Microfluidic Production of Monodispersed Submicron Emulsions Through Filtration and Sorting of Satellite Drops

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BACKGROUND

In the past decade, droplets have been intensively used by the industries as an agent for drug preparations, for plastic polymerizations, and chemical processing. Recent advancements in microfluidic droplet technology has enabled the precise sampling and processing of small volumes of fluids (picoliter to femtoliter) by the controlled viscous shearing in microchannels. Microfluidic technologies has transformed droplets to be used as liquid reaction vessels for screening protein crystallization conditions, as micro templates for assisting self-assembling of materials, as molds for curing polymeric micro spheres, and as components for micro electrical actuator. Programmable fluidic assays for sampling glucose concentration of human physiological fluids, DNA analysis, nano particle synthesis machinery have been individually demonstrated using droplet based microfluidic system.

However two drawbacks limit the use of these technologies: 1) the generation of satellite droplets have always being a problem limiting the volume and accuracy of the metered fluid sample. 2) Generation of monodispersed droplets smaller than 1?m has been difficult to achieve. The solution to both problem lies in the use of satellite sorting technologies, in which, satellite droplets, the by product of droplet generation can not only be filtered but also simultaneously be used as a production mechanism for nano-particle synthesis.

TECHNOLOGY DESCRIPTION

University of California researchers have developed a method that can switch, sort, and select the desired satellite droplets in the microfluidic channel. The device can act as an satellite droplet filter that purifies the primary droplet generation process, it can act as dynamic switches for parallel processing of satellite droplets under different chemical reaction process, or it can be used to passively sort satellite droplets of desired size without any moving components (valves, actuators, and etc). Droplet as small as <100nm can be filtered out from primary droplets, and the population of the sorted satellite droplet can have a coefficient of variation of less than 5% (limited by the imaging resolution.) Thousands of satellite droplets have been generated and sorted per second under optimal conditions. The device has no moving components, is simple to fabricate, can easily be mass produced, and has a low material cost.

APPLICATIONS

For chemical, pharmaceutical, and material processing, undesired satellite droplets can be removed to have high purity reaction process. Possible contaminant particles are also automatically removed through this process. The sorted satellite droplets can also be used to synthesize <100nm diameter containers for template assisted polymeric reactions, targeted delivery of molecular drugs, self-assembled formation of artificial cells, screening single molecules in reagents, analysis of proteins and nucleic acids, combinatorial synthesis of functional particles with bi-polar characteristics, and growth of nano-crystals.

PATENT STATUS

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OTHER INFORMATION

CATEGORIZED AS

- » **Materials & Chemicals**
  - » Chemicals
  - » Composites
- » **Medical**
  - » Devices
  - » New Chemical Entities, Drug Leads
- » **Nanotechnology**
  - » Electronics
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- » **Research Tools**
  - » Other

RELATED CASES

2005-652-0

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,892,434	02/22/2011	2005-652

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