

WHAT IS CLAIMED IS:

1. An optical imaging system for nucleic acid sequencing, the system comprising:
 - an actuator;
 - a mounting element configured to receive a substrate, wherein the substrate comprises an exterior and an interior;
 - vertical walls bounding an exterior region of the substrate, the vertical walls being configured to retain a fluid within the exterior region, and wherein the substrate comprises an array of spots for binding nucleic acid sequences in the interior of the substrate; and
 - an objective comprising a distal end that is configured to be near the substrate exterior, wherein the distal end of the objective is configured to be immersed in the fluid;
 - wherein the actuator is configured to relocate the objective relative to the substrate from a first location over the exterior surface of the substrate to a second location over the exterior surface of the substrate while the distal end of the objective remains immersed in the fluid.
2. The system of Claim 1, wherein the fluid comprises an oil.
3. The system of Claim 2, wherein the fluid comprises water.
4. The system of Claim 2, wherein the distal end of the objective is flat so as to reduce turbulence as the objective is moved from the first location to be second location.
5. The system of Claim 4, wherein the objective comprises a proximal portion and a distal portion, wherein the distal portion is untapered.
6. The system of Claim 2, wherein the actuator is configured to relocate the objective from the first location to the second location at a speed between 10 mm/s and 3750 mm/s.
7. The system of Claim 2, wherein an interior of the vertical walls are flat.
8. The system of Claim 2, wherein an interior of the vertical walls are curved.

9. The system of Claim 2, further comprising a fluid delivery subsystem for delivering fluid to the region.

10. The system of Claim 9, further comprising a fluid monitoring subsystem for determining whether a portion of the fluid has evaporated from the region, wherein the fluid delivery subsystem is configured to deliver additional fluid upon a positive determination by the fluid monitoring subsystem.

11. The system of Claim 10, wherein the fluid delivery subsystem comprises a conduit coupled to a fluid reservoir.

12. The system of Claim 10, wherein the fluid monitoring system comprises an optical sensor for detecting a presence of air bubbles in the fluid, and wherein determining whether a portion of the fluid has evaporated from the region comprises determining whether a threshold number of air bubbles are detected in the fluid.

13. A method for optically imaging a substrate for sequencing a nucleic acid sequence, the method comprising:

disposing a fluid on an exterior region of a substrate, wherein the region is bounded by vertical walls, and wherein the substrate comprises an interior including an array of spots for binding one or more nucleic acid sequences;

positioning an objective at a first location over the exterior surface of the substrate such that a distal end of the objective is in contact with the fluid; and

repositioning the objective to a second location over the exterior surface of the substrate while the distal end of the objective remains immersed in the fluid.

14. The method of Claim 13, wherein the fluid comprises an oil.

15. The method of Claim 13, wherein the fluid comprises water.

16. The method of Claim 13, wherein the distal end of the objective is flat so as to reduce turbulence as the objective is repositioned from the first location to be second location.

17. The method of Claim 16, wherein the objective comprises a proximal portion and a distal portion, wherein the distal portion is untapered.

18. The method of Claim 13, wherein the objective is repositioned from the first location to the second location at a speed between 10 mm/s and 3750 mm/s.

19. The method of Claim 13, wherein an interior of the vertical walls are flat.

20. The method of Claim 13, wherein an interior of the vertical walls are curved.

21. The method of Claim 13, further comprising:
determining that a portion of the fluid has evaporated from the region; and
delivering additional fluid via a fluid delivery subsystem based on the determination.

22. The method of Claim 21, wherein the fluid delivery subsystem comprises a conduit coupled to a fluid reservoir.

23. The method of Claim 21, wherein determining that the portion of the fluid has evaporated from the region comprises:

detecting a presence of air bubbles in the fluid; and
determining that a threshold number of air bubbles has been detected.

24. An optical imaging system for nucleic acid sequencing, the system comprising:

an actuator;

a mounting element configured to receive a substrate, wherein the substrate comprises an array of spots for binding nucleic acid sequences, wherein an exterior surface of the substrate is configured to receive a droplet, the exterior surface of the substrate comprising a first material; and

an objective comprising a distal end configured to be near the exterior surface of the substrate, the distal end of the objective comprising a second material, wherein the second material is configured to provide a higher friction against the droplet than the first material; wherein the actuator is configured to relocate the objective relative to the substrate

from a first location over the exterior surface of the substrate to a second location over the exterior surface of the substrate such that the objective and the exterior surface of the substrate maintain contact with the droplet during relocation.

25. The system of Claim 24, wherein the droplet comprises an oil, and wherein the first material is oleophobic and the second material is oleophilic.

26. The system of Claim 24, wherein the droplet comprises water, and where in the first material is hydrophobic and the second material is hydrophilic.

27. The system of Claim 26, wherein the first material comprises Teflon.

28. The system of Claim 26, wherein the second material comprises glass, silicon dioxide, sapphire, or calcium oxide.

29. The system of Claim 24, wherein the distal end of the objective is concave so as to facilitate maintaining contact between the objective and the droplet.

30. The system of Claim 29, wherein the distal end of the objective has a radius of curvature of between 45 mm and 160 mm, and a depth of between 0.6 mm and 2.1 mm.

31. The system of Claim 24, wherein the actuator is configured to relocate the objective from the first location to the second location at a speed between 10 mm/s and 3750 mm/s.

32. The system of Claim 24, further comprising a droplet delivery subsystem for delivering a droplet to the exterior surface of the substrate.

33. The system of Claim 32, further comprising a droplet monitoring subsystem for determining whether the objective and the exterior surface of the substrate are in contact with the droplet, wherein the droplet delivery subsystem is configured to deliver an additional droplet upon a negative determination by the droplet monitoring subsystem.

34. The system of Claim 32, wherein the droplet delivery subsystem comprises a conduit coupled to a fluid reservoir.

35. A method for optically imaging a substrate for sequencing a nucleic acid sequence, the method comprising:

disposing a droplet on an exterior surface of the substrate, wherein the substrate comprises an array of spots for binding nucleic acid sequences, and wherein the exterior surface of the substrate comprises a first material;

positioning an objective at a first location over the exterior surface of the substrate such that a distal end of the objective is in contact with the droplet, wherein the distal end of the objective comprises a second material, the second material being configured to provide a higher friction against the droplet than the first material; and

repositioning the objective to a second location over the exterior surface of the substrate, wherein during repositioning the objective is configured to maintain the droplet with the distal end of the objective such that the objective and the exterior surface of the substrate maintain contact with the droplet at the second location.

36. The method of Claim 35, wherein the droplet comprises an oil, and wherein the first material is oleophobic and the second material is oleophilic.

37. The method of Claim 35, wherein the droplet comprises water, and where in the first material is hydrophobic and the second material is hydrophilic.

38. The method of Claim 37, wherein the first material comprises Teflon.

39. The method of Claim 37, wherein the second material comprises glass, silicon dioxide, sapphire, or calcium oxide.

40. The method of Claim 35, wherein the distal end of the objective is concave so as to facilitate maintaining contact between the objective and the droplet.

41. The method of Claim 40, wherein the distal end of the objective has a radius of curvature of between 45 mm and 160 mm, and a depth of between 0.6 mm and 2.1 mm.

42. The method of Claim 37, wherein the objective is repositioned from the first location to the second location at a speed between 10 mm/s and 3750 mm/s.

43. The method of Claim 37, further comprising:
determining that the objective and the exterior surface of the substrate are not in contact with the droplet; and
delivering an additional droplet via a droplet delivery subsystem based on the determination.

44. The method of Claim 43, wherein the droplet delivery subsystem comprises a conduit coupled to a fluid reservoir.

45. The system of claim 1, wherein the substrate comprises a flowcell including a first substrate and a second substrate, wherein the exterior region is on the first substrate, wherein the array of spots are on an interior surface of the second substrate.

46. The method of claim 13, wherein the substrate comprises a flowcell including a first substrate and a second substrate, wherein the exterior region is on the first substrate, wherein the array of spots are on an interior surface of the second substrate.

47. The system of claim 24, wherein the substrate comprises a flowcell including a first substrate and a second substrate, wherein the exterior surface is on the first substrate, wherein the array of spots are on an interior surface of the second substrate.

48. The method of claim 35, wherein the substrate comprises a flowcell including a first substrate and a second substrate, wherein the exterior surface is on the first substrate, wherein the array of spots are on an interior surface of the second substrate.