The Chinese University of Hong Kong

Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

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Date	:	3 July 2019 (Wednesday)
Time	:	2:30 p.m.
Venue	:	Room 215 William MW Mong Engineering Building (ERB)

Title: Microheating-induced Particle/Cell Manipulation and Nucleic Acid Amplification

The use of microheating-induced temperature gradient for target manipulation in microfluidics is an emerging topic in recent years. The mechanical forces behind this approach are due to a phenomenon called thermophoresis. Thermophoresis refers to particle motion along thermal gradients, which is caused by particle-solvent interactions that are sensitive to physical and chemical parameters such as particle size, temperature, pH value, and ionic concentration. Resistive heating is an ideal method to generate this temperature gradient within microfluidic devices, in addition to the merits of easy fabrication and miniaturization. Using simple deposition and photolithography, we have fabricated gold micro-resistors on a silica glass substrate to demonstrate the manipulation of micro-sized particles and live cells using Joule heating. Electric current crowding at narrow channels results in temperature gradients that can be readily controlled and well-used for the sorting, trapping and transferring of polystyrene sphere (PS) and live cells.

Another method to generate a stable temperature gradient in microfluidics is to convert photon energy into heat. Optical trapping has long been developed for a variety of bio-applications due to its high spatial and force resolution, as well as non-contacting capacity. To further enhance target confinement and immobilization, we fabricate a 2D array of micro-wells using polydimethylsiloxane (PDMS). In this case, we could guide the target cell into a micro-well using an optical tweezer. This was followed by heating the cell with the same laser source through plasmonic absorption in the gold film that we pre-coated on the bottom of the micro-well array. By adjusting the incident laser power, we successfully achieve a series of cell analysis steps including cell lysis to release the nucleus DNA and the subsequent nucleic acid amplification. The assay time was within one hour.

In summary, we have demonstrated two entirely different micro-heaters for achieving localized thermal gradients that may offer the capability of photon-free particle manipulation and single cell analysis. Furthermore, both designs are ready for direct integration with lab-on-a-chip devices.

***** ALL ARE WELCOME *****

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