Plasmofluidic Microlenses for Label-Free Optical Sorting of Bioparticles

Tech ID: 33054 / UC Case 2019-973-0

BACKGROUND

Optical chromatography (OC) is an optofluidic technique enabling label-free fractionation of microscopic particles, e.g., bioparticles from heterogenous mixtures. This technique relies on a laser beam along a microfluidic channel to create opposing optical scattering and fluidic drag forces. Variable strength and balance of these forces may be harnessed for selective sorting of bioparticles based on their size, composition, and morphology. OC has been successfully applied to fractionation of blood components such as human erythrocytes, monocytes, granulocytes, and lymphocytes. OC offers unique capabilities as a modern separation technique, especially when combined with multi-stage sequential fractionation and microfluidic network-based purification approaches, and it particularly excels in distinguishing bioparticles with subtle differences. However, there are several key limitations with OC being widely adopted. In order to create strong optical scattering forces along the microfluidic channels, expensive and sophisticated laser sources must be precisely aligned along the fluidic channel with a well-controlled beam waist profile, requiring a complicated optical alignment procedure that employs multiple multi-axis positioners. While microfluidic approaches using OC hold promise for broader use, multiplexed and high throughput systems remain overly complicated and cost-prohibitive.

TECHNOLOGY DESCRIPTION

To overcome these challenges, researchers at UC Santa Cruz have developed a system and methods to address the shortcomings of existing OC tactics by eliminating the need for sophisticated instrumentation and precise alignment requirements. UCSC's plasmofluidic microlense system and methods provide for objective-free focusing and self-alignment of opposing optical scattering and fluidic drag forces for selective separation of exosome size bioparticles. Unlike existing optical chromatography techniques that require complicated instrumentation (e.g., lasers, objectives, and precise alignment stages), UCSC's optofluidic plasmonic microlenses on a micrometer scale (about 4μm × 4μm) allow for multiplexed and high-throughput sorting of nanoparticles using low-cost broadband light sources. Moreover, the system offers readily tunable, highly reliable and selective separation of nano-sized bioparticles by adjusting the light intensity (i.e. radiation pressure) and/or the fluid flow rate (i.e. opposing drag force) based on size and minor difference in chemical makeup (i.e. refractive index).

APPLICATIONS

- microfluidics

ADVANTAGES

- cost-effective
- high-performance
- leverages industry-standard parts

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,913,867	02/27/2024	2019-973

RELATED MATERIALS

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OTHER INFORMATION

KEYWORDS

optical chromatography, microfluidic, microfluidics, bioparticles, fractionation, plasmofluidic, plasmofluidics, exosome, exosomes, optofluidic, optofluidics, label-free separation, label-free

CATEGORIZED AS

- **Biotechnology**
  - Bioinformatics
- **Engineering**
  - Engineering
- **Research Tools**
  - Screening Assays
- **Sensors & Instrumentation**
  - Biosensors
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RELATED CASES

2019-973-0

▶ Zhu, X., Cicek, A., Li, Y. et al. Plasmofluidic Microlenses for Label-Free Optical Sorting of Exosomes. Sci Rep 9, 8593 (2019).
https://doi.org/10.1038/s41598-019-44801-3 - 06/13/2019

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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