Ultrafast Single-Cell Level Enzymatic Tumor Profiling

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LECTURE ABSTRACT

In the context of tumor analysis, the implementation of precision medicine requires on-time clinical measurements, which requires rapid large-scale single-cell screening that obtains cell population distributions and functions in tumors to deter-mine disease progression for therapeutics. In this study, a high-throughput screening (HTS) platform integrating optical fluorescence detectors and a computational method was developed as a droplet-based microfluidic system (Droplet-Screen) to comprehensively analyze multiple proteolytic activities of a patient's tumor (with ~0.5-2M cells) at single-cell resolution within two hours. The data-driven analytical method identified distinct cell types and status through protease profiling with high precision. Multiple protease activities of single cells harvested from a tumor were thus determined with a throughput of ~100 cells per second. This platform was used to screen protease activities of a wide range of cell types, forming a library. With the development of advanced computational clustering and cell mapping, rapid quantitative tumor profiling with a comprehensive description of cell population distributions and functions could be obtained for clinical treatments.

SPEAKER BIOSKETCH

Dr. Chen is developing a research program focused on integrative droplet microfluidic platforms for clinical enzyme measurement and single cell characterization for biomedical applications. Compared with most current fluidic platforms using gene sequence for diagnosis, microfluidic assay offers unique advantage in rapid measurement to characterize biological fluids for on-time precision medicine. Dr. Chen has collaborated with clinicians/researchers at the National University Hospital of Singapore (NUHS) and Massachusetts General Hospital (MGH) to develop integrative microfluidic devices for diagnosis. One of his projects is now sponsored by an industrial partner, MediaTek, and aims to develop a wearable microfluidic sensor for personal care at home. With this program, he has delivered promising research outcomes, including more than 40 papers in international journals including Nature Communications, PNAS, JACS and Lab on a Chip. Moreover, he has secured the external grant of ~4M USD to support the research activities and was nominated by the committee in Royal Society of Chemistry (RSC), as an Emerging Investigator in Lab on a Chip.