

Microfluidic Device for Rapid Simultaneous Detection of DNA, RNA, and Protein Biomarkers in Single Cells

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Background

Molecular diagnostics is currently the fastest growing segment (~12%) of the overall global \$45.6 B diagnostics market. There are many existing molecular diagnostic technologies that can measure one category of biomarkers, such as PCR for nucleic acids, or immunoassays for proteins, but true multiplexed detection of multiple nucleic acid and protein biomarkers in the same cell remains a challenge, especially for rare sample types such as biopsies and primary cells. In addition, most molecular diagnostics must be performed in specialized facilities, requiring days to weeks of turn-around time and high reagent and labor costs.

We present an automated microfluidic chip based device along with its suite of customized molecular assays that enables the multiplexed detection of mRNA¹, small non-coding RNA², proteins³, and post-translational modifications⁴ in the same intact cells, with ~95% reduction in sample and reagents and under 8 hours of assay time. The device produces fluorescent images as well as flow cytometric measurements of each biomarker, and provides an unprecedented, comprehensive look into the molecular physiological state of cells. Commercialization of the microfluidic device will produce a new generation of *in vitro* diagnostics that enable point-of-care cell-based assays to rapidly diagnose complex disorders or track patient responses to drug therapies, bypassing long wait times and high costs with improved clinical outcomes.

Technology

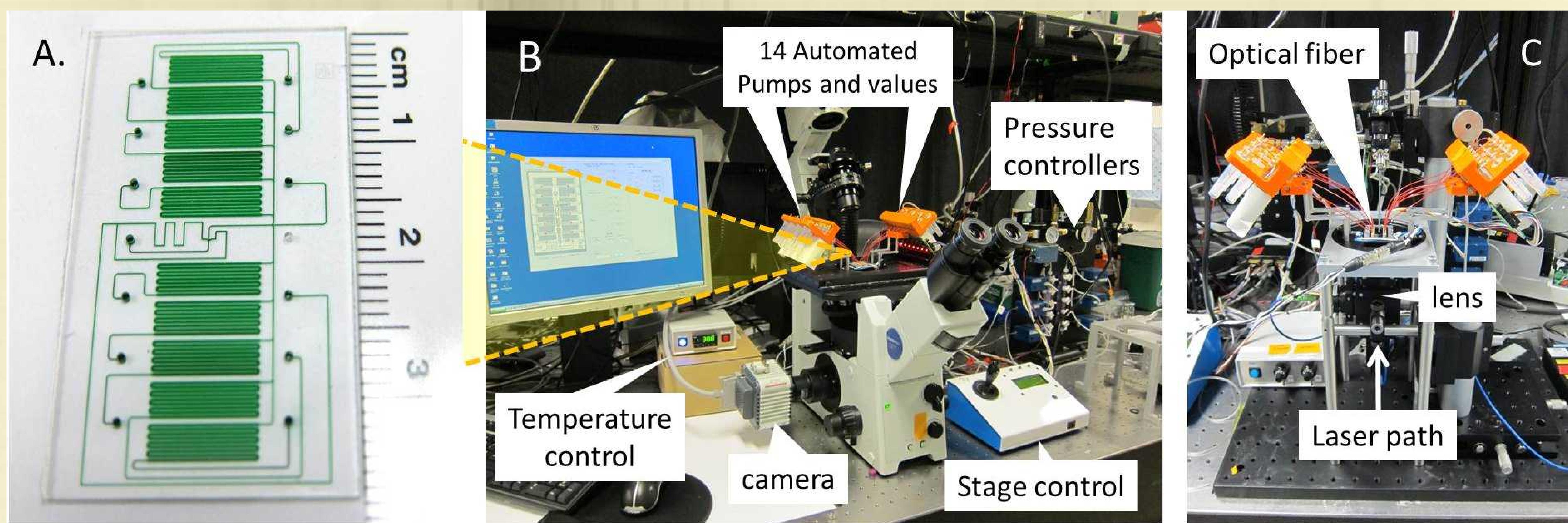


Figure 1. Microfluidic platform details. A). 10 chamber microfluidic chip, each serpentine chamber is individually addressable to allow 10 different conditions per experiment. B). The 10 chamber chip is situated in a manifold (orange dash) with 14 pumps and valves that use positive pressure to drive the movement of cells and reagents on and off the chip. The manifold is retrofitted to a commercial inverted microscope with attached camera. A series of custom add-on features including the pumps and valves, pressure controllers and temperature control are controlled by the user using a GUI with programmable features for automated sample preparation. C). The chip and manifold can be placed in a custom micro-flow cytometer for flow cytometric analysis.

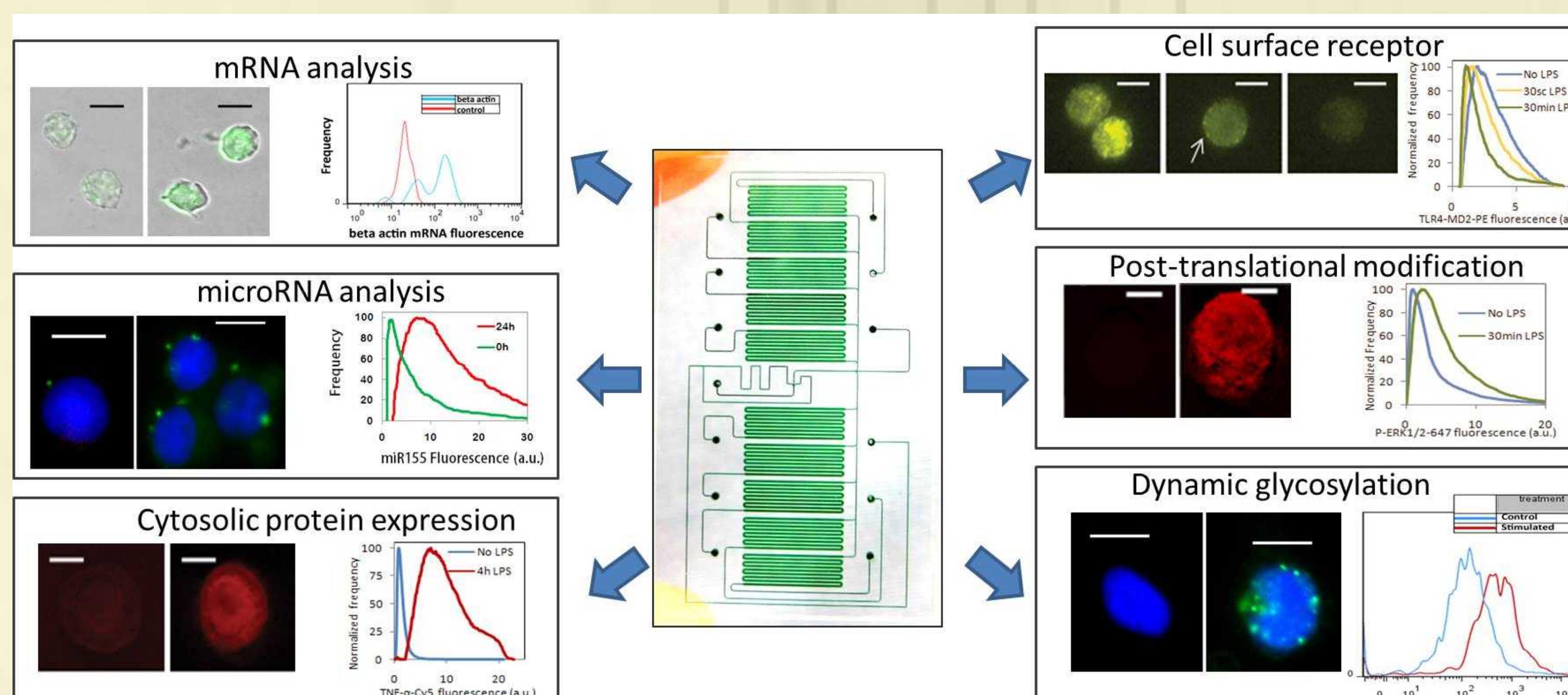


Figure 2. Suite of microfluidic molecular assays developed for the platform. mRNA, miRNA, and protein quantitation, as well as transient cell surface receptor activation, post-translational modifications including phosphorylation and dynamic glycosylations are all detectable on the chip platform. All assays are compatible for multiplexing.

References

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