CLAIMS

1. A method comprising:

(i) providing an apparatus comprising an intake system, an injector, and a process system, wherein:

(a) the injector comprises a first injector conduit and a second injector conduit different from the first injector conduit;

(b) the injector can be in a first configuration providing a fluid communication between the first injector conduit and the intake system and a fluid communication between the second injector conduit and the process system, or in a second configuration providing a fluid communication between the first injector conduit and the process system and a fluid communication between the second injector conduit and the intake system, but not both at the same time; and

(c) the process system comprises a partitioner in fluid communication with the injector when the injector is in the second configuration;

wherein the apparatus is electrically grounded;

(ii) flowing a first fluid from a source of the first fluid through a first intake conduit and into the first injector conduit when the injector is in the first configuration so that the first fluid occupies at least part of the first injector conduit;

(iii) changing the configuration of the injector from the first configuration to the second configuration;

(iv) flowing a second fluid that is substantially immiscible with the first fluid from a source of the second fluid through a first process conduit fluidly connected to the source of second fluid and the first injector conduit into the first injector conduit so that the second fluid displaces the first fluid from the first injector conduit into a second process conduit fluidly connected to the process system;

(v) flowing the first fluid from the injector and into a first partitioner conduit in the partitioner and flowing a third fluid that is substantially immiscible with the first fluid into a second partitioner conduit in the partitioner, wherein the partitioner produces a mixture comprising a plurality of partitions of the first fluid in the third fluid that flows out of an outlet of the partitioner;

(vi) while the injector is in the second configuration, flowing a fourth fluid substantially immiscible with the second and third fluids into the second injector conduit so that the fourth fluid occupies at least part of the second injector conduit;

(vii) changing the configuration of the injector from the second configuration to the first configuration;

(viii) while the injector is in the first configuration, flowing the second fluid into the second injector conduit so that it displaces the fourth fluid into the process system; and

(ix) flowing the fourth fluid into the partitioner and flowing the third fluid into the partitioner to produce a mixture comprising a plurality of partitions of the fourth fluid in the third fluid.

2. The method of claim 1, further comprising:

(x) changing the injector from the second configuration to the first configuration; and
(xi) flowing a first cleaning fluid through the first injector conduit to remove some or all of first fluid that remains in the first injector conduit after step (iv) from the first injector conduit.

3. The method of claim 2, comprising serially repeating steps (ii)-(vii) for a plurality of fluids in addition to the first fluid, wherein each of the plurality of fluids can be the same as or different from the first fluid, and wherein each of the plurality of fluids is substantially immiscible with the second fluid and the third fluid, to produce a plurality of different mixtures each comprising a plurality of partitions of one of the fluids from the plurality of fluids in the third fluid from the partitioner.

4. The method of claim 3, wherein the plurality of fluids in addition to the first fluid comprises at least four different fluids.

5. The method of claim 1, wherein the partitioner produces the mixture comprising a plurality of partitions of the first fluid in the third fluid and said mixture comprises at least 100 partitions of the first fluid in the third fluid.

6. The method of claim 1, wherein at least 95% of inner surfaces of sections of the first injector conduit, the first intake conduit, the second process conduit, and the partitioner, through which the first fluid flows, have greater affinity for the second and third fluids than for the first fluid.

7. The method of claim 6, wherein at least 99% of the inner surfaces have greater affinity for the second and third fluids than for the first fluid.

8. The method of claim 6, wherein the first fluid comprises an aqueous phase and the second and third fluids comprise a fluorinated oil, and wherein the inner surfaces comprise a fluorinated material.

9. The method of claim 1, further comprising flowing the mixture comprising a plurality of partitions of the first fluid in the third fluid through a conduit from the outlet of the partitioner through a reactor, wherein the reactor provides energy to initiate and/or promote one or more physical or chemical reactions in one or more of the partitions.

10. The method of claim 1, further comprising flowing the mixture comprising a plurality of partitions of the first fluid in the third fluid through a conduit from the outlet of the partitioner to a detector conduit in a detector, wherein the detector conduit comprises an interrogation region, and

wherein the detector detects at least one characteristic of at least a portion of the partitions as they flow in single file through the interrogation region.

11. The method of claim 10, wherein the detector comprises:

(a) a source of electromagnetic energy to provide electromagnetic energy to the interrogation region, wherein the interrogation region is configured for single file movement of partitions through the detector conduit,

(b) a detection element to detect electromagnetic energy emitted from a partition in the interrogation region; and

(c) an optical restriction positioned between the interrogation region and the detection element, wherein the optical restriction is configured and positioned such that when a first partition is passing through the interrogation region, not more than 25% of electromagnetic radiation reaching the detection element is from one or more partitions other than the first partition.

12. The method of claim 10, wherein:

the detector comprises:

(a) a source of electromagnetic energy to provide electromagnetic energy to the interrogation region, wherein the interrogation region is configured for single file movement of partitions through the detector conduit, and

(b) a detection element to detect electromagnetic energy emitted from a partition in the interrogation region; and

wherein the detector is configured to modulate output of the source of electromagnetic energy by a carrier periodic function to multiply the signal of the detection element by the carrier periodic function and to integrate the resultant product over multiple periods of the carrier periodic function.

13. The method of claim 1, wherein, in step (ii), an opening of the first intake conduit is positioned to be immersed in the first fluid to create a fluid connection for flow of the first fluid into the first injector conduit, wherein a major dimension of the opening of the first intake conduit is less than a characteristic dimension of any other conduit in the apparatus.

14. A method comprising:

(i) providing an apparatus comprising an intake system, an injector, and a process system, wherein:

(a) the injector comprises a first injector conduit;

(b) the injector can be in a first configuration providing a fluid communication between the first injector conduit and the intake system or in a second configuration providing a fluid communication between the first injector conduit and the process system, but not both at the same time; and

(c) the process system comprises a partitioner in fluid communication with the injector when the injector is in the second configuration;

(ii) flowing a first fluid from a source of the first fluid through a first intake conduit and into the first injector conduit when the injector is in the first configuration so that the first fluid occupies at least part of the first injector conduit;

(iii) changing the configuration of the injector from the first configuration to the second configuration;

(iv) flowing a second fluid that is substantially immiscible with the first fluid from a source of the second fluid through a first process conduit fluidly connected with the source of the second fluid and the first injector conduit into the first injector conduit so that the second fluid displaces the first fluid from the first injector conduit into a second process conduit fluidly connected to the process system; and

(v) flowing the first fluid from the injector and into a first partitioner conduit in the partitioner and flowing a third fluid that is substantially immiscible with the first fluid into a second partitioner conduit in the partitioner wherein the partitioner produces a mixture comprising a plurality of partitions of the first fluid in the third fluid that flows out of an outlet of the partitioner, wherein the apparatus is electrically grounded.

15. The method of claim 14, further comprising:

(vi) changing the injector from the second configuration to the first configuration; and

(vii) flowing a first cleaning fluid through the first injector conduit to remove some or all of the first fluid that remains in the first injector conduit after step (iv) from the first injector conduit.

16. The method of claim 14, wherein the injector further comprises a second injector conduit, different from the first injector conduit, wherein the injector is configured so that the second injector conduit is in fluid communication with the process system when the injector is in the first configuration or in fluid communication with the intake system when the injector is in the second configuration, but not both at the same time, and wherein the method further comprises:

(vi) while the injector is in the second configuration, flowing a fourth fluid substantially immiscible with the second and third fluids into the second injector conduit so that the fourth fluid occupies at least part of the second injector conduit;

(vii) changing the configuration of the injector from the second configuration to the first configuration;

(viii) while the injector is in the first configuration, flowing the second fluid into the second injector conduit so that it displaces the fourth fluid into the process system; and

(ix) flowing the fourth fluid into the partitioner and flowing the third fluid into the partitioner to produce a mixture comprising a plurality of partitions of the fourth fluid in the third fluid.

17. The method of claim 14, further comprising flowing the mixture comprising a plurality of partitions of the first fluid in the third fluid through a conduit from the outlet of the partitioner through a reactor, wherein the reactor provides energy to initiate and/or promote one or more physical or chemical reactions in one or more of the partitions.

18. The method of claim 14, further comprising flowing the mixture comprising a plurality of partitions of the first fluid in the third fluid through a conduit from the outlet of the partitioner to a detector conduit in a detector, wherein the detector conduit comprises an interrogation region, and wherein the detector detects at least one characteristic of at least a portion of the partitions as they flow in single file through the interrogation region.

19. The method of claim 14, wherein, in step (ii), an opening of the first intake conduit is positioned to be immersed in the first fluid to create a fluid connection for flow of the first fluid into the first injector conduit, wherein a major dimension of the opening of the first intake conduit is less than a characteristic dimension of any other conduit in the apparatus.