FIBER OPTIC PLASMONIC NANOPROBES: TOWARDS MULTIFUNCTIONAL PHOTONIC DEVICES AND COMPONENTS

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We have recently proposed and demonstrated a valuable fabrication route for the integration and patterning of functional materials at micro and nano-scale onto optical fibers, posing the basis for a new and emerging technological vision named "Lab on Fiber" [1, 2]. The validation of the proposed process has been carried out through the realization, directly onto the fiber tip, of 2D metallo-dielectric nano-crystals supporting local surface plasmon resonances (LSPR). In this contribution, we demonstrated the effectiveness of the proposed methodology to realize versatile technological platforms at nano-scale to be used for label-free chemical and biological sensing as well as basic component for novel polarization sensitive photonic devices.
Specifically, we first demonstrate how, by taking advantages from the large set of degrees of freedom (metal and dielectric thickness, periodic or aperiodic patterns) exhibited by the platform, it is possible to tailor the field distribution of the plasmonic mode enabling the control on the refractive index sensitivity of the final device. With a view towards surface sensitivity (which indeed is the key parameter in chemical and biological applications), we experimentally observed that the proposed device is able to detect the formation of nano-sized overlays over very limited active areas. Moreover, we demonstrate how it is possible, by properly choosing the geometrical parameters, to control the number and the field distribution of the excited LSPR posing new basis for optimal resonance engineering.
Finally, we show how to obtain polarization sensitive devices starting from the same technological platform, by breaking the circular crystal symmetry at both unit cell or entire lattice levels (with elliptical holes and different periods in the two perpendicular directions, respectively).

[1] M. Consales, A. Ricciardi, A. Crescitelli, E. Esposito, A. Cutolo, A. Cusano, ACS Nano 6 (2012), 3163.
[2] M. Consales, M. Pisco, A. Cusano, Phot. Sens. 2, 4 (2012) 289.