



HAL
open science

Polymer resonators for glucose sensing and milk sphingomyelin gel/fluid phase transition detection

Qingyue Li, Véronique Vie, Rigoberto Castro-Beltran, Hervé Lhermite, Etienne Gaviot, Alain Moréac, Denis Morineau, Claire Bourlieu-Lacanal, Didier Dupont, Ludovic Frein, et al.

► **To cite this version:**

Qingyue Li, Véronique Vie, Rigoberto Castro-Beltran, Hervé Lhermite, Etienne Gaviot, et al.. Polymer resonators for glucose sensing and milk sphingomyelin gel/fluid phase transition detection. Progress In Electromagnetics Research Symposium - PIERS 2017, May 2017, St Petersburg, Russia. pp.156. hal-01527933

HAL Id: hal-01527933

<https://hal.science/hal-01527933v1>

Submitted on 26 May 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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

Q. Li¹, V. Vié¹, R. Castro-Beltrán^{1,2}, H. Lhermite³, E. Gaviot⁴,
A. Moréac¹, D. Morineau¹, C. Bourlieu⁵, D. Dupont⁵, L. Frein¹, and B. Bêche^{1,6}

¹Institut de Physique de Rennes, IPR CNRS 6251, Université de Rennes 1, Rennes 35042, France

²Universidad de Guanajuato, México

³Institut d'Electronique et de Télécommunications de Rennes, IETR CNRS 6164
Université de Rennes 1, Rennes 35042, France

⁴Laboratoire d'Acoustique, LAUM CNRS 6613, Université du Maine, Le Mans 72000, France

⁵Science et Technologie du Lait et de l'Oeuf, STLO INRA 1253
Agrocampus Ouest, Rennes 35042, France

⁶Institut Universitaire de France-IUF Paris, Paris 75005, France

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 $280 \text{ pm} \cdot \text{mg}^{-1} \cdot \text{ml}^{-1}$ [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].

REFERENCES

1. Castro-Beltrán, R., N. Huby, G. Loas, H. Lhermite, D. Pluchon, and B. Bêche, "Improvement of efficient coupling and optical resonances by using taper-waveguides coupled to cascade of UV210 polymer micro-resonators," *IoP — J. Micromech. Microeng.*, Vol. 24, 125006.1-7, 2014.
2. Specht, M., N. Huby, H. Lhermite, R. Castro-Beltrán, G. Loas, and B. Bêche, "Fabrication and optical characterization of pedestal micro-structures on DUV210 polymer: Waveguides structures towards micro-resonators," *Eur. Phys. J. Appl. Phys.*, Vol. 71, 10501.1-6, 2015.
3. Castro-Beltrán, R., N. Huby, V. Vié, H. Lhermite, L. Camberlein, E. Gaviot, and B. Bêche, "A laterally coupled UV210 polymer racetrack micro-resonator for thermal tunability and glucose sensing capability," *Taylor & Francis — Adv. Device Mater.*, Vol. 1, 80–87, 2015.
4. Li, Q., V. Vié, H. Lhermite, E. Gaviot, A. Moréac, C. Bourlieu, D. Dupont, S. Beaufile, and B. Bêche, "Milk sphingomyelin gel/fluid phase transition detection with athermal racetrack polymer resonators," to be published, 2017.