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Polymer Resonators for Glucose Sensing and Milk Sphingomyelin Gel/Fluid Phase Transition Detection

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Abstract— Integrated photonics is increasingly used in sensors and metrology applications. Moreover, the ability to develop new photonic devices through simple, low cost and mass production fabrication steps based on new materials and hybrid approaches is substantial. Our devices devoted to optical resonances and sensors applications and their solving approach highlight the interest to develop specific hybrid processes such as nano-biomolecular film deposition as lipids, self-assembled and micro-fluidic devices, treatments coupled with microtechnology thin layers processes using deep UV lithography and so on. The photonic structure is composed of specific amplified deep UV photoresist-polymer waveguides coupled by a sub-wavelength gap with racetrack microresonators [1, 2] allowing a quasi temperature-independent operation. Our work describes a low-cost biophotonic sensor shaped by way of cheap processes as hybrid silicon/silica/polymer resonators able respectively to detect glucose concentration and also biological molecules gel/fluid phase transition as lipids at very low concentration [3, 4]. Different concentrations of glucose solutions result in a red shift of the resonant wavelengths with a linear sensitivity of $280\,\mathrm{pm}\cdot\mathrm{mg}^{-1}\cdot\mathrm{ml}^{-1}$ [3]. Furthermore, with an appropriate vesicle lipid deposition process specific in biology associated to an apt experimental bio-thermo-photonic protocol, the dynamic evolution of the sphingomyelin lipid phase transition was assessed: then, the ability to detect their own gel/liquid transition phase and melting temperature has been demonstrated, the ability to detect their own gel/liquid transition phase and melting temperature has been demonstrated with a mass product factor 109 lower than that of more conventional method [4].

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