Optical Space-Time Coding Technique in Microfluidic Devices

Tech ID: 21898 / UC Case 2012-002-0

BACKGROUND

Particle counting and differentiation based on optical detection in microfluidic devices has attracted significant attention because the technology promises cheaper, portable, and easy-to-operate devices for research, clinical, environmental, and industrial applications. For both sample analysis and sorting, detection of the intrinsic properties of each particle is the most critical step and particularly important for single-cell analysis in contrast with detection of average properties of an ensemble. Forward scattering (FS) and large angle scattering (LAS) or side-scattering signals (SS) are the most commonly used signals for analysis since these reveal the size, shape, and granularity of each individual particle without the need for labeling. However, side scattering signals are orders of magnitude weaker and usually detected by photomultiplier tubes (PMTs), which require high voltage (>1000V) operation and are expensive and fragile, not suitable for point-of-care clinics. Furthermore, most microfluidic devices produce weaker and noisier side scattering signals than commercial systems, and the large coefficients of variation values of such devices have severely limited the applicability of the side scattering signals in devices such as flow cytometers and complete blood count devices.

TECHNOLOGY DESCRIPTION

Disclosed are optical coding methods and devices to detect FS and LAS signals in a microfluidic channel using commodity Si PIN photoreceivers instead of sophisticated PMTs. In the invention, a spatial pattern on a mask is converted into a temporal waveform for both FS and LAS signals, thus enhancing the detection sensitivity utilizing digital signal processing algorithms as well as enabling measurement of the position (x, y) and velocity of each particle. The velocity and position information facilitate measuring particle behaviors in microfluidic devices and complex properties such as inertial focusing and fluid dynamic sample separation. The invention's optical space-time coding has enabled achieving LAS coefficients of variations that are among the best for microfluidic devices. The viability of the technique has also been verified with lymphocyte samples, showing signal patterns comparable with commercial systems.

ADVANTAGES

The invention delivers record performance with significant cost saving and simplified operation to favor point-of-care applications.

INTELLECTUAL PROPERTY INFO

This technology has a patent pending and is available for licensing and/or sponsorship.

RELATED MATERIALS

- An Optical-Coding Method to Measure Particle Distribution in Microfluidic Devices, AIP Advances 1, 022155 (2011).
- Applying an Optical Space-Time Coding Method to Enhance Light Scattering Signals in Microfluidic Devices, Biomicrofluidics 5, 034116 (2011).

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,074,978	07/07/2015	2012-002

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OTHER INFORMATION

KEYWORDS

microfluidics, flow cytometer, cell detection, cell counting, cell sorting, micro-sorter, hydrodynamics, optical coding

CATEGORIZED AS

- **Medical**
  - Devices
  - Diagnostics
- **Research Tools**
  - Screening Assays

RELATED CASES

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