Master Degree Project in Applied Physics, SCI School for HT19/VT20

Title: Multiplexed profiling of extracellular vesicles (EVs) using an electrokinetic sensor.

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Background and state of the art: Although significant improvements have been achieved in detection and targeted therapy approaches, cancer remains the leading cause of death. Nowadays, tumors are mainly diagnosed through invasive biopsies. These are challenging for some cancer types, therefore large interest has been put into small extracellular vesicles (sEVs) liquid biopsies,[1] where the tumor and its treatment response is monitored in body fluids. sEVs are nanosized vesicles released by cells that are derived from the endolysosomal pathway and enclosed by a lipid bylayer.[2] These molecules have attracted interest as a source of liquid biopsies for cancer diagnostics because they reflect their cells of origin, thereby bringing information about the tumor type and stage. Available techniques to detect EVs in body fluids (optical, electrochemical, etc..), are limited by a number of factors, the most important of which include high costs, bulky and expensive detection devices and extensive labeling for detection.

Main goal: We have already demonstrated a novel label-free electrokinetic sensor, based on streaming current, that is successful in detecting and profiling EVs from cancer cells by targeting their membrane proteins. The next goal will be to extend the platform for multiplexed EV detection, possibly on a chip, and demonstrate detection of these vesicles from patient samples. For this purpose, the thesis project will focus on:

- Functionalization of microchannels/microchip for specific EV detection
- Optimization of the multiplexed detection setup
- Electrical measurements for EV detection from patient samples

Applications: Please contact Associate Professor Dr. Ilya Sychugov, ilyas@kth.se; Project starting in September 2019, but an earlier date can be discussed.

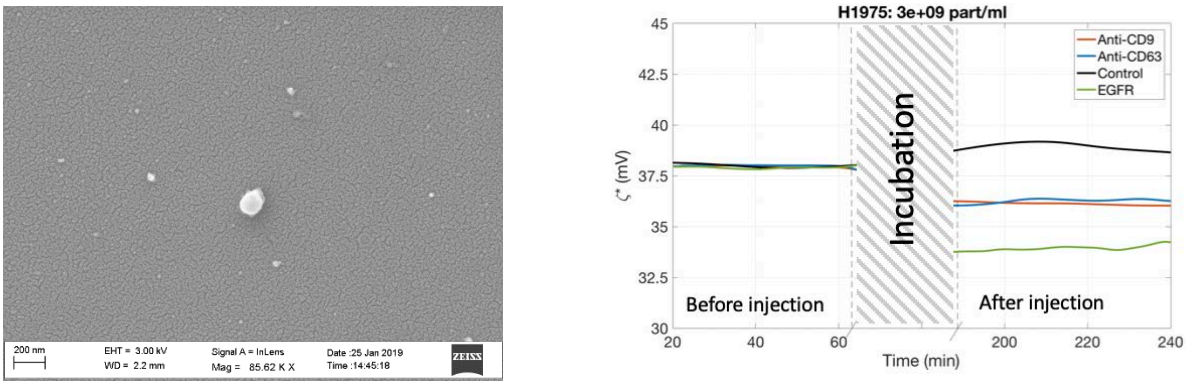

Figure 1. Left: SEM imaging of a sEV. Right: Example of electrokinetic measurements detecting sEV by different surface proteins.

References:

1- Cui, S.; Cheng, Z.; Qin, W.; Jiang, L. Exosomes as a Liquid Biopsy for Lung Cancer. Lung Cancer 2018, 116 (25), 46–54.

2- El Andaloussi, S.; Mäger, I.; Breakefield, X. O.; Wood, M. J. A. Extracellular Vesicles: Biology and Emerging Therapeutic Opportunities. *Nat. Rev. Drug Discov.* **2013**, *12* (5), 347–357.