Novel Single-Cell Screening: Optimized Droplet-Based Microfluidics for High-Throughput Screening of Adherent Cells

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Cell screening has revolutionized the field of medicine, with hundreds of cancer drugs owing their discovery these techniques. However, current methods involve analyzing population of cells (100/1000 cells) instead of expression on the single-cell level. To detect significant differences in cell heterogeneities and improve screening accuracy, single-cell expression must be detected. In this study, I developed for human cells a new form of droplet microfluidics -- a method of screening that relies on the encapsulation of small volumes of liquid as emulsions to form monodisperse droplets. To enhance the viability of cells during screening, I developed a novel method of generating microgels of collagen in droplets to act as viable isolated extracellular matrices (ECMs). Cells encapsulated with collagen adhered to substrates and proved 2x more viable for further analyses. This new method of screening was completed with picoliter/nanoliter volumes of reagents in a matter of minutes (compared to mL samples and hour-long assays required for traditional methods). Compared to current well plate-based tests, this technique has the ability to screen human cells 1,000x faster and with 100,000x less reagents. This method can thus be used to accelerate cancer drug discovery and disease diagnosis, among a wide variety of other applications.

Awards Won:
Fourth Award of $500