

Process For Creating Stable Double Emulsions

Tech ID: 20244 / UC Case 2007-574-0

SUMMARY

UCLA Researchers in the Departments of Chemistry, Physics, and Bioengineering have developed a process for creating double emulsions (droplets within droplets) for applications in pharmaceuticals, drug delivery, cosmetics, and personal care products. By contrast to more common double emulsions that have microscale droplet sizes, UCLA researchers have created nanoscale double emulsions that have both inner and outer droplet diameters below 100 nm, and these droplets can display a choice of biologically active co-polypeptide moieties.

BACKGROUND

Simple emulsions are dispersions of droplets of one liquid phase in another immiscible liquid phase. The most common are oil-in-water (O/W) or water-in-oil (W/O) emulsions that typically have microscale diameters. Double emulsions are more complex emulsions that consist of droplets within droplets, such as water-in-oil-in-water (W/O/W). The two primary means of creating double emulsions are structured microfluidic methods and sequential emulsification. Microfluidic methods are capable of producing highly uniform W/O/W emulsions, but it is a low-throughput process. A W/O/W double emulsion created by sequential emulsification must be size-fractionated to achieve uniform monodisperse droplets, but fractionation is also a low-throughput process. Most double emulsions rely on two surfactants for stability, not a single surfactant that can stabilize both inner and outer droplets. None of the existing double emulsification methods have so far been successful in creating nanoscale double emulsions in which both the inner and outer droplets are both sub-100 nm using a single type of surfactant.

INNOVATION

The invention utilizes novel amphiphilic diblock copolypeptides that function as surfactants to stabilize stable double emulsions that can be formed using a variety of mixing methods using a single interfacial agent that is not biased against complex droplet topologies. An additional innovation is that both the inner aqueous droplets and outer oil droplets can be formed with diameters as small as tens of nanometers.

APPLICATIONS

Co-polypeptide stabilized double emulsions provide both microscale and nanoscale drug delivery vehicles that can package both water-soluble and oil-soluble drugs or other cargo. Dual delivery of hydrophobic and hydrophilic cargo will have applications in pharmaceuticals, cosmetics, and personal care products.

ADVANTAGES

- ▶ Control of inner and outer droplet sizes from the microscale down to tens of nanometers
- ▶ Tunable block lengths and compositions of the diblock copolypeptides to alter emulsion properties
- ▶ The inner liquid droplet (e.g. water) can contain water soluble cargo: DNA, RNA, oligonucleotides, peptides, proteins, salts, viruses, vitamins, serums, molecular motors, drug molecules, cells, vesicles, nanoparticles, fullerenes, carbon nanotubes, sugars, quantum dots, metal nanoparticles, magnetic nanoparticles, fluorescent dyes, etc.
- ▶ The outer droplet (e.g. oil) can contain hydrophobic cargo: fats, lipids, waxes, oils, fragrances, cholesterol, steroids, drug molecules, polymers, polypeptides, micelles, quantum dots, nanoparticles, carbon nanotubes, fullerenes, etc.
- ▶ A variety of oils can be used, including oils that are biologically compatible.

STATE OF DEVELOPMENT

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OTHER INFORMATION

KEYWORDS

microfluidics drug delivery therapeutic
materials

CATEGORIZED AS

- ▶ **Materials & Chemicals**
 - ▶ Biological
 - ▶ Nanomaterials
 - ▶ Polymers
- ▶ **Medical**
 - ▶ Delivery Systems
 - ▶ Disease: Dermatology
- ▶ **Nanotechnology**
 - ▶ NanoBio

RELATED CASES

2007-574-0, 2008-433-0, 2008-625-0,
2019-954-0, 2014-182-0, 2017-705-0

The process has been experimentally verified.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,890,585	02/06/2024	2019-954
United States Of America	Issued Patent	10,285,940	05/14/2019	2014-182
United States Of America	Issued Patent	9073022	07/07/2015	2008-625
United States Of America	Issued Patent	8,283,308	10/09/2012	2007-574

RELATED TECHNOLOGIES

- ▶ [Process For Recycling Surfactant In Nanoemulsion Production](#)
- ▶ [Ultrastable Nanoemulsions In Disordered And Ordered States](#)
- ▶ [Method of Making Multicomponent Nanoemulsions](#)

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Measuring Size Distributions of Small-Scale Objects](#)
- ▶ [Process For Recycling Surfactant In Nanoemulsion Production](#)
- ▶ [Method of Making Multicomponent Nanoemulsions](#)
- ▶ [Novel Multi-Scale Pre-Assembled Phases of Matter](#)
- ▶ [Ultrastable Nanoemulsions In Disordered And Ordered States](#)
- ▶ [Mechanical Process For Creating Particles Using Two Plates](#)
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