CLAIMS

1. A system for processing a sample, comprising:

an array comprising (i) a first plurality of electrodes, (ii) a second plurality of electrodes, (iii) a liquid coating filling in gaps between adjacent electrodes of said first plurality of electrodes and said second plurality of electrodes, (iv) a dielectric disposed over said first plurality of electrodes, said second plurality of electrodes, and said liquid coating filling in gaps between said adjacent electrodes, and (v) a liquid layer disposed over said dielectric, wherein said liquid layer is configured to support a droplet on a surface of said liquid layer, wherein said droplet comprises said sample, wherein said liquid layer comprises a liquid that has a wetting affinity characteristic for said dielectric, wherein said liquid is immiscible with said droplet, and wherein said first plurality of electrodes and said second plurality of electrodes are configured to supply an electric field to induce said droplet to motion along a surface of said liquid layer; and

a controller operatively coupled to said first plurality of electrodes and said second plurality of electrodes, wherein said controller is configured to direct at least a subset of said first plurality of electrodes and said second plurality of electrodes to supply said electric field to alter a wetting characteristic of said surface of said liquid layer, to thereby induce said droplet to motion along said surface of said liquid layer.

2. The system of claim 1, wherein said electric field is between a subset of electrodes of said first plurality of electrodes, a subset of electrodes of said second plurality of electrodes, or between said first plurality of electrodes and said second plurality of electrodes.

3. The system of claim 1, wherein said surface of said liquid layer comprises one or more paths, wherein a path of said one or more paths comprises one or more tracks for motion of said droplet.

4. The system of claim 1, wherein said surface of said liquid layer is configured to support an additional droplet comprising an additional sample or a chemical sample.

5. The system of claim 1, further comprising a light source operatively coupled to said controller, wherein said controller is configured to alter said wetting characteristic of said surface of said liquid layer by directing said light source to apply light to said array.

6. The system of claim 1, further comprising one or more dispensers configured to dispense or remove said droplet to or from said surface.

7. The system of claim 1, wherein said dielectric comprises a polymeric material.

8. The system of claim 7, wherein said polymeric material is removable.

9. The system of claim 1, wherein said first plurality of electrodes and said second plurality of electrodes are coplanar.

10. The system of claim 1, wherein said first plurality of electrodes and said second plurality of electrodes are non-coplanar.

11. The system of claim 1, wherein said array further comprises one or more stations, wherein said one or more stations are selected from the group consisting of a mixing station, a temperature control station, a magnetic field station, an acoustic field station, a nucleic acid delivery station, an optical inspection station, an optical manipulation station, a droplet input station and a droplet output station.

12. The system of claim 1, wherein said liquid layer comprises an upper surface, and wherein said upper surface of said liquid layer, said droplet, and a gas form a liquid-liquid-gas interface.

13. The system of claim 1, wherein said liquid layer and said dielectric form an electrical barrier between (1) said first plurality of electrodes and said second plurality of electrodes, and (2) said droplet.

14. The system of claim 1, wherein said liquid coating comprises a photoresist, epoxy, potting compound, liquid polymer, or other dielectric.

15. The system of claim 1, wherein said droplet comprises a biological sample.

16. The system of claim 1, wherein said electric field induces said droplet to motion in at least two directions along said surface of said liquid layer.

17. A method for processing a sample, comprising:

(a) providing an array comprising: (i) a first plurality of electrodes, (ii) a second plurality of electrodes, (iii) a liquid coating filling in gaps between adjacent electrodes of said first plurality of electrodes and said second plurality of electrodes, (iv) a dielectric disposed over said first plurality of electrodes, said second plurality of electrodes, and said liquid coating filling in gaps between said adjacent electrodes, and (v) a liquid layer disposed over said dielectric, wherein said liquid layer is configured to support a droplet on a surface of said liquid layer, wherein said droplet comprises said sample, wherein said liquid layer comprises a liquid that has a wetting affinity characteristic for said dielectric, and wherein said liquid is immiscible with said droplet;

(b) introducing said droplet comprising said sample on said surface of said liquid layer disposed over said dielectric; and

(c) directing at least a subset of said first plurality of electrodes and said second plurality of electrodes to supply an electric field to alter a wetting characteristic of said surface of said liquid layer, to thereby induce said droplet to motion along said surface of said liquid layer.

18. The method of claim 17, wherein altering said wetting characteristic comprises controlling charging and discharging of one or more electrodes of said first plurality of electrodes and said second plurality of electrodes in sequence.

19. The method of claim 17, wherein altering said wetting characteristic comprises applying light to said array.

20. The method of claim 17, further comprising, during or subsequent to (b), subjecting said droplet to heating, cooling, a magnetic field, a light field, acoustic energy, or mixing to manipulate said sample.

21. The method of claim 17, wherein said sample comprises a nucleic acid or a protein, and wherein subsequent to (c), said nucleic acid or protein is processed within said droplet.

22. The method of claim 17, further comprising, during or subsequent to (b), introducing an additional droplet comprising one or more additional samples over said surface.

23. The method of claim 22, further comprising merging said droplet and said additional droplet.

24. The method of claim 17, further comprising splitting said droplet.

25. The method of claim 17, further comprising replenishing said liquid layer.

26. The method of claim 17, wherein said dielectric comprises a polymeric material.

27. The method of claim 17, wherein said liquid layer and said dielectric form an electrical barrier between (1) said first plurality of electrodes and said second plurality of electrodes, and (2) said droplet.

28. The method of claim 17, wherein said liquid coating comprises a photoresist, epoxy, potting compound, liquid polymer, or other dielectric.