

Integrated racetrack micro-resonator based on porous silicon ridge waveguides for sensing application

P. Girault, P. Azuelos, N. Lorrain, L. Poffo, J. Lemaitre, P. Pirasteh, A. Gutierrez, I. Hardy, M. Thual, L. Bodiou, M. Guendouz and J. Charrier

UMR FOTON, CNRS, Université de Rennes 1, ENSSAT, Lannion, France

Porous silicon (PSi) is material which physical and optical properties have been widely studied for biological sensors. Indeed, the wide internal surface of PSi, as well as its biocompatibility have significant advantages for use in the fields of sensors. Moreover, integrated micro-resonators (MRs), by their geometry and operating principle, allow to fabricate very sensitive and miniaturized sensors. The PSi MR is destined to be used as an optical transducer for domains using the sensing and analysis of specific molecules such as health, food industries and security. The porous nature of the ridge waveguide allows the target molecules to be infiltrated in the guiding layer and being detected by direct interaction with the propagated light. This volume detection will significantly enhance the sensor sensitivity and will allow a lowest limit of detection compared to those obtained by using usual MRs based on evanescent wave detection. Integrated racetrack MR made from partially oxidized PSi ridge waveguides are implemented using an electrochemical etching method of silicon substrate, followed by a thermal oxidation and then by a standard photolithography process. The obtained MRs are structurally and optically characterized. The work has demonstrated experimentally the possibility of sensing concentrations of glucose with a partially oxidized porous silicon MR as transducer. A sensitivity of 560 nm/RIU is obtained which is currently the highest measured value.