MULTIPLEXED SINGLE-MOLECULE PLASMONIC BIOSENSOR FOR CANCER CELL-FREE DNA BIOMARKER

Lead partner:
Danube Private University

Scientific management:
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Additional participating institutions:
AIT Austrian Institute of Technology - Standort Giefinggasse

Field(s) of action
Health and nutrition

Scientific discipline(s)
2100 - Nanotechnology (50 %)
3040 - Medical Biotechnology (30 %)
1030 - Physics, Astronomy (20 %)

Funding tool: Basic research projects

Project-ID: FTI24-G-027

Project start: 01. März 2025

Project end: 29. Februar 2028

Runtime: 36 Monate / ongoing

Funding amount: € 358.887,00

Brief summary:
The project aims at the development of an optical plasmonic platform for readout of individual binding events serving in highly sensitive detection of methylated DNA present as cell-free circulating DNA in human blood plasma at ultra-low concentration. In addition, the proposed approach offers multiplexed signals corresponding to different analytes and does not need a compartmenting method such as microdroplet, and microwell. The platform consists of tailored plasmonic nanostructures for localizing optical excitation and generating hotspots in order to enhance optical spectroscopic signal associated with relevant target analytes. Enzyme-free and isothermal catalytic hairpin assembly amplification is used to increase optical signal strength by producing an amplicon, customized with a long flexible polymer linker composed of a combination of several DNA strands. Optically probing the plasmonic surface after DNA amplification presents the distribution of bright spot corresponding to the position where DNA amplification occurred, that offers digitally countable signal representing from target detection assay. Tailoring DNA strands for amplification produces distinct cluster groups emitting respective signals for multiplexing detection of heterogeneous DNA samples. Conjugating methylated cytosine-specific protein with the trigger of DNA amplification will alter to assess the presence of methylation as well as the detected target DNA analyte in the same fashion as the multiplexed detection. Kinetic analysis of amplification associated with the methylation will indicate the degree of methylation. The digital plasmonic platform is delivered to detect in parallel several methylated DNA samples relating to lung cancer species at aM concentration level.

Keywords:
Biosensor development, nanotechnology, optics, single molecule detection, methylated DNA, cancer diagnosis

RESULTS

PEER-REVIEWED PUBLICATION

Tethered Split-Aptamer Biosensor for Plasmon-Enhanced Fluorescence-Based Continuous Monitoring of Vancomycin
Content: (Impact of biointerface design on derivative flexible-polymer-based tethering technology)
Authors: Gizem Aktug, Naoto Asai, Anil Bozdogan, Catia Santa, Khulan Sergelen, and Jakub Dostalek
https://doi.org/10.1021/acssensors.5c03606