NANOPORE-FACILITATED SINGLE MOLECULE DETECTION OF MICRO-RNAS

Developing new technologies for cancer screening and early diagnosis is a critical issue for saving cancer patients' lives. MicroRNAs (miRNAs) are a class of short (~18-24-nt) non-coding RNAs molecules that regulate gene expression at the post-transcriptional level. Aberrant expression of miRNAs has been found in all types of tumors. Thus miRNAs have been recognized as potential cancer biomarkers. Most notably, specific miRNAs are released from the primary tumor into blood circulation, making the detection of circulating miRNAs profile a powerful tool for noninvasive cancer detection, diagnosis, staging, and monitoring.

We developed a robust *nanopore sensor* that selectively detects single molecules of circulating miRNAs derived from primary cancer.

The nanopore is a fabricated 2-nm molecular pore. Such a tiny pore can generate a signature current signal when a miRNA molecule is specifically captured in it. These signals function as fingerprints that enable us to identify a specific miRNA and quantify its concentration. The prototype of nanopore sensor has demonstrated the capability to discriminate single nucleotide difference between miRNAs (single nucleotide polymorphisms, SNPs). In clinical tests, the nanopore has shown the power to differentiate miRNA levels in blood from lung cancer patients and healthy people.

Due to the label-free single molecule detection without nucleic acids amplification, the nanopore sensor is higher selective, precise and accurate over the gold standard RT-PCR and microarray. This noninvasive clinical test requires a mere 5 ml of peripheral blood, with a reduced cost from several hundred dollars today to less than 20 dollars per sample. The developing nanopore array would give a high throughput capability for detecting miRNA profile. If validated in clinical trial, the nanopore sensor will become a system available to monitor cancer patients and to screen high risk populations for early diagnosis of cancers which will potentially save the lives of millions.

POTENTIAL AREAS OF APPLICATIONS:

- Detection of microRNAs, study of DNA, RNA, DNA/RNA hybrid unzipping kinetics
- Study of miRNA mechanism and principle of regulation
- Drug discovery and development
- Biomarker characterization
- Diagnostics and prognostics.

PATENT STATUS: Provisional patent application on file

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