

Optical Fiber Meta-Tip for biological sensing

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Optical sensors have gained a significant role in many fields of research, especially in medicine and clinical diagnostics. In particular, sensors based on the Lab-On-Tip (LOT) technology [1], where metal/dielectric nanostructures are integrated on the end-face of an optical fiber, are of strategic importance in view of the inherent advantages of miniaturization and portability, integrability in needles or catheters and in microfluidic circuits, which are ideal characteristics for in vivo and in situ analyses. LOT biosensors developed in the past are mostly based on the integration on the fiber tip of suitably designed plasmonic nanostructures [2]. However, a huge challenge exists when applying these sensors for label-free detection of analytes with ultralow concentrations or small molecules. To overcome such limitation, we proposed in 2017 the integration of Metasurfaces (MSs) on the tip of the optical fiber (*Optical fiber meta-tip*, OFMT) [3]. For their extraordinary properties, MSs are able to enhance the light-matter interaction on the fiber tip, thus sensibly improving the performance of LOT biosensors. Here we present our results on OFMTs, showing past, present and future work. Specifically, we report for the first time on the remarkable capabilities of plasmonic OFMTs to perform label-free detection of cancer biomarkers with improved performances with respect to state-of-the-art LOT sensors. We also show how to further enhance their performances, as well as the first results about dielectric OFMTs for fluorescence-based labelled sensing, consisting of Silicon MSs integrated on a multi-mode fiber tip.

[1] A Cusano et al., Springer 2015, ISBN: 978-3-319-06998-2

[2] P.Vaiano et al., Laser & Photonics Review 2016, 10(6):858-858

[3] M Principe et al., *Light Sci Appl* 6 (2017) e16226.