

# Microfluidic Devices for Controlled Viscous Shearing and Formation of Amphiphilic Vesicles

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## BACKGROUND

Amphiphilic vesicles are artificial cells with applications in drug delivery (including biomolecular nanomedicine such as DNA, peptides, proteins), combinatorial chemistry, nanoscale chemical reaction chambers, biomolecular devices (power, optical, electrical), and various biosensors.

## TECHNOLOGY DESCRIPTION

Researchers at the University of California, Irvine, have developed a microfluidic device (i.e. Lab-on-a-chip) that controls viscous shearing of oil-water droplets on a micro- and nano-scale and allows the subsequent formation of amphiphilic vesicles (liposomes, polymer vesicles, micelles, etc.). The technology includes various microfluidic designs for different nanomanufacturing features such as speed of droplet formation, droplet size ranges, multi-lamellar amphiphilic layers and symmetric vesicles. Also included are designs for post-assembly and post-processing (splitting, fusing, sorting) of the droplets.

This first part of the invention includes various new microfluidic device designs for oil-water co-flows with tunable viscous shear forces higher than the immiscible interfacial tension forces to generate favorable conditions for droplet formation. The higher the shear force the smaller the droplet size. There are two major inventions in the droplet formation step:

The design of oil-water-oil sheath flow to establish stable interfaces with controllable shear forces. This enables reproducible, and batch fabrication of the devices.

The pressure gradient design to generate favorable conditions for high speed droplet formation.

The second part of the invention is the method to generate bilayer membranes for artificial cells in microfluidic devices. The third part of the invention includes various microfluidic post-assembly and post-processing, that can further split droplets into even smaller droplets, fuse droplets into larger ones, or sort the droplets based on density and size.

## APPLICATIONS

The combined features and functions of these devices enables an integrated amphiphilic vesicle production-line on a single microfluidic chip.

## PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,595,195	09/29/2009	2003-210

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## OTHER INFORMATION

### CATEGORIZED AS

- » **Materials & Chemicals**
  - » Nanomaterials
- » **Nanotechnology**
  - » NanoBio
  - » Tools and Devices

### RELATED CASES

2003-210-0

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