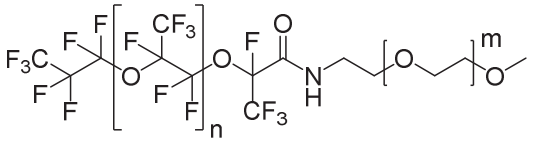
emulsion systems than those with other fluorosurfactants, including fluorosurfactants having two fluorophilic tails and one hydrophilic head group (hereinafter "tri-block surfactant").

[0005a] In one aspect, the present disclosure provides a method for forming an emulsion comprising a plurality of droplets, comprising: (a) bringing a first fluid phase in contact with a second fluid phase that is immiscible with said first fluid phase to generate an emulsion comprising said plurality of droplets, wherein said plurality of droplets comprises: (i) said first fluid phase or said second fluid phase; (ii) a first surfactant at an interface between said first fluid phase and said second fluid phase, wherein said first surfactant is a di-block copolymer comprising a perfluorinated polyether block bonded to a polyethylene glycol block and having the structure of Formula II:



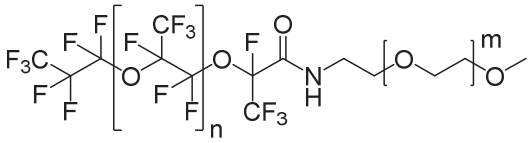
Formula II

wherein m is an integer from 5 to 50 and n is an integer from 5 to 60; and (iii) a second surfactant that is different than said first surfactant, wherein said second surfactant is n-dodecyl-D-maltoside; and (b) upon or subsequent to generating at least a subset of said plurality of droplets, (i) collecting said plurality of droplets or (ii) directing said plurality of droplets along a channel, wherein upon collecting or directing said plurality of droplets along said channel, at most 5% of said plurality of droplets coalesce.

[0006] In an example, the present disclosure provides a method for forming an emulsion comprising a plurality of droplets, comprising: (a) bringing a first fluid phase in contact with a second fluid phase that is immiscible with the first fluid phase to generate an emulsion comprising the plurality of droplets, wherein the plurality of droplets comprises (i) the first fluid phase or the second fluid phase, (ii) a first surfactant at an interface between the first fluid phase and the second fluid phase, and (iii) a second surfactant that is different than the first surfactant; and (b) upon generating at least a subset of the plurality of droplets, (i) collecting the plurality of droplets or (ii) directing the plurality of droplets along a channel, wherein upon collecting or directing the plurality of droplets along the channel, at most 5% of the plurality of droplets coalesce.

[0007] In some examples of examples provided herein, the first surfactant at the interface prevents the second surfactant from flowing from the first fluid phase to the second fluid phase. In some examples of examples provided herein, the first surfactant is a di-block copolymer

droplet generator, wherein said controller is programed to: (i) bring a first fluid phase in contact with a second fluid phase that is immiscible with said first fluid phase to generate said emulsion comprising said plurality of droplets, wherein said plurality of droplets comprises: (1) said first fluid phase or said second fluid phase; (2) a first surfactant at an interface between said first fluid phase and said second fluid phase, wherein said first surfactant is a di-block copolymer comprising a perfluorinated polyether block bonded to a polyethylene glycol block and having the structure of Formula II:

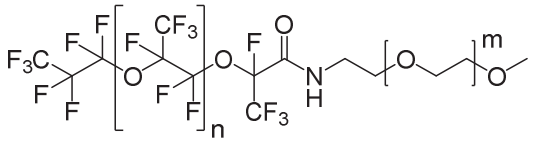


Formula II

wherein m is an integer from 5 to 50 and n is an integer from 5 to 60; and (3) a second surfactant that is different than said first surfactant, wherein said second surfactant is n-dodecyl-D-maltoside; and (ii) upon or subsequent to generating at least a subset of said plurality of droplets, (1) direct collection of said plurality of droplets or (2) direct said plurality of droplets along a channel, wherein upon collecting or directing said plurality of droplets along said channel, at most 5% of said plurality of droplets coalesce.

[0008] Another example of the present disclosure provides a system for forming an emulsion comprising a plurality of droplets, comprising a droplet generator that is configured to generate an emulsion comprising a plurality of droplets; and a controller operatively coupled to the droplet generator, wherein the controller is programed to: (i) bring a first fluid phase in contact with a second fluid phase that is immiscible with the first fluid phase to generate the emulsion comprising the plurality of droplets, wherein the plurality of droplets comprises (1) the first fluid phase or the second fluid phase, (2) a first surfactant at an interface between the first fluid phase and the second fluid phase, and (3) a second surfactant that is different than the first surfactant; and (ii) upon generating at least a subset of the plurality of droplets, (i) direct collection of the plurality of droplets or (ii) direct the plurality of droplets along a channel, wherein upon collecting or directing the plurality of droplets along the channel, at most 5% of the plurality of droplets coalesce.

[0008a] In one aspect, the present disclosure provides a non-transitory computer-readable medium comprising machine-executable code that, upon execution by one or more computer processors, implements method for forming an emulsion comprising a plurality of droplets, said method comprising: (a) bringing a first fluid phase in contact with a second fluid phase that is immiscible with said first fluid phase to generate an emulsion comprising said plurality of droplets, wherein said plurality of droplets comprises: (i) said first fluid phase or said second fluid phase; (ii) a first surfactant at an interface between said first fluid phase and said second fluid phase, wherein said first surfactant is a di-block copolymer comprising a perfluorinated polyether block bonded to a polyethylene glycol block and having the structure of Formula II:



Formula II

wherein m is an integer from 5 to 50 and n is an integer from 5 to 60; and (iii) a second surfactant that is different than said first surfactant, said second surfactant being n-dodecyl-D-maltoside; and (b) upon or subsequent to generating at least a subset of said plurality of droplets, (i) collecting said plurality of droplets or (ii) directing said plurality of droplets along a channel, wherein upon collecting or directing said plurality of droplets along said channel, at most 5% of said plurality of droplets coalesce.

[0009] Still another example of the present disclosure provides a non-transitory computer-readable medium comprising machine-executable code that, upon execution by one or more computer processors, implements method for forming an emulsion comprising a plurality of droplets, the method comprising: (a) bringing a first fluid phase in contact with a second fluid phase that is immiscible with the first fluid phase to generate an emulsion comprising the plurality of droplets, wherein the plurality of droplets comprises (i) the first fluid phase or the second fluid phase, (ii) a first surfactant at an interface between the first fluid phase and the second fluid phase, and (iii) a second surfactant that is different than the first surfactant; and (b) upon generating at least a subset of the plurality of droplets, (i) collecting the plurality of droplets or (ii) directing the plurality of droplets along a channel, wherein upon collecting or directing the plurality of droplets along the channel, at most 5% of the plurality of droplets coalesce.

[0010] Additional examples and advantages of the present disclosure will become readily apparent to those skilled in this art from the following detailed description, wherein only illustrative examples of the present disclosure are shown and described. As will be realized, the present disclosure is capable of other and different examples, and its

CLAIMS

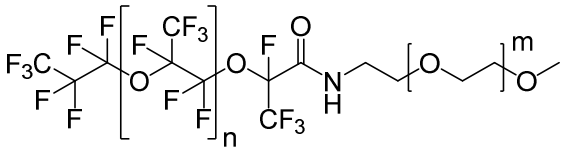
WHAT IS CLAIMED IS:

1. A method for forming an emulsion comprising a plurality of droplets, comprising:

(a) bringing a first fluid phase in contact with a second fluid phase that is immiscible with said first fluid phase to generate an emulsion comprising said plurality of droplets, wherein said plurality of droplets comprises:

(i) said first fluid phase or said second fluid phase;

(ii) a first surfactant at an interface between said first fluid phase and said second fluid phase, wherein said first surfactant is a di-block copolymer comprising a perfluorinated polyether block bonded to a polyethylene glycol block and having the structure of Formula II:



Formula II

wherein m is an integer from 5 to 50 and n is an integer from 5 to 60; and

(iii) a second surfactant that is different than said first surfactant, wherein said second surfactant is n-dodecyl-D-maltoside; and

(b) upon or subsequent to generating at least a subset of said plurality of droplets,

(i) collecting said plurality of droplets or

(ii) directing said plurality of droplets along a channel, wherein upon collecting or directing said plurality of droplets along said channel, at most 5% of said plurality of droplets coalesce.

2. The method of Claim 1, wherein said first surfactant forms a barrier at said interface that prevents said second surfactant from flowing from said first fluid phase to said second fluid phase.

3. The method of Claim 2, wherein said di-block copolymer reduces droplet coalescence when compared with a tri-block copolymer comprising at least two perfluorinated polyether blocks bonded to a polyethylene glycol block.

4. The method of Claim 3, wherein at least a subset of said droplet coalescence is surface-mediated.

5. The method of Claim 4, wherein said di-block copolymer reduces said surface-mediated droplet coalescence when compared with said tri-block copolymer.

6. The method of Claim 1, wherein said di-block copolymer is at a concentration from about 2.5 mM to about 3.0 mM.

7. The method of Claim 1, wherein said second surfactant facilitates cell lysis.

8. The method of Claim 1, wherein said plurality of droplets comprise reagents necessary for nucleic acid amplification.

9. The method of Claim 1, wherein said plurality of droplets comprises particles with nucleic acid barcodes.

10. The method of Claim 9, wherein said particles are beads or gel beads.

11. The method of claim 9, wherein an individual droplet of said plurality of droplets comprises at most one particle from said particles.

12. The method of Claim 1, wherein said first fluid phase is an aqueous phase and said second fluid phase is a non-aqueous phase.

13. The method of Claim 12, wherein said non-aqueous phase is an oil phase.

14. The method of Claim 12, wherein said non-aqueous phase comprises a fluorinated oil.

15. The method of Claim 1, wherein said plurality of droplets comprises biological molecules.

16. The method of Claim 15, wherein said biological molecules comprise nucleic acid molecules.

17. The method of Claim 1, wherein at most 2% of said plurality of droplets coalesce.

18. The method of claim 1, wherein said plurality of droplets is generated at an intersection of at least a first channel and a second channel, wherein said first fluid phase or said second fluid phase, but not both, is directed along said first channel.

19. A system for forming an emulsion comprising a plurality of droplets, comprising

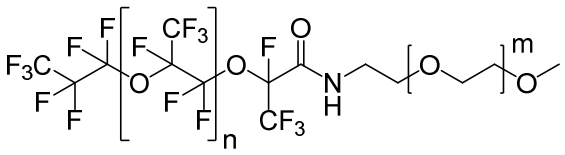
a droplet generator that is configured to generate an emulsion comprising said plurality of droplets; and

a controller operatively coupled to said droplet generator, wherein said controller is programed to:

(i) bring a first fluid phase in contact with a second fluid phase that is immiscible with said first fluid phase to generate said emulsion comprising said plurality of droplets, wherein said plurality of droplets comprises:

(1) said first fluid phase or said second fluid phase;

(2) a first surfactant at an interface between said first fluid phase and said second fluid phase, wherein said first surfactant is a di-block copolymer comprising a perfluorinated polyether block bonded to a polyethylene glycol block and having the structure of Formula II:



Formula II

wherein m is an integer from 5 to 50 and n is an integer from 5 to 60; and

(3) a second surfactant that is different than said first surfactant, wherein said second surfactant is n-dodecyl-D-maltoside; and

(ii) upon or subsequent to generating at least a subset of said plurality of droplets,

(1) direct collection of said plurality of droplets or

(2) direct said plurality of droplets along a channel, wherein upon collecting or directing said plurality of droplets along said channel, at most 5% of said plurality of droplets coalesce.

20. The system of Claim 19, wherein said first surfactant at said interface prevents said second surfactant from flowing from said first fluid phase to said second fluid phase.

21. The system of claim 19, wherein said di-block copolymer reduces droplet coalescence when compared with a tri-block copolymer comprising at least two perfluorinated polyether blocks bonded to a polyethylene glycol block.

22. The system of claim 21, wherein at least a subset of said droplet coalescence is surface-mediated.

23. The system of claim 22, wherein said di-block copolymer reduces said surface-mediated droplet coalescence when compared with said tri-block copolymer.

24. The system of claim 19, wherein said di-block copolymer is at a concentration from about 2.5 mM to about 3.0 mM.

25. The system of claim 19, wherein said second surfactant facilitates cell lysis.

26. The system of claim 19, wherein said plurality of droplets comprise reagents necessary for nucleic acid amplification.

27. The system of claim 19, wherein said plurality of droplets comprises particles with nucleic acid barcodes.

28. The system of claim 27, wherein said particles are beads or gel beads.

29. The system of claim 28, wherein an individual droplet of said plurality of droplets comprises at most one particle from said particles.

30. The system of claim 19, wherein said first fluid phase is an aqueous phase and said second fluid phase is a non-aqueous phase.

31. The system of claim 30, wherein said non-aqueous phase is an oil phase.

32. The system of claim 31, wherein said non-aqueous phase comprises a fluorinated oil.

33. The system of claim 19, wherein said plurality of droplets comprises biological molecules.

34. The system of claim 33, wherein said biological molecules comprise nucleic acid molecules.

35. The system of claim 19, wherein at most 2% of said plurality of droplets coalesce.

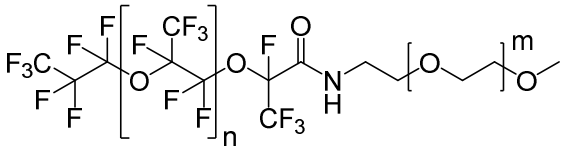
36. The system of claim 19, wherein said plurality of droplets is generated at an intersection of at least a first channel and a second channel, wherein said first fluid phase or said second fluid phase, but not both, is directed along said first channel.

37. A non-transitory computer-readable medium comprising machine-executable code that, upon execution by one or more computer processors, implements method for forming an emulsion comprising a plurality of droplets, said method comprising:

(a) bringing a first fluid phase in contact with a second fluid phase that is immiscible with said first fluid phase to generate an emulsion comprising said plurality of droplets, wherein said plurality of droplets comprises:

(i) said first fluid phase or said second fluid phase;

(ii) a first surfactant at an interface between said first fluid phase and said second fluid phase, wherein said first surfactant is a di-block copolymer comprising a perfluorinated polyether block bonded to a polyethylene glycol block and having the structure of Formula II:



Formula II

wherein m is an integer from 5 to 50 and n is an integer from 5 to 60; and

(iii) a second surfactant that is different than said first surfactant, said second surfactant being n-dodecyl-D-maltoside; and

(b) upon or subsequent to generating at least a subset of said plurality of droplets, (i) collecting said plurality of droplets or (ii) directing said plurality of droplets along a channel, wherein upon collecting or directing said plurality of droplets along said channel, at most 5% of said plurality of droplets coalesce.