss the observed dynamics. The obtained results are an important step towards a 2x2 nanophotonic integrated switch.

020

Focused ion beam for Photonics: A new versatile fabrication method

Jonathan Schrauwen, Dries Van Thourhout and Roel Baets
Supervisor(s): Dries Van Thourhout

Focused ion beam is a direct-write technique to make sub-micrometer structures in various materials. A finely focused beam (spotsize < 10nm) of Gallium ions in accelerated onto the target material, where it sputters atoms, implants the ions, and damages the structure of the target material. Our goal is to make this technique into a versatile way of making sub-micrometer structures for photonic applications. This can only be done if we minimize the effects that cause optical losses, namely implantation and material damage. To achieve this we study the interaction of focused ion beams and etch enhancement gasses. We have fabricated photonic structures that couple light from an integrated optical circuit to fiber. This proves the ability of focused ion beam to make low-loss photonic devices.

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