

Time-resolved investigations and biotechnological applications of plasmonic nanostructures

Monday, 9 September 2019 12:10 (20 minutes)

Plasmonics exploits the collective motion of conduction electrons in metals (plasmons), thus enabling light to couple with nanoscale objects, with the consequent generation of a plenty of novel and unexpected optical effects and functionalities. Plasmonic nanostructures have been deeply studied in the last decade due to their crucial impact on several areas of nanoscience and nanotechnology. Their unrivalled capability to squeeze light well beyond its diffraction limit, leading to extremely confined and enhanced electromagnetic fields on the nanoscale at optical frequencies, is of great interest for the prospect of real-life applications, such as energy harvesting and photovoltaics, wave-guiding and lasing, optoelectronics, fluorescence emission enhancement, plasmon-assisted bio-interfaces and nanomedicine. In this framework, traditional studies of the resonant behavior of plasmonic nanoantennas rely on standard intensity detection schemes. Up to date, the temporal dynamics of plasmonic nanoantennas remains challenging. In the first part of the talk we will show that, by combining femtosecond multi-THz time-domain spectroscopy and high-resolution confocal microscopy, it is possible to measure full time- and field-resolved response of single plasmonic antennas (see Fig. 1) [1]. In the second part of the talk, we will then show practical applications of plasmonic nanostructures for molecular sensing [2,3], single cell enhanced spectroscopy [4-6], optical trapping [7] and enhanced resonant energy transfer [8].

[1] M. P. Fischer, N. Maccaferri, K. Gallacher, J. Frigerio, G. Pellegrini, G. Isella, A. Leitenstorfer, D. J. Paul, P. Biagioni, D. Brida, in preparation (2019).

[2] R. Verre, N. Maccaferri, K. Fleischer, M. Svedendahl, N. Odebo Länk, A. Dmitriev, P. Vavassori, I. V. Shvets, M. Käll *Nanoscale* 8, 10576 (2016).

[3] P. Ponzellini, X. Zambrana-Puyalto, N. Maccaferri, L. Lanzanò, F. De Angelis, D. Garoli *Nanoscale* 10, 17362 (2018).

[4] M. Ardini, J.-A. Huang, C. S. Sánchez, M. Z. Mousavi, V. Caprettini, N. Maccaferri, G. Melle, G. Bruno, L. Pasquale, D. Garoli, F. De Angelis *Sci. Rep.* 8, 12652 (2018).

[5] V. Caprettini, J.-A. Huang, F. Moia, A. Jacassi, C. A. Gonani, N. Maccaferri, R. Capozza, M. Dipalo, F. De Angelis *Sci. Adv.* 5, 1800560 (2018).

[6] J.-A. Huang, V. Caprettini, Y. Zhao, G. Melle, N. Maccaferri, L. Deleye, X. ZambranaPuyalto, M. Ardini, F. Tantussi, M. Dipalo, F. De Angelis *Nano Lett.* 19, 722 (2019).

[7] G. C. Messina, X. Zambrana-Puyalto, N. Maccaferri, D. Garoli, F. De Angelis *arXiv:1903.03865* (2019).

[8] X. Zambrana-Puyalto N.Maccaferri, P. Ponzellini, G. Giovannini, F. De Angelis, D. Garoli *Nanoscale Advances*, in press (2019).

Summary

Topic

1. Applications and interdisciplinary subjects

Primary author: MACCAFERRI, Nicolò (University of Luxembourg,)

Presenter: MACCAFERRI, Nicolò (University of Luxembourg,)

Session Classification: Invited Talk