CLAIMS

1. A method for aligning a sample to an array, the method comprising:

receiving, by a data processor, sample image data comprising a sample image of the sample, the sample image having a first resolution;

receiving, by the data processor, array image data comprising an array image comprising an overlay of an array with the sample, and an array fiducial, the array image having a second resolution lower than the first resolution of the sample image;

registering, by the data processor, the sample image to the array image by aligning the sample image and the array image;

generating, by the data processor, an aligned image based on the registering, the aligned image comprising an overlay of the sample image with the array; and

providing, by the data processor, the aligned image.

2. The method the preceding claim, wherein the sample image data is received from a user or from a computing device remote from the data processor.

3. The method of any one of the preceding claims, wherein the aligned image further comprises the array fiducial aligned with the sample.

4. The method of any one of the preceding claims, wherein the sample image further comprises a sample fiducial and the registering further comprises aligning the array fiducial with the sample fiducial.

5. The method of claim 4, wherein the sample image is of the sample on a first substrate comprising an edge, and wherein the sample fiducial comprises the edge.

6. The method of any one of the preceding claims, wherein the sample fiducial comprises a stamp or a sticker applied by a user to the first substrate on which the sample is placed, the sample fiducial delineating a sample area into which the sample is placed on the sample substrate.

7. The method of any one of the preceding claims, wherein the sample fiducial is configured based on one or more sample sizes.

8. The method of any one of the preceding claims, wherein the sample is located on the first substrate and the array is located on a second substrate.

9. The method of any one of the preceding claims, wherein the sample fiducial is located on a first side of the first substrate, the first side of the first substrate opposite a second side of the first substrate on which the sample is located and the array image is acquired at a field depth suitable to acquire the sample and the sample fiducial in the same focal plane.

10. The method of any one of the preceding claims, wherein the array fiducial is located on a first side of a second substrate, the first side of the second substrate opposite a second side of the second substrate on which the array is located.

11. The method of any one of the preceding claims, wherein the sample fiducial is located on the first substrate adjacent to, within, or distant from sample.

12. The method any one of the preceding claims, wherein the array fiducial is located on the second substrate adjacent to, within, or distant from a reagent configured on the second substrate.

13. The method of any of the preceding claims, wherein the first substrate comprises one or more sample fiducials and/or the second substrate comprises one or more array fiducials.

14. The method of any one of the preceding claims, wherein the array image is acquired such that a portion of the array overlays atop a portion of the sample based on a location of the array fiducial and/or the sample fiducial.

15. A method for aligning a sample to an array, the method comprising:

receiving, by a data processor, sample image data comprising a sample image of the sample and a sample fiducial, the sample image having a first resolution;

receiving, by the data processor, instrument fiducial data comprising an instrument fiducial image of a first instrument fiducial and a second instrument fiducial;

receiving, by the data processor, array image data comprising an array image having a second resolution lower than the first resolution of the sample image, the

array image comprising the array and an array fiducial overlaid atop the sample and the sample fiducial;

registering, by the data processor, the instrument fiducial image to the array image by aligning the first instrument fiducial and the array fiducial;

registering, by the data processor, the instrument fiducial image to the sample image by aligning the second instrument fiducial and the sample fiducial;

generating, by the data processor, an aligned image based on registering the instrument fiducial image to the sample image and based on registering the instrument fiducial image to the array image, the aligned image comprising the sample aligned with the array; and

providing, by the data processor, the aligned image.

16. The method of any one of the preceding claims, wherein the sample image comprises a plurality of sample portion images, each sample portion image associated with a portion of the sample, wherein a size of each sample portion image is less than a size of a single field of view of the sample image.

17. The method of claim 16, wherein registering the sample image to the array image further comprises

cropping, by the data processor, the sample image to determine the plurality of sample portion images; and

registering one or more sample portion images in the sample image to a corresponding portion of the sample in the array image.

18. The method of claims 17, wherein registering the one or more sample portion images in the sample image to the corresponding portion of the sample in the array image is performed after registering the sample image to the array image.

19. The method of any one of the preceding claims, further comprising aligning, by the data processor, the sample and the array within a sample holder configured to receive the first substrate comprising the sample and the second substrate comprising the array.

20. The method of any one of the preceding claims, wherein the array image comprises a plurality of array portion images, each array portion image associated with a portion of the

array, wherein a size of each array portion image is less than a size of a single field of view of the array image.

21. The method of claim 20, wherein the registering further comprises

determining, by the data processor, the plurality of array portion images in the array image; and

registering, by the data processor, one or more array portion images in the array image to a corresponding portion of the sample in the sample image.

22. The method of any one of claims 16-21, wherein the sample image comprises an overlay of the array with the sample and the array fiducial.

23. The method of claim 20, wherein the sample and the array are on a single substrate.

24. A method for processing sample image data, comprising:

receiving, by a data processor, a first sample image dataset comprising a first plurality of sample portion images corresponding to portions of a sample, each of the sample portion images having a first resolution;

receiving, by the data processer, a second sample image dataset comprising a sample image of the sample, the sample image having a second resolution lower than the first resolution of each of the sample portion images;

registering, by the data processor, one or more sample portion images to a corresponding portion of the sample in the sample image.

25. The method of any one of the preceding claims, wherein the sample image comprises a plurality of sample portion images, each sample portion image associated with a portion of the sample, the method further comprising

receiving, by the data processor, an array image dataset comprising an array image comprising a single field of view of an array and an array fiducial;

determining, by the data processor, the array fiducial and the sample are within the single field of view of the array image; and

determining, by the data processor, one or more reagent locations of the array using the array image; wherein the generated aligned image comprises the one or more reagent locations.

26. The method of any one of the preceding claims, wherein the sample image comprises a plurality of sample portion images, each sample portion image associated with a portion of the sample, and wherein the array image comprises a plurality of array portion images, each array portion image associated with a portion of the array and comprising a single field of view, the registering further comprising

determining, by the data processor, the plurality of sample portion images in the sample image;

registering, by the data processor, one or more sample portion images in the sample image to a corresponding portion of the sample in the array image;

determining, by the data processor, the plurality of array portion images in the array image; and

registering, by the data processor, one or more array portion images in the array image to a corresponding portion of the sample in the sample image.

27. A system for aligning a sample to an array, the system comprising:

a sample holder comprising

a first retaining mechanism configured to retain a first substrate received within the first retaining mechanism, the first substrate comprising a sample, and

a second retaining mechanism configured to retain a second substrate received within the second retaining mechanism, the second substrate comprising an array, the sample holder configured to adjust a location of the first substrate relative to the second substrate to cause all or a portion of the sample to be aligned with the array;

a microscope operatively coupled to the sample holder, the microscope configured to view the first substrate and the second substrate within the sample holder; and acquire image data associated with the sample and/or the array; and

a first computing device communicatively coupled to the microscope and to the sample holder, the computing device comprising a display, a data processor, and a non-transitory computer readable storage medium storing computer readable and executable instructions, which when executed cause the data processor to perform operations comprising

receiving sample image data comprising a sample image of the sample, the sample image having a first resolution;

receiving array image data comprising an array image having a second resolution lower than the first resolution of the sample image, the array image comprising the array and an array fiducial overlaid atop the sample;

registering the sample image to the array image by aligning the sample image and the array image;

generating an aligned image based on the registering, the aligned image comprising the sample aligned with the array; and

providing the aligned image.

28. The system of the preceding claim, wherein the sample image data is received from a user or from a computing device remote from the data processor.

29. The system of any one of the preceding claims, wherein the aligned image further comprises the array fiducial aligned with the sample.

30. The system of any one of the preceding claims, wherein the sample image further comprises a sample fiducial and the registering further comprises aligning the array fiducial with the sample fiducial.

31. The system of claim 29, wherein the sample image is of the sample on a first substrate comprising an edge, and wherein the sample fiducial comprises the edge.

32. The system of any one of the preceding claims, wherein the sample fiducial comprises a stamp or a sticker applied by a user to the first substrate on which the sample is placed, the sample fiducial delineating a sample area into which the sample is placed on the first substrate.

33. The system of any one of the preceding claims, wherein the sample fiducial is configured based on one or more sample sizes.

34. The system of any one of the preceding claims, wherein the sample is located on the first substrate and the array is located on a second substrate.

35. The system of any one of the preceding claims, wherein the sample fiducial is located on a first side of the first substrate, the first side of the first substrate opposite a second side of the first substrate on which the sample is located and the array image is acquired at a field depth suitable to acquire the sample and the sample fiducial in the same focal plane.

36. The system of any one of the preceding claims, wherein the array fiducial is located on a first side of a second substrate, the first side of the second substrate opposite a second side of the second substrate on which the array is located.

37. The system of any one of the preceding claims, wherein the sample fiducial is located on the first substrate adjacent to, within, or distant from sample.

38. The system any one of the preceding claims, wherein the array fiducial is located on the second substrate adjacent to, within, or distant from a reagent configured on the second substrate.

39. The system of any of the preceding claims, wherein the first substrate comprises one or more sample fiducials and/or the second substrate comprises one or more array fiducials.

40. The system of any one of the preceding claims, wherein the array image is acquired such that a portion of the array overlays atop a portion of the sample based on a location of the array fiducial and/or the sample fiducial.

41. A system for aligning a sample to an array, the system comprising:

a sample holder comprising

a first retaining mechanism configured to retain a first substrate received within the first retaining mechanism, the first substrate comprising a sample, and

a second retaining mechanism configured to retain a second substrate received within the second retaining mechanism, the second substrate comprising an array, the sample holder configured to adjust a location of the first substrate relative to the second substrate to cause all or a portion of the sample to be aligned with the array;

a microscope operatively coupled to the sample holder, the microscope configured to view the first substrate and the second substrate within the sample holder; and acquire image data associated with the sample and/or the array; and

a first computing device communicatively coupled to the microscope and to the sample holder, the computing device comprising a display, a data processor, and a non-transitory computer readable storage medium storing computer readable and executable instructions, which when executed cause the data processor to perform operations comprising

receiving sample image data comprising a sample image of the sample and a sample fiducial, the sample image having a first resolution;

receiving instrument fiducial data comprising an instrument fiducial image of a first instrument fiducial and a second instrument fiducial;

receiving array image data comprising an array image having a second resolution lower than the first resolution of the sample image, the array image comprising the array and an array fiducial overlaid atop the sample and the sample fiducial;

registering the instrument fiducial image to the array image by aligning the first instrument fiducial and the array fiducial;

registering the instrument fiducial image to the sample image by aligning the second instrument fiducial and the sample fiducial;

generating an aligned image based on registering the instrument fiducial image to the sample array image and based on registering the instrument fiducial image to the array image, the aligned image comprising the sample aligned with the array; and

providing the aligned image.

42. The system of any one of the preceding claims, wherein the sample image comprises a plurality of sample portion images, each sample portion image associated with a portion of the sample, wherein a size of each sample portion image is less than a size of a single field of view of the sample image.

43. The system of claim 42, wherein the registering further comprises

cropping, by the data processor, the sample image to determine the plurality of sample portion images; and

registering one or more sample portion images in the sample image to a corresponding portion of the sample in the array image.

44. The system of claims 43, wherein registering the one or more sample portion images in the sample image to the corresponding portion of the sample in the array image is performed after registering the sample image to the array image.

45. The system of any one of the preceding claims, wherein the data processor is further configured to align the sample and the array within a sample holder configured to receive the first substrate comprising the sample and the second substrate comprising the array.

46. The system of any one of the preceding claims, wherein the array image comprises a plurality of array portion images, each array portion image associated with a portion of the array, wherein a size of each array portion image is less than a size of a single field of view of the array image.

47. The system of claim 46, wherein the registering further comprises

determining the plurality of array portion images in the array image; and

registering one or more array portion images in the array image to a corresponding portion of the sample in the sample image.

48. The system of any one of the preceding claims, wherein the sample image comprises a plurality of sample portion images, each sample portion image associated with a portion of the sample, and the array image comprises a single field of view, the method further comprising

receiving an array image dataset comprising an array image comprising a single field of view of an array and an array fiducial;

determining the array fiducial and the sample are within the single field of view of the array image; and

determining one or more reagent locations of the array using the array image; wherein the generated aligned image comprises the one or more reagent locations.

49. The system of any one of the preceding claims, wherein the sample image comprises a plurality of sample portion images, each sample portion image associated with a portion of the sample, and wherein the array image comprises a plurality of array portion images, each array portion image associated with a portion of the array and comprising a single field of view, the registering further comprising

determining the plurality of sample portion images in the sample image;

registering one or more sample portion images in the sample image to a corresponding portion of the sample in the array image;

determining the plurality of array portion images in the array image; and

registering one or more array portion images in the array image to a corresponding portion of the sample in the sample image.

50. A non-transitory computer readable medium storing instructions, which when executed by at least one data processor cause the at least one data processor to perform operations comprising:

receiving sample image data comprising a sample image of a sample, the sample image data received from a microscope operatively coupled to the at least one data processor and to a sample holder, the sample image having a first resolution, the microscope configured to view a first substrate comprising the sample within the sample holder;

receiving, from the microscope, array image data comprising an array image having a second resolution lower than the first resolution of the sample image from the microscope, the array image comprising an array and an array fiducial overlaid atop the sample, the microscope configured to view a second substrate comprising the array and the array fiducial overlaid atop the sample;

registering the sample image to the array image by aligning the sample image and the array image;

generating an aligned image based on the registering, the aligned image comprising the sample aligned with the array; and

providing the aligned image.

51. A system for aligning a sample to an array, the system comprising:

a sample holder comprising

a first retaining mechanism configured to retain a first substrate received within the first retaining mechanism, the first substrate comprising a sample, and

a second retaining mechanism configured to retain a second substrate received within the second retaining mechanism, the second substrate comprising an array, the sample holder configured to adjust a location of the first substrate relative to the second substrate to cause all or a portion of the sample to be aligned with the array;

an image capture device operatively coupled to the sample holder, the image capture device configured to view the first substrate and the second substrate within the sample holder; and acquire image data associated with the sample and/or the array; and

a first computing device communicatively coupled to the image capture device and to the sample holder, the computing device comprising a display, a data processor, and a non-transitory computer readable storage medium storing computer readable and executable instructions, which when executed cause the data processor to perform operations comprising

receiving sample image data comprising a sample image of the sample and a sample fiducial, the sample image having a first resolution;

receiving instrument fiducial data comprising an instrument fiducial image of a first instrument fiducial and a second instrument fiducial;

receiving array image data comprising an array image having a second resolution lower than the first resolution of the sample image, the array image comprising the array and an array fiducial overlaid atop the sample and the sample fiducial;

registering the instrument fiducial image to the array image by aligning the first instrument fiducial and the array fiducial;

registering the instrument fiducial image to the sample image by aligning the second instrument fiducial and the sample fiducial;

generating an aligned image based on registering the instrument fiducial image to the sample array image and based on registering the instrument fiducial image to the array image, the aligned image comprising the sample aligned with the array; and

providing the aligned image.