

A Device For Continuous Focusing And Rotation Of Biological Cells And Its Application For High Throughput Electroration Flow Cytometer

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SUMMARY

UCLA researchers in the Department of Mechanical and Aerospace Engineering have developed a novel device for high-throughput label-free analysis of cells.

BACKGROUND

Cytometry is an essential analytical tool in cell biology and disease diagnosis and has an estimated market size of over \$6.3 billion by 2020. While many flow techniques require fluorescent tags, labeling requires additional handling as well as the presence of specific antibodies or markers on the cells of interest. One label-free technique is electroration (ROT), where the rotation of a cell in a magnetic field can be correlated to its characteristic dielectric properties. In conventional ROT, cells must be carefully positioned so each receives the same electric field strength for accurate comparison. However, this presents significant challenges at the single-cell level and results may be affected by friction between the cell and the surrounding medium. Novel high throughput methods of isolating and analyzing cells using ROT would significantly improve the label-free analysis of cells.

INNOVATION

Professor Chiou and coworkers have developed a novel microfluidic device for high throughput analysis of cells using electroration (ROT). Using dielectrophoresis (DEP), cells are aligned and focused within a tunnel-shaped electric field. A second set of electrical signals is then applied to rotate the focused cells and a high-speed camera is used to image the rotating cells. Post-processing analysis enables the measurement of cell size, texture, shape, and rotation speed. This technique does not require fluorescent labeling and flow throughput in the device is improved by 4 orders of magnitude compared to conventional electroration-based cell analysis, up to 42 cells/sec.

APPLICATIONS

- ▶ Diagnosis based on cell dielectric properties
- ▶ Sorting subpopulations of cells
- ▶ 3D cell imaging and cell growth

ADVANTAGES

- ▶ Analysis of a high concentration of cells (10^6 /mL)
- ▶ Can be used in flow mode
- ▶ Four orders of magnitude faster throughput than conventional label-free electroration-based cell analysis (42 cells/sec)
- ▶ Sort and analyze subpopulations of cells

STATE OF DEVELOPMENT

Devices have been fabricated and shown to separate leukemia, lymphoma, and cervical cancer cells.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,566,994	01/31/2023	2017-522

CONTACT

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Microfluidic, flow cytometry, electroration, cell analysis, cellular biophysics, microchannel flow, electroration flow, continuous flow, focusing, single-cell analysis, plastic, substrates

CATEGORIZED AS

- ▶ **Biotechnology**
 - ▶ Health
- ▶ **Engineering**
 - ▶ Engineering
- ▶ **Medical**
 - ▶ Diagnostics
- ▶ **Nanotechnology**
 - ▶ NanoBio
 - ▶ Tools and Devices
- ▶ **Research Tools**
 - ▶ Other
- ▶ **Sensors & Instrumentation**
 - ▶ Analytical
 - ▶ Scientific/Research

RELATED CASES

2017-522-0

RELATED MATERIALS

- ▶ [Kung, Y.-C.; Man, T.; Huang, K.-W.; Chong, W.; King, J.; Chiou, P.-Y.; A high throughput electrorotation flow cytometer for single-cell analysis in continuous flows, 2017 IEEE 12th International Conference on Nano/Micro Engineered and Molecular Systems \(NEMS\), 2017.](#)

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Single-Pixel Optical Technologies For Instantly Quantifying Multicellular Response Profiles](#)
- ▶ [Plasmonic Nanoparticle Embedded PDMS Micropillar Array and Fabrication Approaches for Large Area Cell Force Sensing](#)

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