Development and Application of a Plasmonic Microarray for Multiplexed DNA Detection

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A two-dimensional plasmonic microarray and its potential for multiplex detection will be presented in this research work. Arrays of sensor spots - each consisting of an ensemble of gold nanoparticles (AuNP) - were prepared by the defined deposition of colloidal nanoparticle solutions on chemically modified glass substrates (schematics Fig. 1a) [1]. The used piezo-dispensing system for the particle deposition additionally allowed the functionalization of individual sensor spots with receptor molecules (schematics in Fig. 1b). The quality of the generated spots and the target accuracy of the additional deposition of the dissolved receptor elements was investigated by dark field microscopy. The dark field image in Fig 1a shows an array of bare sensor spots and Fig. 1b a partially functionalized sensor spot array. In the presented study the generated array was functionalized with various single stranded capture DNA sequences for the potential detection of sepsis relevant fungi pathogens [2]. After integration of the prepared sensor chip in a microfluidic chamber the parallel read-out of the extinction spectra of 50 individual sensor spots was enabled by Fourier-transform imaging spectroscopy. The extinction spectra were measured before and after incubation with corresponding target sequences and allowed the parallel determination of the sensor response of the spots modified with different capture DNA sequences. The specific detection of target sequences on the corresponding capture spots was successfully demonstrated for four out of five investigated sequences. The developed detection scheme based on the plasmonic microarray opens up new potentials for on-site platform systems based on plasmonic nanostructures.

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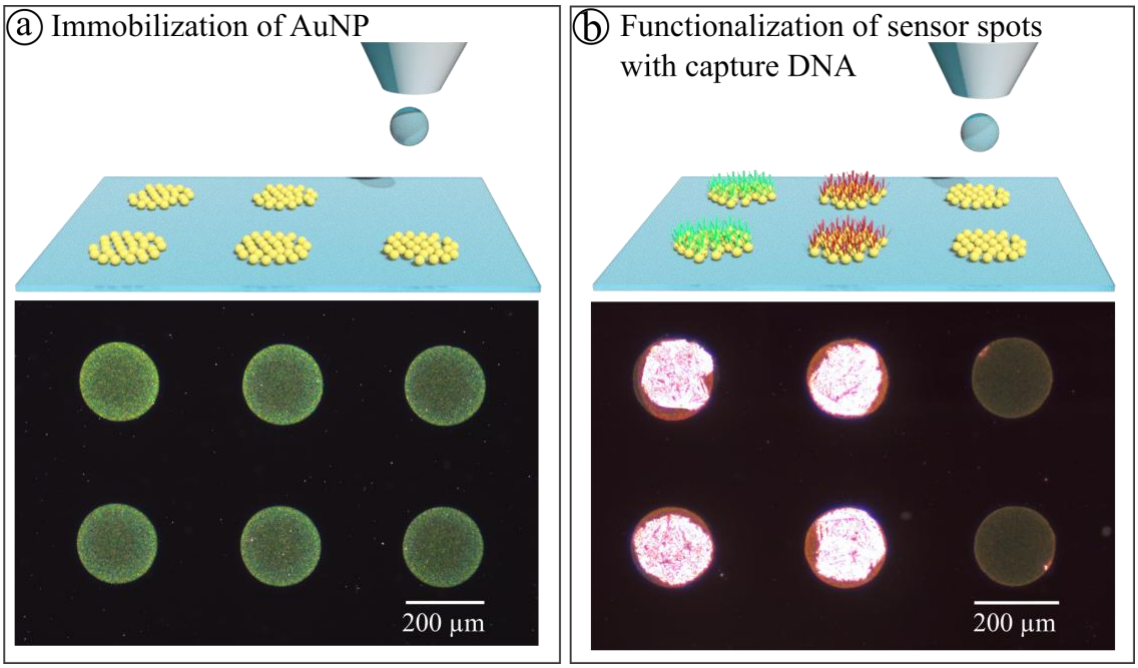

Fig. 1 Schematic representation of the manufacturing process of nanoparticle-based sensor spots by means of a microarray spotter. (a) Schematic of the immobilization process of the gold nanoparticles (AuNP) on a chemically modified glass substrate (top). Dark field image of six sensor spots of 80 nm spherical gold nanoparticles (bottom). (b) Functionalization of sensor spots (top). Dark field image of four sensor spots after functionalization of DNA sequences dissolved in citrate buffer and two non-modified sensor spots (below). Modified from [3].

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