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NANOP 2017
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NANOPHOTONICS AND MICRO/NANO OPTICS
INTERNATIONAL CONFERENCE / SEPT 13-15, 2017
BARCELONA

Integrating Nanofluidics with Single Particle Plasmonics

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The combination of the precise nanoscale mass transport offered by nanofluidics, and the sub-wavelength sensing function provided by a single plasmonic hot spot, creates fascinating opportunities for a range of applications stretching from biosensing and single molecule detection at low concentrations, to single nanoparticle catalysis. In this talk, I will present our efforts towards integrating nanofluidics with single particle plasmonics in these different directions.

Specifically, I will first present our generic platform, which is comprised of nanofluidic channels that are functionalized with single plasmonic nanoantenna sensors and/or catalyst nanoparticles (Figure 1). These structures are locally grown inside the nanofluidic system by means of advanced nanofabrication techniques based on electron beam lithography and reactive ion etching, before sealing with a transparent lid that enables dark-field scattering spectroscopy [1].

For a sensing application in the liquid phase, the dimensions of the nanofluidic system can be tailored such that the entire analyte volume is forced to pass the plasmonic hot spot within the decay length of the near field, thereby significantly enhancing the probability of direct interaction between the sensor surface and the analyte molecules [1].

For applications in the gas phase and in heterogeneous catalysis, such a design offers the fascinating prospect of not only addressing individual catalyst nanoparticles by means of plasmonic readout to, for example, derive their hydrogenation [2] or oxidation state [3] in operando, but also to use online mass spectrometry connected to the nanofluidic system to analyze reaction products and reaction rates.

In my talk I will illustrate these two applications on specific examples from our recent research, and discuss the potential of nanofluidic devices integrated with single particle plasmonics in a wider perspective by, for example, highlighting the multiplexing potential.

[1] Fritzsche, J., et al. Nano Letters, 16 (12), 7857–7864 (2016)
[2] Syrenova, S., et al. Nature Materials, 14, 1236–1244 (2015)
[3] Larsson, E.M., et al. Science 326, 1091-1094 (2009).

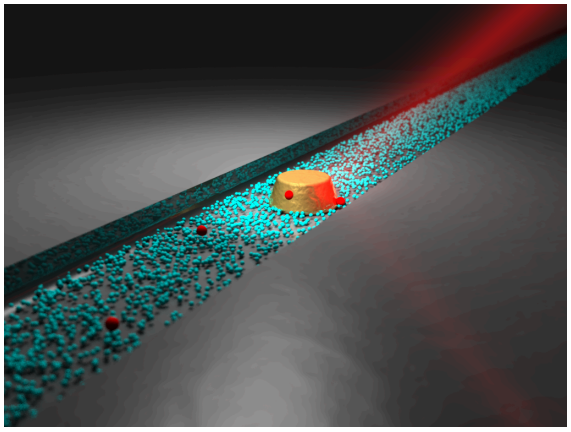

Figure 1: Nanochannel_singleAu2.png