

# BIOENGINEERING & BIOMEDICAL ENGINEERING RESEARCH SEMINAR

## IN SITU DETECTION OF EXOSOME PROTEINS USING PRINTED MICROARRAYS

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### ABSTRACT

Tissue biopsies are currently the most reliable way to make a cancer diagnosis and advise a course of treatment, despite their risks and limitations. Liquid biopsies, which involve easily accessible biological fluids, could significantly improve the diagnosis process. Released by all cell types—including cancer cells—, exosome-like extracellular vesicles (ELEV)s are of particular interest in that context, as their biomolecular cargo holds valuable information about their cell of origin. Proteins are an especially important cargo component; for instance, subsets of integrins were linked to specific sites of metastasis formation<sup>1</sup>, and it was shown that the detection of a specific proteoglycan target, glypican-1, can distinguish pancreatic cancer patients from healthy subjects<sup>2</sup>. In this work, we optimized an antibody microarray to capture cancer ELEVs and probe their protein content. Specifically, IgGs targeting surface markers were diluted in 29 different buffers and inkjet-printed in a microarray format. The arrays were then incubated overnight with GFP-tagged ELEV samples, after what the captured vesicles were probed with detection antibodies. The tested combinations were compared based on the signal-to-noise ratio and coefficient of variation associated with the ELEV and detection signals. The best performing assay was then chosen to profile 4 different cancer cell lines for 15 surface targets, including standard exosome markers, integrins, and receptors of interest. This characterization work has the potential to help disease profiling efforts and is thus a step towards the development of new cancer diagnosis and treatment modalities.

## MOLECULARLY IMPRINTED MICROSHELL THROUGH LAYER-BY-LAYER ASSEMBLY OF NATURAL POLYELECTROLYTES ON E-COLI

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### ABSTRACT

Molecular imprinting aims to replicate cellular binding sites (receptors or ligands) by molding an impression of their structure onto a polymeric substrate. These imprints can be used to either complement or replicate the function of the template sites and present an interesting approach in biosensing as well as drug delivery applications. Current methods used in molecular imprinting, which involve the assembly and crosslinking of monomers around the template, are only effective for small molecules and present a challenge with larger structures like proteins, viruses and cells. Layer-by-layer (LbL) assembly of polyelectrolytes is proposed to tackle the challenge of imprinting larger biological structures as it allows for the synthesis of robust nanolayers onto large microstructures such as cells. The technique has been used for a variety of material surface modifications and it has numerous biological applications with notable examples including the construction of hollow polyelectrolyte capsules for enzyme encapsulation, and formation of polyelectrolyte capsules on red blood cells for immunocamouflage. Our laboratory has previously exploited this technique to obtain polyelectrolyte-coated E. coli for use as a bio-recognition element and discovered that a hollow polyelectrolyte capsule can be formed by cell lysis. Therefore, the aim of this study is to construct the hollow capsule by LbL assembly using E. coli DH5alpha as a substrate and chitosan/alginate bilayers as a polyelectrolyte coating. It is hypothesized that hollow capsules that resemble the surface morphology of the cell will be formed using these polyelectrolytes and the stability as well as bio-interaction and molecular imprinting capability of these capsules will be analyzed for applications as a drug delivery element.

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