Label-Free Identification of Cancer Cells using DNA Aptamers and Laser-Based Biosensors

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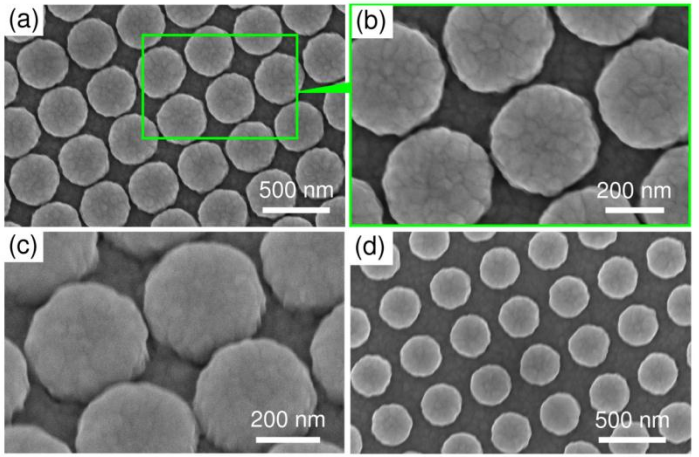
Objective: To develop a biosensor for early detection and classification of cancer based on profiling the expression of cancer cell biomarkers.

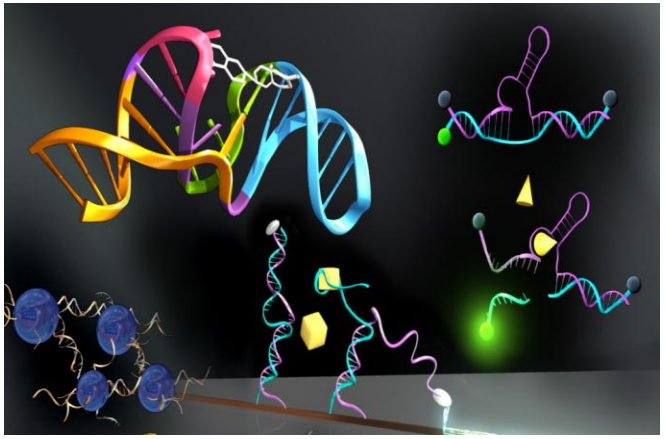
Motivation: Personalized chemotherapy is an unmet challenge in cancer treatment. Many modern cancer drugs work by targeting particular cancer biomarkers expressed on cell membranes. As biomarker expression levels vary from person to person, so do individual responses to treatments. A diagnostic tool under development capable of measuring expression of multiple cancer biomarkers will replace a lengthy and dangerous trial-and-error approach currently used for determining drug effectiveness. Furthermore, the ability to track levels of biomarker expression over the course of treatment will enable doctors to timely adjust medication dosages, thereby enhancing treatment effectiveness.

Research Highlights:

- Developed a fabrication protocol of SERS sensors using gold, rather than silver, for improved sensor biocompatibility and reduced background noise.



SEM images of Ag-coated nanodome array SERS substrates[1]



Nucleic-acid based sensors, artist's rendition[2]

- Developed a surface chemistry protocol for immobilizing DNA aptamers
- Studied substrate wetting properties and dramatically improved analyte detection levels via better surface wetting.
- Demonstrated robust label-free detection of single-stranded immobilized aptamers.

Future research:

- Demonstrate differentiation of an immobilized aptamer layer before/after exposure to its specific recognition target.
- Characterize sensitivity of substrate to the molecular makeup of aptamers.
- Characterize dose/response due to exposure to target molecules.
- Perform detection and quantification of unknown concentrations of biomarker molecules taken from cancer cell supernatant.

[1] C.J. Choi et. al. *Nanotech.* 21, 415301 (2010), [2] J. Liu, Z. Cao, Y. Lu, *Chem. Rev.* 109, 1948–1998 (2009).