

On-chip, Real-time Feedback Control for Electrical Manipulation of Droplets

Tech ID: 20467 / UC Case 2007-244-0

BACKGROUND

The uniformity of each droplets volume in a digital microfluidic system is useful and often critical to the overall functions. Digitization of liquids, e.g. generating droplets from liquid reservoirs, is a key step to determine the droplet volume. Reasonable level of accuracy can be achieved by simple signal switching during the digitizing processes. However, the performance is subject to random variations over the devices and operation conditions. The known feedback mechanisms to control droplet uniformity required external equipments (pumps and valves) in the system hardware and closed the loop once per droplet in the feedback algorithm (i.e., the feedback is droplet-to-droplet).

INNOVATION

UCLA researchers have developed an on-chip, real-time feedback system that accurately detects and controls the droplet volume. The system hardware uses no external pumps and valves, and the feedback algorithm employs continuous loop closing during each droplet generation (i.e., the feedback is within a droplet). With the developed feedback mechanism, the standard deviation of the generated droplet volumes was 5x smaller than that without feedback. Furthermore, the invented feedback allows generation of any droplet volume within a range, not limited by the size of driving pads on the chip anymore. The researchers have integrated the feedback control and microfluidic device on a portable 7 x 5 board, achieving a volume precision better than 1%.

APPLICATIONS

- ▶ Improved precision in digital microfluidic applications
- ▶ Flexible and efficient sample dilution and mixing
- ▶ The improvements without sacrificing the system portability

ADVANTAGES

- ▶ Droplet uniformity is greatly improved compared to simple electronic switching
- ▶ Real-time feedback provides the ability to overcome inherent uncertainty in chips and environment
- ▶ Real-time feedback can be applied to a wide range of liquids
- ▶ The invention allows for device portability since no additional hardware is added
- ▶ Users can generate varying droplet volumes during operation, not limited by the chip used

STATE OF DEVELOPMENT

The technology has been experimentally verified. A system has been built, tested and it has been performance characterized.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,266,076	02/23/2016	2007-244

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Methods of Restoring and Maintaining Gas Film on Superhydrophobic Surfaces while Underwater](#)

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OTHER INFORMATION

KEYWORDS

mems, microfluidics materials chip biosensor

CATEGORIZED AS

- ▶ **Semiconductors**
- ▶ Other
- ▶ Processing and Production

RELATED CASES

2007-244-0

- ▶ A Low-Profile Flow Shear Sensing Unit
- ▶ Complete Transfer of Liquid Drops by Modification of Nozzle Design
- ▶ Stereo Image Acquisition By Lens Translation
- ▶ Method of Fluid Manipulation By Electrodewetting
- ▶ A Built-In Mechanism Of Gas Maintenance In Microfeatures On A Submerged Surface
- ▶ No-Assembly Devices for Microfluidics Inside a Cavity
- ▶ Liquid-Repellent Surfaces Made of Any Materials
- ▶ Micropumping of Liquids by Directional Growth and Selective Venting of Bubbles
- ▶ Microstructured Cathode for Self-Regulated Oxygen Generation and Consumption

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