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Multiplexed MicroRNA Detection on an Electronic Chip

Status	Current
Competition	Development of New Technologies Competition
Sector	Development of New Technologies
Genome Centre	Ontario Genomics Institute
Project Leader	Shana Kelley & Ted Sargent

Project Description

Gene expression, the process that turns information encoded within the human genome into instructions for cellular and physiological function, is fundamental to all biology. Understanding gene expression is essential to the progress of medicine: the level of expression of specific genes gives clues as to whether an individual may be entering into the early stages of disease. Every day, scientists working in genomics understand the links between gene expression and human health more clearly.

Investigations into microRNA - a class of nucleic acids discovered only a little over a decade ago - have led to a new understanding of how an individual's gene expression reflects his state of health. However, the powerful technologies used in other fields of genomics to quantify genetic material have proven cumbersome - arguably entirely unsuited - to measuring microRNA. This has hampered the field from making even more rapid progress. For example, it can take tens of hours and cost tens of thousands of dollars just to measure a single fingerprint of microRNA expression levels.

We propose to Genome Canada a partnership – in concert with the Prostate Cancer Foundation of Canada, the Ontario Research Foundation, the University of Toronto, and the Canadian Microelectronics Corporation - to build a platform technology ideally-suited to quantifying microRNA expression levels. In contrast with existing methods, the technology we propose to develop will cost under $10 per assay and will require 1 hour of operator time and an additional 1 hour of measurement time. Our technology will provide the sensitivity needed to work with samples already available in tissue banks. It will provide the dynamic range needed to quantify expression levels known to be relevant in genomics and clinical research based on microRNA.

Unlike existing platforms - which typically involve a number of enzymatic amplification steps, and often must measure light emitted from fluorescent probes - our chip will be purely electronic. The chip must simply measure the current that flows in a given microRNA-specific 'pixel' in response to the presence, or the absence, of that strand's complementary pair, the target of interest. The $5 camera chips in nearly ever cell phone sold today can sense as few as 5 electrons in each pixel; our circuits need far less sensitivity, requiring only 1000 electrons' worth of current flow per pixel to deliver research-relevant data.

The project will strive for relevance to the Genome Canada platform community through quarterly calls with its Technology Development Advisory Board, made up of an internationally acclaimed chemical biologist at Caltech; a Canada-based world leader in genomics and proteomics; and two industry experts with outstanding records of achievement in taking research innovations into clinical-research-relevant commercial production. We will engage in a close collaboration with the clinical research community, including one involving Dr. Fei-Fei Liu, a clinical oncologist based at Princess Margaret Hospital.

Project leader Kelley and her co-leader Sargent are intent on commercializing the technology. The prototype developed with the support of Genome Canada will provide a system that can be used to demonstrate the technology in order to raise Series A venture funding. Kelley has previously participated in fundraising for a successful clinical diagnostics company sold in 2006 for $232M.

Sargent recently attracted US$7.5M in venture capital to found an imaging company located in MaRS, a technology start-up incubator facility co-located with the University of Toronto and its affiliated teaching hospitals.