Bioanalytics Using Plasmonic Nanostructures

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Abstract. Today, innovative tools for diagnostics and bioanalytics are needed, to be usable 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 miniaturization, and without the need for markers. Upon binding of molecules, the localized surface plasmon resonance (LSPR) of these structures 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, imaging spectrometer setups, e.g. based on a Michelson interferometer or multiple LEDs have been developed, able to readout a whole array of sensors in one step [5]. On the sensor side, microarrays of gold nanoparticle spots were fabricated 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 higher quality and reproducibility can be achieved [7]. Using this microarray approach, a multiplex DNA-based detection of fungal pathogens involved in sepsis could be demonstrated [8]. DNA-based signal amplification, e.g. by hybridization chain reaction, improves the sensitivity [9]. Beyond DNA detection, LSPR sensing is also applicable for the detection of protein targets, such as CRP [10].

REFERENCES

[1] Philosophical Transactions **A 369**, 3483 (2011).

[2] Angew Chem Int Ed **51**, 11208 (2012)

[3] J Nanopart Res **15**, 1531 (2013)

[4] Sensing and BioSensing Research **7**, 62 (2016)

[5] Biosensors and Bioelectronics **81,** 287 (2016), Advanced Photonics Research, in revision (2023)

[6] Analytical and Bioanalytical Chemistry **411**, 1537 (2019)

[7] Chemical Engineering Journal **288,** 432 (2016)

[8] ACS Sensors **4,** 335 (2019)

[9] Biosensors and Bioelectronics 167, 112465 (2020)
Scientific Reports **12**, 836 (2022)