Semicylindrical Whispering Gallery Mode Microresonator for Biosensing

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The semicylindrical Whispering gallery mode ($WG_{m,\ell}$) microresonator based on dielectric-metal-dielectric structure is investigated (Fig. 1) for biosensing applications. The microresonator is excited by a plane wave polarized along semicylinder axis. The wave incidents from the side of a dielectric substrate covered by a thin metal layer and penetrates into another dielectric of a semicylindrical form with high refractive index [1].

The resonant wavelength of the system strongly depends on the semicylinder radius, as well as on the refractive indices of the surrounding medium and semicylinder. Particularly, a single molecular layer bound on the resonator surface causes the change of both the radius and surround refractive index, which lead to the resonant wavelength shift. Unlike the traditional methods of WGM excitation (e.g. tapered fiber or prism), which rarely support high radial order modes, in such system it is easy to excite WGMs with high radial orders with more strong evanescent part. Molecules bound on the microresonator surface are interacting with the surface evanescent field and can be detected from a change of optical resonance wavelength[2,3].

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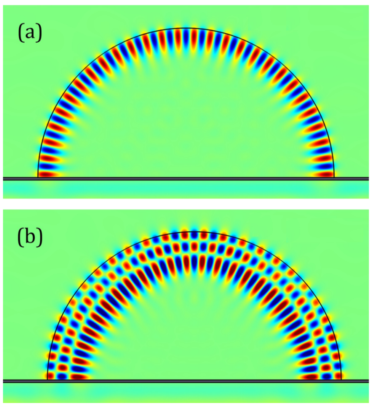

Fig. 1. Cross section of the semicylindrical microresonator: modes with radial number (a) 1 and (b) 3

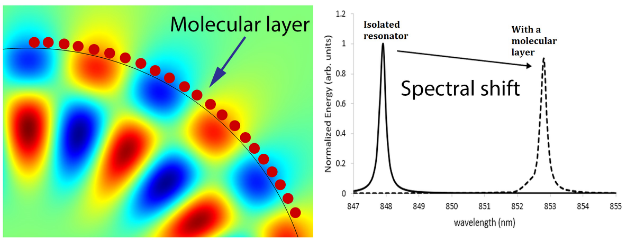

Fig. 2. Schematic of the resonator with a WGM of radial mode number 2 and bound molecular layer (red). The inset shows the resonant wavelength shift due to the bound layer on microresonator surface.

[1] H. Haroyan et al., Applied optics 57.22 (2018) 6309-6313.
[2] F. Vollmer et al., Proc. Natl. Acad. Sci. 105 (2008) 20701–20704.
[3] K. Wilson and F. Vollmer, Proc. Encyclopedia of Nanotechnology (2012) 2837–2849.