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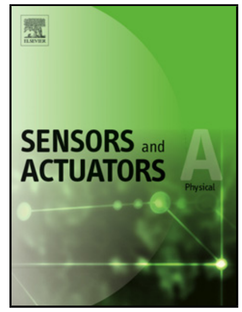

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Self-assembling and packaging of microbottle resonators for all-polymer lab-on-chip platform

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Highlights

- An integrated full polymeric platform based on microbottle resonators is proposed.
- Fast self-assembling process is adopted for microbottle fabrication.
- Evanescently coupled SU8 planar waveguide are used for interrogation system.
- The proposed microbottles packaging improves robustness to external disturbances.

Abstract

An integrated full polymeric sensing platform composed by a self-assembled bottle microresonators packaged with planar waveguide in a stable structure is presented. Microbottles made of SU-8 resist and NOA resins have been fabricated and characterized. The interrogation system is constituted by evanescently coupled planar waveguide fabricated in SU-8 on polymethyl methacrylate substrate. A simple and effective method for the packaging of the microbottle has been adopted. It provides high mechanical stability to avoid surrounding disturbance able to affect the coupling efficiency between the resonator and the waveguide. The choice of polymers as fabrication material enables the use of this method for low-cost lab-on-chip production. The viability of the platform has been demonstrated via refractometric sensing establishing a bulk sensitivity of 120 nm per refractive index unit.

Keywords: Optical polymers; Optical resonators; Packaging.

1. Introduction

In recent years, label-free technology has been a subject of growing interest in Lab-on-a-Chip (LoC) sensors. In particular, optical microresonators that supporting whispering gallery modes (WGMs) have been widely investigated as the key element of those platforms [1]. This is due to the high sensitivity of the optical modes of WGMs to external perturbations. Different microresonators geometries supporting WGM have been proposed, such as cylinders, spheres, rings, disks, bottles, bubbles and capillaries. These resonators, demonstrating high Q-factors (exceeding 10^5) have permitted detection of nanoparticles [2], DNA [3] and viruses [4]. Among WGM resonators, some peculiar characteristics make the microbottle resonator very attractive. In those resonators, the axial radius is usually much greater than the azimuthal radius [5]. Hence, the distribution of WGMs along the axis of a microbottle resonator can have a characteristic variation length greater than the one of microsphere and microtoroid resonators. Therefore, the external access to microbottles is greatly simplified, making these resonators very attractive as candidate for LoC platforms.

In spite of the promising properties of such microresonators, there are some practical limitations hindering the mass production of LoC platforms based on microresonators supporting WGMs. In the traditional microresonator-tapered fiber coupling system [6-8], any tiny vibration can modify the relative positions of the tapered fiber and microresonator, consequently influencing the coupling efficiency and the resonant frequency [7, 9]. In those coupling systems, the Q-maintenance can be very challenging, also requiring the use of expensive and bulky 3D translation stages that strongly limits the sensor portability. For this reason, several packaging approaches have been reported to circumvent those problems [9-14].