

High-throughput optical biosensing with localized surface plasmon resonance imaging (LSPRi)

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Abstract:

Surface plasmon resonance (SPR) based biosensor devices have been on the market for more than four decades. Besides high sensitivity and label-free detection, the imaging capability of SPRi devices also enables high-throughput measurements with up to several thousand parallel measurement spots on a single sensor surface [1]. Localized surface plasmon resonance (LSPR) based sensors utilize nanostructures instead of thin films, and they offer several advantages compared to SPR, such as the possibility to maximize surface sensitivity by tailoring the nanoparticles' near field to the size of the used receptor/target molecules, and also the simpler, transmission-based optical setups [2]. However, to date, no LSPR imaging-based devices are on the market. The talk will address theoretical considerations for realizing and optimizing nanoparticle arrangements for use as LSPRi sensor elements and will present a technology for fabricating a tightly packed nanoparticle layer consisting of hexagonally arranged gold nanoellipsoids with tunable interparticle gaps, exhibiting high surface sensitivity [3]. A custom device that uses a simplified form of hyperspectral imaging to implement the LSPRi principle on a 4 mm by 5 mm sensor surface comprising patterned nanoparticle layers will also be introduced, along with practical applications for small-molecule sensing (DNA-DNA hybridization and aptamer-heavy-metal ion binding).

Keywords:

biosensors, plasmonics, LSPR imaging, nucleotide sensors, nanoparticles

References:

- [1] J. Xu, P. Zhang, Y. Chen, Surface Plasmon Resonance Biosensors: A Review of Molecular Imaging with High Spatial Resolution, *Biosensors* 14(2), 84 (2024); doi: 10.3390/bios14020084
- [2] A. Bonyár, Label-Free Nucleic Acid Biosensing Using Nanomaterial-Based Localized Surface Plasmon Resonance Imaging: A Review, *ACS Applied Nano Materials* 3(9), 8506–8521 (2020); doi: 10.1021/acsanm.0c01457
- [3] T. Lednický, A. Bonyár, Large Scale Fabrication of Ordered Gold Nanoparticle–Epoxy Surface Nanocomposites and Their Application as Label-Free Plasmonic DNA Biosensors, *ACS Applied Materials & Interfaces* 12(4), 4804–4814 (2020); doi: 10.1021/acsami.9b20907.