# Wireless Real-time Microscope in Ultracentrifuge

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## Introduction

The objective of this project is to develop a new class of centrifugation devices based on the "lab-in-a-tube (LabTube)" concept.

### Research Background

**1) Lab on a chip:** Integrated laboratory work into a chip platform

a. Miniaturization and high throughput
b. Control of the microenvironment
c. Increased sensitivity and non-invasiveness
d. Continuous flow and real-time analysis

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**2) Lab on a disc:** Centrifugal force acts as the pumping force

a. Multiple analysis steps integrated
b. Individual assays run simultaneously
c. No external interconnects required

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**3) Active "lab-in-a-tube" (LIAT) platform**

a. Microfluidics chip and microcontroller electronics b. Integrated in a common tube
c. Direction of force controlled by changing the angle d. Next-generation lab-on-a-disc (LOAD) platform

## Design and Fabrication

**1) Wireless real-time microscope in a tube 1.0**

Size: D25mm x H89mm
Elements: a. 3D-Printing skeleton (Nylon PA12)
b. Integrated circuits (50x lens added)
c. Microfluidic chip

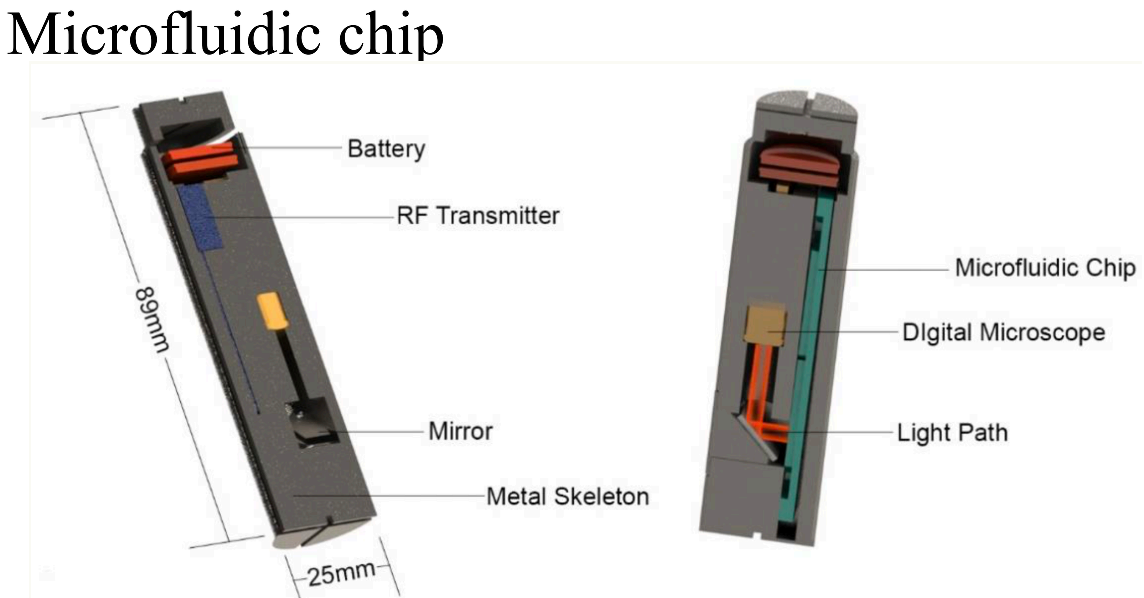


Fig.1 Schematic of the proposed method

**2) Wireless real-time microscope in a tube 2.0**

Size: D25mm x H89mm
Improvements:
a. Magnification: 50x
b. Light source: White LED
c. Light path: Transmission
d. Battery: Lithium battery

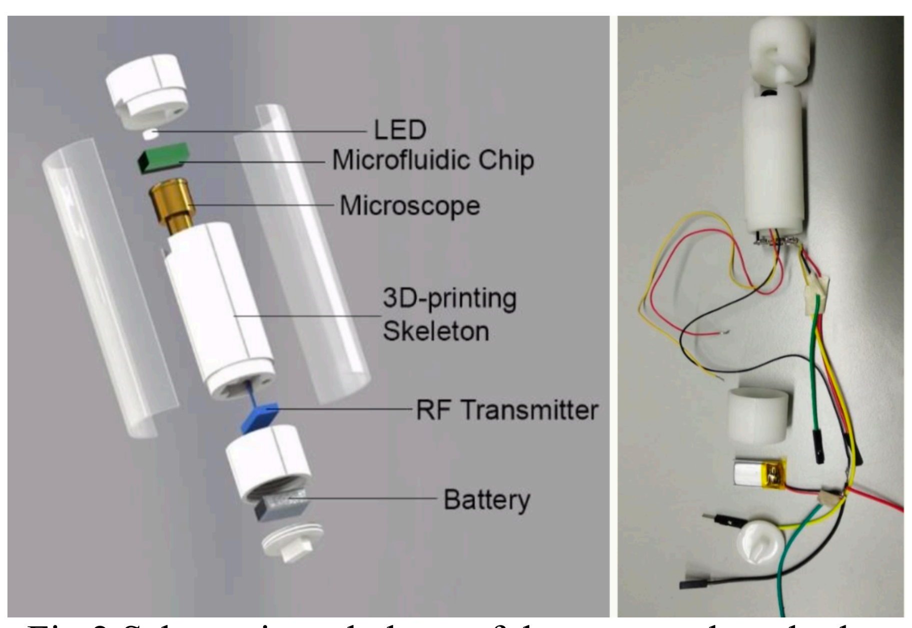


Fig.2 Schematic and photo of the proposed method

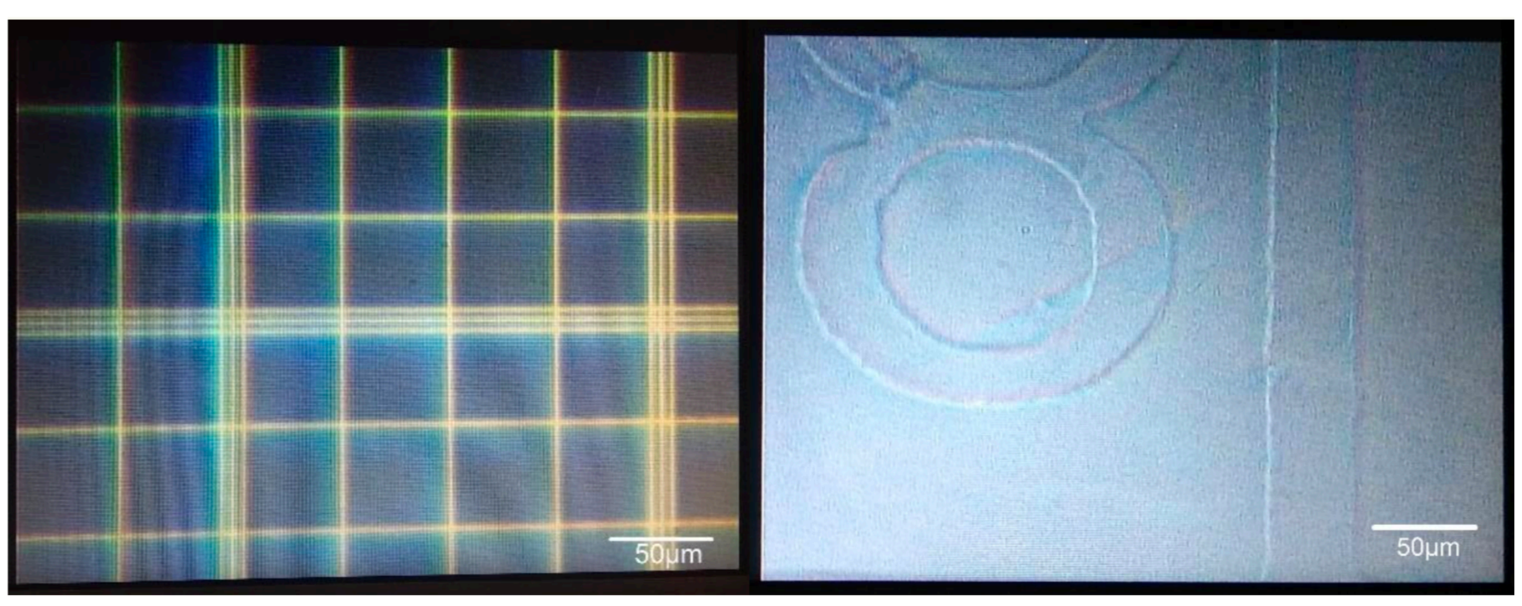


Fig.3 Hemocytometer observed through the invented microscope

## Innovativeness

**Miniaturized wireless microscope system**

**a. Real-time data feedback**

Integrated optical microscope
Capturing image responses from the sample

**b. Extreme g-force used for mechanical actuation**

Contents preloaded to the chip
Separation of products from bio/chemical reactions Density assessment of intracellular organelles Binding force measurement

## Possible Application

**1) Miniaturized wireless microscope system**

a. Integrated to a microfluidics chip
b. **Real-time monitor** on bio/medical reactions
c. Monitoring the response from **cellular** materials undergo extreme g force
d. **Mechanical parameter** assessment of live cells

An essential cell physiology indicator

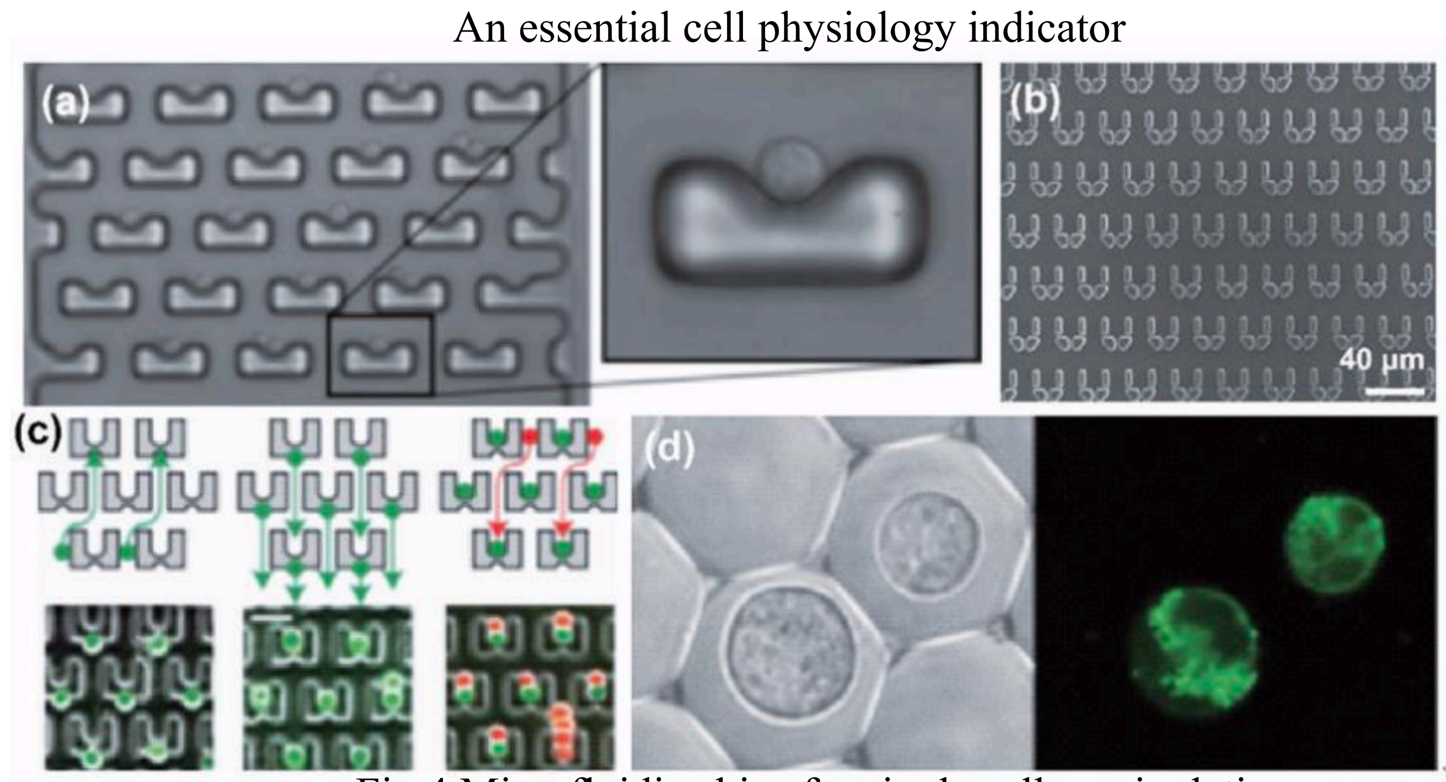


Fig.4 Microfluidic chips for single cell manipulation

**2) Wireless-controlled opto-mechatronics**

a. Real-time actuation and sample processing
b. Centrifugation force modulated by changing angle
c. Automatic fractionation of a fluidic sample performed d. 3D centrifugal microfluidics application

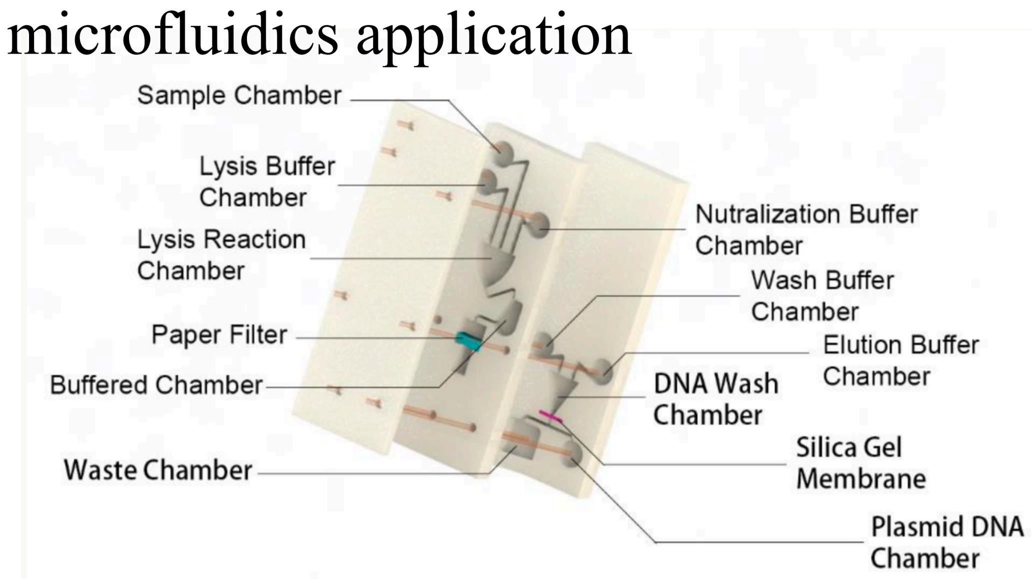


Fig.5 Multi-layer bioassay microfluidic chip

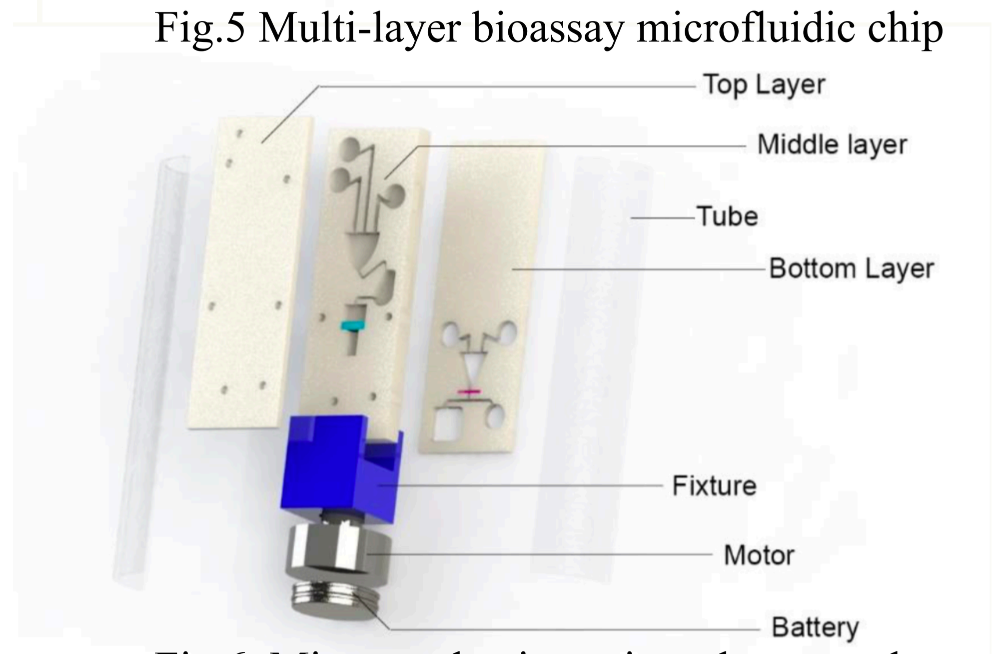


Fig.6 Micromechanics to introduce angular movement

**3) Active centrifugal microfluidic chip**

a. On-demand local heating/cooling
b. Signal ex

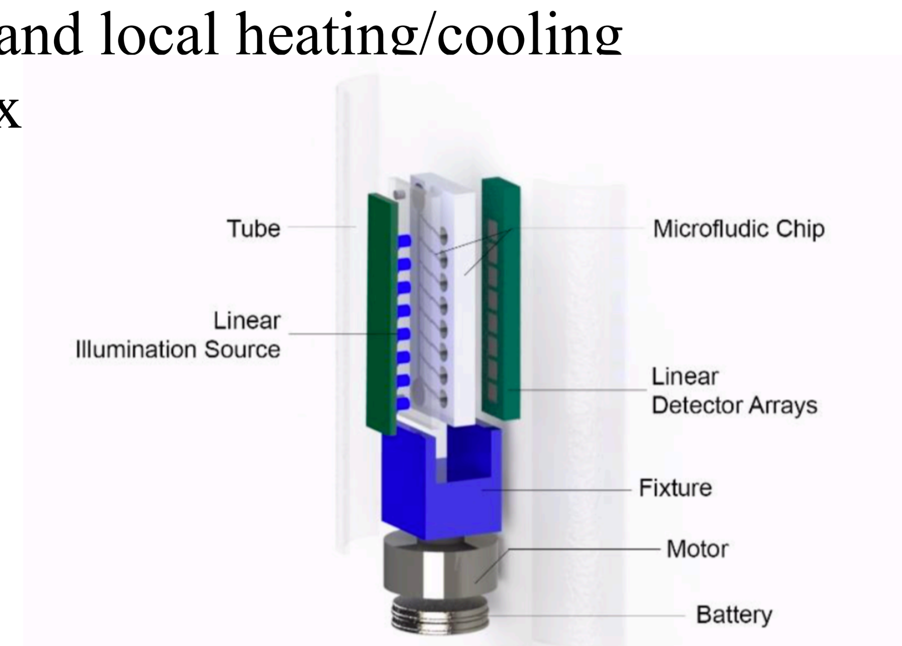


Fig. 7 Linear illumination excitation and detection arrays