Heterogeneous nanoplasmonics for quantum optics and biosensing

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Extensive research in Nano-optics over the last decade has made possible controlling optical fields on the nanometer scale. Such concentration of light, well below the limit of diffraction, opens plenty of new opportunities towards enhanced interaction with tiny amounts of matter down to the single molecule/atom level. In this talk we will present our recent advances in enhanced light-matter interaction on the nanometer scale and their applications to both quantum optics and biosensing.

The first part of the talk focuses on the controlled interaction of single quantum emitters with optical nanostructures. We first discuss different strategies to deliver a single quantum emitter in the hot spot of a plasmonic nanostructure. Next we show how these techniques are applied to deterministically locate single nano-diamonds in the hot spot of plasmonic antennas and waveguides [1,2]. In particular, we discuss the possibility to build on-chip single photon sources [3] as well as nanolasers [4].

In the second part of the talk, we change gear and present our latest advances in the optical, label free detection of biomarkers based on gold nanoantennas integrated into a state-of-the-art microfluidic platform. We first demonstrate the capability of our platform to detect low concentrations (<1ng/ml) of protein cancer markers in human serum [5] with low unspecific binding and high repeatability. In a second step we present a novel design that enables to simultaneously determine the absolute concentration of four different target molecules from an unknown sample. The system is validated in the context of breast cancer, as a strategy to assess the risk for brain metastasis [6]. Our research demonstrates the high potential of optical nanoresonators for the detection of different biomarkers in real biological samples and thus gets us closer to future nano-optical point-of-care devices.

References

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