High-Throughput Intracellular Delivery of Biomolecular Cargos via Vibrational Cell Deformability within Microchannels

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SUMMARY

UCLA Researchers in the Departments of Chemistry and Materials Science & Engineering have developed a novel means of delivering intracellular cargo.

BACKGROUND

Gene editing of various cell types remains the focus of many therapeutic approaches across a wide spectrum of disease states. However, intracellular delivery of gene editing material, or other cargo, to the most exciting target cell types (e.g. stem and immune cells) remains difficult. Various approaches for intracellular delivery have been developed based broadly on one of two approaches: membrane-disruption-mediated or carrier-mediated delivery. Unfortunately, current techniques such as sonoporation suffer from low efficiency of gene transfer and high cell death due to irreversible damage to the cell membrane, all while requiring cells be fixed in one place during cargo delivery. An ideal technology for intracellular cargo delivery would cause minimal cell perturbation, be scalable, be useful across all cell types and be cost effective.

INNOVATION

Dr. Weiss and collaborators are developing a novel microfluidics device which utilizes vibrational cell deformation to deliver intracellular cargo. The invention both aligns cells for single cell flow-through and delivers cargo intracellularly by deforming the target cell membrane. Use of vibrational cell deformation within a microfluidic device removes the fouling associated with other devices where compressive force is applied via physical contact with microchannel walls. This invention is designed to be scalable via use in a highly parallel setting and is compatible with GMP processes. As proposed this novel device could allow for genetic manipulation of cells necessary for hematopoietic stem cell transplant for an infant in 1 hour.

APPLICATIONS

- Genetic modification of cells via various expression/manipulation techniques (RNAi, CRISPR/Cas9, TALENs, etc.)
- Generation of stem cell and immune cell therapies involving gene editing

ADVANTAGES

- Scalable via parallel work-flow setup
- Compatible with GMP processes
- Potentially reduced toxicities and increased delivery efficacy, especially with difficult to transfect/transduce cell populations

STATE OF DEVELOPMENT

The device concept has been proposed, with a prototype in current development.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,684,922	06/27/2023	2017-454
Germany	Issued Patent	602018015293.8	04/07/2021	2017-454
France	Issued Patent	3580556	04/07/2021	2017-454
United Kingdom	Issued Patent	3580556	04/07/2021	2017-454

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OTHER INFORMATION

KEYWORDS

acoustic waves, intracellular cargo, cargo delivery, transduction, expression, microfluidic, transfection

CATEGORIZED AS

- **Medical**
  - Delivery Systems
  - Devices
  - Research Tools
  - Expression System
  - Other

RELATED CASES

2017-454-0

European Patent Office	Published Application	3868864	08/25/2021	2017-454

Additional Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Determining Oil Well Connectivity Using Nanoparticles
- Multiple-Patterning Nanosphere Lithography
- Scalable Lipid Bilayer Microfluidics for High-Throughput Gene Editing
- Guided Magnetic Nanospears For Targeted And High-Throughput Intracellular Delivery
- High-Throughput Microfluidic Gene-Editing via Cell Deformability within Microchannels

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