## Proposed abstract for Microfluidics 2022 Conference

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# Aspiration Microfluidic Channel for Oocyte Characterization

Oocyte development is largely dependent on its mechanical properties. Cell mechanics control the outcome of cell division. In recent years, various techniques such as the micropipette aspiration (MPA) and optical tweezers are being used to measure the mechanical properties of membranes. The traditional MPA systems, however, have low throughputs and limited potential for automation and require bulky infrastructures. These methods have been used to investigate the mechanical characteristics of single cells including the elastic and viscoelastic properties, etc. In MPA methods, by applying a specific suction pressure, the cell aspirates into a micropipette. The amount of aspirated surface into the pipette is then recorded and measured using an electron microscope over time. During the aspiration, any leakage between the cell and the micropipette needle causes an error in the measurement of suction pressure. Due to the complexity of pressure measurement, the accuracy of the results largely depends on the skill of the user of the equipment. Furthermore, surface water evaporation and bubbles in the micropipette lead to errors in measuring the applied pressure. Although the aspiration force is applied to the entire oocyte volume, since the direction of the applied pressure is random, the average values for the measured mechanical characteristics of the entire cell are considered. On the other hand, these techniques are generally labor-intensive and time-consuming, typically involving a difficult process of manipulation.

Microfluidic channels have been developed in the past two decades for various biomedical applications, due to advantages such as the real-time analysis, system integration, transparency for the direct optical access, labor and precise control, lower cost, and reduced space. Furthermore, microfluidic channels can be integrated with other techniques and can enhance traditional cell analysis methods. Biological cell analysis and characterization can be performed based on the shape, size and deformability of single cells in microfluidic chips. Various methods have been applied for microfluidic single-cell trapping including hydrodynamic trapping, dielectrophoresis trapping, chemical trapping, gel trapping, magnetic trapping, acoustic trapping, laser trapping, etc.

In this lecture, I present a new method for designing and manufacturing of microfluidic channel in order to measure and evaluate the mechanical properties of mouse oocyte. The proposed process has advantages of high accuracy, fast and easy operation. In our proposed technique, the oocytes are trapped in a specific channel, as shown in Fig. 1.

This is one part of new results of research work by the team under my supervision during the past four years.

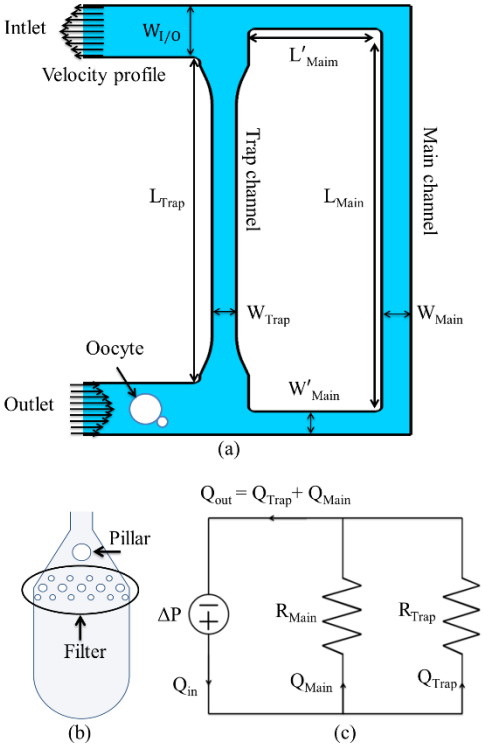



**Fig. 1** (a) A top view of the proposed microfluidic channel chip consisting of the main and trap channels. (b) Schematic of the designed filter at the inlet and outlet of the microfluidic chip. (c) Electrical equivalent circuit of the chip.

Fig. 2 shows the experimental system. The microfluidic channel was placed in a microscope and the trapping process was recorded using a high-speed camera. A syringe pump that accurately injected fluid volume at 0.001 µl/min to 100 ml/min into the microfluidic device, was connected to the microfluidic chip via the inlet. The oocytes that were healthy in terms of morphological features and had sizes between 90 and 120 µm, were selected for this experiment.

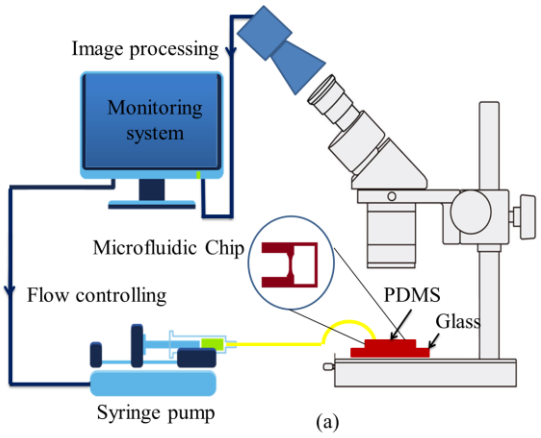



**Fig. 2** Schematic of the experimental setup. The microfluidic channel was placed on a microscope and the trapping process was recorded using a high-speed camera.