Optimization of a Signal Enhancement Strategy for the Detection of MicroRNA Using Silicon Photonic Microring Resonator Arrays

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Abstract

MicroRNAs (miRNAs) are an important class of non-coding RNA molecules, regulating gene expression at the transcriptional and post-transcriptional level. As potent gene regulators, miRNAs have been linked to developmental processes and establishment and maintenance of tissue differentiation. As a result, miRNA expression in tissue and blood samples can be associated with disease types and stages and be used to fully distinguish tissue types. These findings, among others, have firmly established the diagnostic value of miRNAs. Recently, our group has shown the ability of silicon photonic microring resonators to quantitatively detect miRNA.This technology is scalable, highly multiplexable (128 sensors/chip), and inexpensive (<$1/assay). Current nucleic acid analysis methods have distinct disadvantages when compared to microring resonators. qRT-PCR is incredibly sensitive but requires expensive reagents and has limited multiplexing capabilities. Conversely, microarrays are highly multiplexable, but labor intensive and expensive. Here we use the microring resonator platform to quantitate expression levels of 7 miRNAs relevant to distinguishing tissue type, while also leaving sensors to normalize data and compare the results to those obtained from qRT-PCR (the current gold standard).