Optomechanical biosensors

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The field of Optomechanics has made impressive advances in the last decades, covering a broad range of applications going from ultrasensitive sensing to fundamental quantum studies. Particularly, the use of optomechanical devices for biosensing has acquired crescent interest in the last years. Optomechanics effects provide extraordinary sensitivity to motion, allowing the detection of mechanical modes of micro and nanostructures at very high frequencies, surpassing the GHz range. A very promising optomechanical platform for biosensing applications are semiconductor microdisks. These devices support a family of modes, the radial breathing modes (RBM), which present extremely high mechanical frequencies (> GHz) and low energy losses in liquids. These assets, together with their remarkably low masses (in the pg range), provide them with extremely low mass sensitivities and high speed, notably, while immersed in liquid [1]. In addition, semiconductor microdisks can be integrated in collective configurations, thus, improving their sensing efficiency while keeping their individual capabilities [2].

Here we show the first application of optomechanical devices as biological sensors. We have applied different individual and collective configurations of semiconductor microdisks (Fig. 1.a). We have developed a novel deposition method which allow us to precisely locate individual and alive bacteria in our sensors (Fig. 1.b). By detecting changes in their mechanical and optical modes, microdisks are capable of determining the mechanical and optical properties of *Staphylococcus Epidermidis* bacteria (Fig. 1.c).

References

[1] Gil-Santos, E. et al. High-frequency nano-optomechanical disk resonators in liquids. Nature Nanotechnology, 2015. 10, p. 810-817.
[2] Gil-Santos, E. et al. Light-mediated cascaded locking of multiple nano-optomechanical oscillators. Physical Review Letters, 2017. 118, p. 063605.

Figures

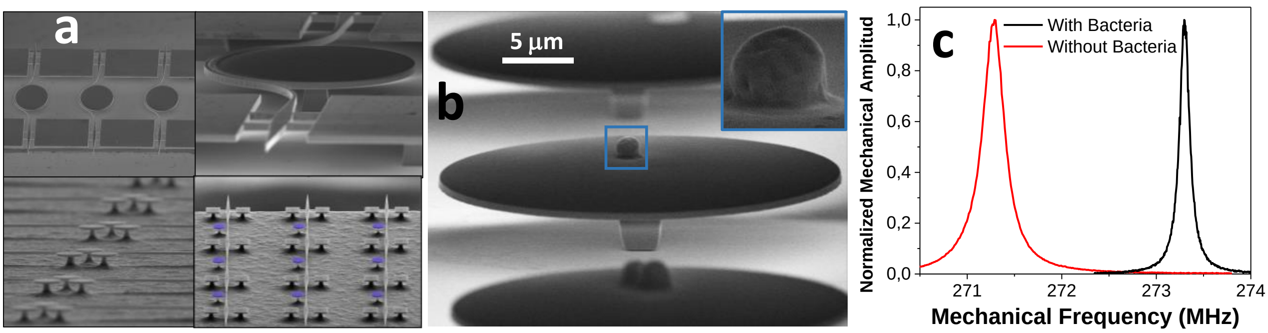

Figure 1. a. Scanning electron microscopy (SEM) images of some of the microdisks sensors configurations tested. **b.** SEM images of optomechanical microdisks (R*T=10*0.32 m2) with Staphylococus Epidermis bacteria absorbed on them. **c.** Mechanical spectra showing the first RBM resonance of a microdisk (R=5 µm and T=320 nm) without and with a Staphyloccoccus epidermis bacteria adsorbed on it.