Bioanalytics using plasmonic nanostructures

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Abstract: Novel requirements for bioanalytical methods emerge due to trends such as personalized medicine or pathogen monitoring in environment and food. Here, innovative tools for diagnostics are needed, to be used outside of dedicated laboratories and with less qualified personnel, at minimal costs. Plasmonic nanostructures promise to provide sensing capabilities with the potential for ultrasensitive and robust assays in a high parallelization, and without the need for markers. Upon binding of molecules, the localized surface plasmon resonance (LSPR) of these structure is changed, and can be used as sensoric readout [1]. This is possible even on a single nanostructure level, using optical darkfield detection introduced more than 100 years ago [2], as demonstrated for DNA detection [3]. In contrast to SPR, LSPR senses only in a very thin layer (on the scale of the particle diameter), resulting in an efficient background suppression [4].

In order to multiplex this approach, an imaging spectrometer based on a Michelson interferometer has been developed, able to readout a whole array of sensors in one step [5]. On the sensor side, microarrays of gold nanoparticle spots were fabrictaed using spotting of pre-synthesized gold nanoparticles [6]. Such chemically synthesized particles allow for a cost-efficient generation of highly crystalline particles as nanosensors; by using microfluidic approaches, a high quality and reproducibility can be achieved [7]. The functionalization of the various particle spots is realized by spotting thiolized DNA onto each spot separately. Using this approach, a multiplex DNA-based detection of fungal pathogens involved in sepsis could be demonstrated [8].

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