destabilizing the mixture and producing, or enhancing production of, two or more consolidated liquid phases.

[0015] Some embodiments discussed herein provide successful separation of two or more phases of an emulsion or other mixture despite high conductivity of a dispersed phase, despite high salt content, and/or despite the presence of a surfactant or other emulsifier. In some embodiments, the conductivity of the mixture is between 1 mS/m to 1 S/m or as high as 10 S/m. The systems and methods described herein are applicable to a wide variety of electrical conductivity ranges. Certain embodiments described herein can separate a variety of mixtures having wide ranges of salt and/or surfactant content without any special adjustment in configuration of electrodes or other invasive manipulation.

[0015a] In one aspect of the present disclosure, there is provided a method for separating two or more phases of an emulsion mixture, the method comprising the steps of:

(a) providing the mixture with a net and unipolar charge, thereby enhancing coalescence of like-phase and like-charge droplets therein and producing, or enhancing the production of, two or more consolidated phases,

wherein the charge densities of a first and a second coalescing like-phase and like-charge droplet are different such that $Q_a/r_a >> Q_b/r_b$, wherein Q_a is the charge of droplet a, Q_b is the charge of droplet b, r_a is the radius of droplet a, and r_b is the radius of droplet b, wherein step (a) comprises bombarding the mixture with ions via corona discharge; and

(b) collecting the two or more consolidated phases.

What is claimed is:

1. A method for separating two or more phases of an emulsion mixture, the method comprising the steps of:

(a) providing the mixture with a net and unipolar charge, thereby enhancing coalescence of like-phase and like-charge droplets therein and producing, or enhancing the production of, two or more consolidated phases,

wherein the charge densities of a first and a second coalescing like-phase and like-charge droplet are different such that $Q_a/r_a >> Q_b/r_b$, wherein Q_a is the charge of droplet a, Q_b is the charge of droplet b, r_a is the radius of droplet a, and r_b is the radius of droplet b, wherein step (a) comprises bombarding the mixture with ions via corona discharge; and

(b) collecting the two or more consolidated phases.

2. The method of claim 1, wherein step (a) comprises providing an emitter electrode and a collector electrode, wherein at least the collector electrode is in physical contact with the mixture and a potential difference is applied between the emitter electrode and the collector electrode at or above a corona discharge threshold.

3. The method of claim 2, wherein the emitter electrode is not in physical contact with the mixture.

4. The method of claim 3, wherein a gaseous medium is located between the emitter electrode and the mixture.

5. The method of claim 2, wherein the collector electrode is grounded.

6. The method of claim 2, wherein the emitter electrode is a sharp electrode.

7. The method of claim 2, wherein the emitter electrode is coated and/or textured.

8. The method of claim 2, wherein the emitter electrode is made of or coated with a material resistant to ionization-induced corrosion.

9. The method of claim 2, wherein the collector electrode comprises one or more members selected from the group consisting of a metal, silicon, and a silicon with native oxide, and/or wherein the collector electrode is coated with a dielectric film.

10. The method of claim 2, wherein the potential difference between the emitter electrode and the mixture is established by applying a high voltage to the emitter electrode or by applying a high voltage to the mixture by reversing a polarity of the emitter electrode.

11. The method of claim 2, wherein an electric field is applied via continuous AC or DC discharge or via pulsed discharge, wherein the discharge is a two-phase, three-phase, or multi-phase discharge and/or wherein the discharge is a direct discharge or a barrier discharge.

12. The method of claim 1, wherein the separating is carried out during transport of the mixture.

13. The method of claim 1, wherein step (a) comprises providing a portion of the mixture with a unipolar charge, the method further comprising mixing the charged portion of the mixture into the remaining portion of the mixture, thereby enhancing coalescence of like-phase and like-charge droplets therein and producing, or enhancing the production of, two or more consolidated phases; and (b) collecting the two or more consolidated phases.

14. The method of claim 1, wherein step (a) comprises injecting, spraying, or otherwise introducing a substance having a net and unipolar charge into the mixture, thereby enhancing coalescence of like-phase and like-charge droplets therein and producing, or enhancing the production of, the two or more consolidated phases.

15. The method of claim 1, wherein step (a) further comprises injecting an ionized gas having a net and unipolar charge into the mixture.

16. The method of claim 14, further comprising agitating the mixture prior to step (a).

17. The method of claim 1, wherein step (a) comprises introducing the mixture to a substrate having a net and unipolar charge that is positive or negative.

18. The method of claim 1, wherein the mixture, while maintaining a net and unipolar charge, comprises a combination of species having positive and negative charges.

19. The method of claim 1, wherein step (a) further comprises applying a charge via tribo-electrification during transport of the mixture via a conduit, the conduit comprising a coating configured to improve tribo-electrification charging.

20. The method of claim 1, wherein step (a) comprises applying a charge by direct injection, conduction, induction of net and unipolar charge, and/or any combination thereof.

21. The method of claim 1, wherein the mixture comprises a plurality of liquid phases and/or wherein the mixture comprises one or more members selected from the group consisting of particles, proteins, DNA, RNA, and cells, and/or wherein the mixture comprises a liquid with low electrical conductivity.

22. The method of claim 1, wherein the mixture comprises an aqueous phase, and the aqueous phase has a salt content of at least 0.5M.

23. The method of claim 1, wherein, prior to introduction of the net and unipolar charge, the mixture comprises a phase of droplets having average droplet diameter

less than or equal to 1000 micrometers in diameter, and wherein the droplets coalesce after introduction of the net and unipolar charge.

24. The method of claim 1, wherein the mixture is a two-phase emulsion comprising an aqueous phase and a non-aqueous phase, wherein the aqueous phase is less than or equal to 50 wt.% of the emulsion and/or wherein the non-aqueous phase is less than or equal to 50 wt.% of the emulsion.

25. The method of claim 1, wherein the mixture is a three-phase mixture.

26. The method of claim 1, wherein the mixture comprises a liquid phase, a solid phase, and a gas phase.

27. The method of claim 1, wherein the mixture is a bubble-in-oil mixture or a foam-in-oil mixture and/or wherein the mixture comprises an emulsifier.

28. The method of claim 1, wherein the mixture comprises at least one phase having a salt content of at least 0.5M.

29. The method of claim 1, wherein the mixture comprises an oil, the oil having an electrical conductivity between 10^{-14} S/m (highly insulating) and 10^{-5} S/m (highly conducting).

30. The method of claim 1, wherein the mixture has an electrical conductivity between 10^{-7} S/m and 100 S/m.

31. The method of claim 4, wherein the gaseous medium is flowing.

32. The method of claim 4, further comprising modulating the gaseous medium temperature and/or pressure to optimize a quality of discharge (V-I) characteristic and to control electrical breakdown limit.