Fourier Transform Imaging Spectrometer for the parallel Readout of Localized Surface Plasmon Resonance (LSPR)

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In this work we describe an optical method, which substantially improves the applicability of sensors based on spectroscopy of a single nanostructure exhibiting Localized Surface Plasmon Resonances (LSPR). Our system combines dark field microscopy and Fourier transform imaging spectroscopy and allows us to collect the scattering signal from several nanoparticles in parallel.

The sensing principle is based on the shift of the LSPR peak wavelength of noble metallic nanoparticles. This dependence of the LSPR peak position on the surrounding medium can be utilized to investigate bio molecular interactions taking place on the surface of nanoparticles, such as DNA-DNA binding events [1]. The observation of these events can be performed by spectroscopic measurements at the single particle level. There are different methods to obtain the spectrum of a single nanoparticle, micro-spectroscopy and imaging spectroscopy. In micro-spectroscopy a spectrum of a defined area can be measured, so that every single nanoparticle has to be targeted individually, which is usually performed manually and therefore time consuming. On the contrary in imaging spectroscopy the spectral information of a whole image section with all nanoparticles can be obtained in parallel.

The parallel read-out of several nanostructures was realized by an imaging spectrometer, based on a Michelson interferometer. The performance of the device was checked by comparison with micro-spectroscopy. As a biological model, a few nm thick polymer layers were consecutively adsorbed on the gold nanoparticles by layer-by-layer deposition technique. The refractive index change of the surrounding medium leads to a LSPR shift which was measured at single particle level.

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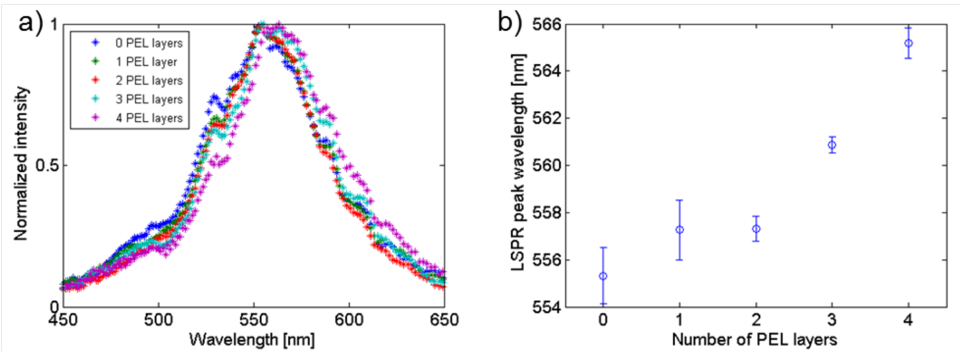

Fig. 1: ***a)*** *Spectra of a single 80 nm spherical gold nanoparticle after various layer deposition steps.*
b) *Corresponding LSPR peak wavelengths determined with a Lorentzian fit. The values represent the averaged LSPR peak wavelengths determined after 5 repetitive measurements after each deposition step. The error bars indicate the standard deviation.*

[1] T. Schneider, et al., Journal of Nanoparticle Research 15, 1 (2013).