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Surface-immobilized whispering gallery mode resonator spheres for optical sensing

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Abstract

We present a simple and fast solution for fixation of resonator spheres for an all-polymer whispering gallery mode sensor in the form of a spin coated UV curing adhesive. The fixation method does not need a precise adjustment of the distance between sphere and substrate. Using low-cost polymer components makes the sensor easy to manufacture. As a proof of principle of the sensing capabilities, we determine unknown optical wavelengths.

Keywords: Spectrometers and spectroscopic instrumentation, Integrated optics devices, Polymers, Micro-optics

PACS: 07.60.-j, 42.82.-m, 42.79.-e, 42.79.Pw

1. Introduction

Whispering-gallery-modes (WGMs) can be excited in microcavities, such as rings, spheres or toroids. They are sharp optical resonances at specific wavelengths. The electromagnetic wave is guided in the cavity by total internal reflection. If the guided wave drives itself by returning in phase after one roundtrip, a traveling wave arises. Its resonance frequency depends on the radius and the refractive index of the sphere as well as the surrounding refractive index [1]. Microcavities which support WGMs can be well applied as optical or biological sensors [2], because changing one of the above parameters causes resonance wavelength shift, resonance line broadening or mode splitting [3, 4]. Consequently, all physical properties varying the radius or the refractive indices of sphere or surrounding medium, respectively, can be detected and quantified. In recent years WGM-sensors have been continuously enhanced with respect to sensitivity and detection limit [5] down to single molecules [6].

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