# IMMUNODIAGNOSTICS BASED ON OPTICALLY DETECTED ROTATIONAL DYNAMICS OF ANISOTROPIC NANOPARTICLES

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The concept of patient-near and personalized therapy desirably requires point-of-need analytical devices as alternatives to time-consuming diagnostics in conventional remote laboratories. Here, we present a “Magnetic Lab-on-a-Bead” (MLoB) approach towards the realization of a portable analytical device for point-of-care diagnostics. The underlying homogeneous biosensing method[1] is based on the optical detection of the rotational dynamics of anisotropic hybrid nanoparticles immersed in the analyte such as whole-blood. The surface of the multicomponent nanoparticles with appropriate magnetic and plasmon-optical properties is functionalized by complementary receptors. Nanoparticles rotating in a time-varying magnetic field act as capture probes and specifically bind target molecules on their surface, which leads to an increase in their hydrodynamic volume. As a consequence, the rotational dynamics of particles changes, which is detected by measuring the phase lag between the actual nanoparticle alignment with respect to the rotating external magnetic field. The phase lag signal originates from scattering measurements of polarized light with nanoparticles supporting plasmon resonances, and directly quantifies the target molecule concentration in the analyte.

The main focus of this presentation is put on the fabrication of nanoparticles and their plasmon resonance analysis by numerical simulations as well as a brief introduction to our newly designed MLoB prototype including first measurement results. Suitable hybrid nanoparticles consisting of sputter-deposited noble metal (Au) and ferromagnetic (NiFe) layers are structured by lithographic methods to elliptically shaped nanoparticles, thus combining both magnetically and optically anisotropic properties with longitudinal and transversal plasmon mode excitation possibility. In comparison to chemical synthesis, nanoparticles fabricated by physical methods feature a narrow size distribution and homogeneous layers, which result in an increased sensitivity due to a higher average optical extinction. Particle scattering cross section calculations suggest a significant sensitivity increase in the presence of plasmonic amplification. By changing the particle composition and/or geometry, the spectral position of the localized plasmon resonance in the gold layer is tuned within the visible to near-infrared regime, a spectral range where the optical absorption in whole-blood is minimal (Fig.1 a), b)). Scanning laser spectroscopy with laser spot diameter comparable to the particle size is carried out to study the light scattering properties of single nanoparticles. Moreover, our MLoB-Setup represents an all-angle measuring system enabling optical detection in reflection, transmission and scattering geometry (Fig.1c)).

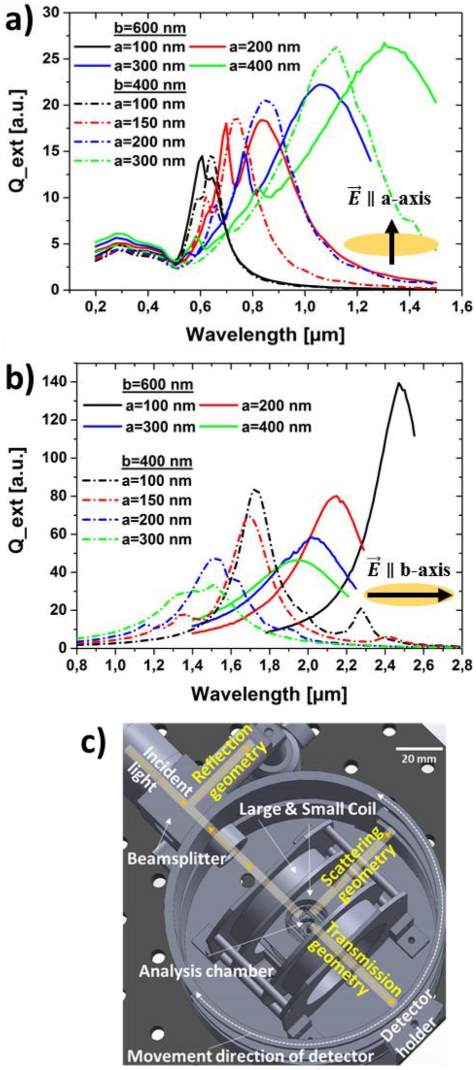

*Figure.1: Extinction efficiency factors for light polarized parallel to the short a) and long b) semi-axis with varying nanoparticle geometry. c) MLoB-Setup illustrating the beam path for optical measurements in reflection, transmission and scattering geometry.*

References:
[1] S. Schrittwieser et al., Procedia Engineering 5 (2010) 1107 – 1110.