**CLAIMS**

1. A wafer alignment system comprising:

an imaging sub-system;

a stage configured to secure and actuate a wafer, wherein two or more reference point targets are formed on the wafer, wherein each reference point target comprises a plurality of sub-patterns arranged in an array, wherein each sub-pattern is different from the other sub-patterns of the plurality of sub-patterns;

a controller coupled to the imaging sub-system and the stage, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive image data of the two or more reference point targets from the imaging sub-system;

determine a center location for each of the two or more reference point targets, wherein determining the center location of each of the two or more reference point targets comprises:

identify each sub-pattern within a respective reference point target via a pattern recognition process;

identify a plurality of center location candidates for the respective reference point target, wherein identifying the plurality of center location candidates for the respective reference point target comprises: applying a model to each identified sub-pattern of the respective reference point target, wherein the model generates a hotspot for each sub-pattern that identifies a center location candidate for the respective reference point target; and

determine a center location for the respective reference point target based on the plurality of center location candidates;

determine an orientation of the wafer relative to a coordinate system of the stage based on the center location determined for each of the two or more reference point targets; and

direct the stage to adjust the rotational position of the wafer to align the wafer with the stage coordinate system based on the determined orientation of the wafer.

2. The system of claim 1, wherein the determining a center location of the respective reference point target based on the plurality of center candidates comprises:

determining the center location of the respective reference point target based on the plurality of center location candidates via a voting scheme, wherein the voting scheme identifies the center location as the center location candidate identified by a majority of the identified sub-patterns.

3. The system of claim 2, wherein the controller is further configured to apply a selected tolerance when executing the voting scheme, wherein the selected tolerance comprises an allowable variance of the plurality of center location candidates.

4. The system of claim 1, wherein an area of each reference point target is substantially equal to a field of view of the imaging sub-system.

5. The system of claim 1, wherein a first reference point target is in a first field and a second reference point target is in a second field.

6. The system of claim 1, wherein each sub-pattern of the two or more reference point patterns has a same shape and different orientation from the other sub-patterns.

7. The system of claim 6, wherein each sub-pattern comprises a three-ray pattern and is rotated by twelve degrees relative to a neighboring sub-pattern.

8. The system of claim 6, wherein each sub-pattern comprises a cross pattern and is rotated by nine degrees relative to a neighboring sub-pattern.

9. The system of claim 6, wherein each sub-pattern comprises a triangle pattern and is rotated by twelve degrees relative to a neighboring sub-pattern.

10. The system of claim 1, wherein each sub-pattern of the two or more reference point patterns has a different shape.

11. The system of claim 1, wherein at least one of the sub-patterns comprise at least one of a cross, circle, star, triangle, ray, or arrow.

12. The system of claim 1, wherein the reference point targets are lithographically formed on the wafer.

13. The system of claim 1, wherein the stage comprises at least one of a rotational stage or translational stage.

14. The system of claim 1, wherein the imaging sub-system comprises:
an illumination source;
a set of optics; and
a camera.

15. The system of claim 1, wherein the imaging sub-system comprises at least one of an imaging overlay metrology sub-system or an inspection sub-system.

16. The system of claim 1, wherein the controller is further configured to implement a two- phase acquisition process utilizing at least three reference point targets, wherein a center sub-pattern of each of the reference point targets is different from the outer sub-patterns of each of the reference point targets.

17. A wafer alignment method comprising:
acquiring image data of reference point targets including a set of sub-patterns; determining a center location for each of the reference point targets, wherein determining the center location of each of the two or more reference point targets comprises:
identifying each sub-pattern within a respective reference point target via a pattern recognition process;
identifying a plurality of center candidates for the respective reference point target, wherein identifying the plurality of center point candidates for the respective reference point target comprises: applying a model to each identified sub-pattern of the respective reference point target to identify a center location candidate of the respective reference point target, wherein the model generates a hotspot for each sub-pattern that identifies a center location candidate associated with the respective reference point target; and
determining a center location of the respective reference point target based on a plurality of center location candidates;
determining an orientation of the wafer relative to a coordinate system of a stage based on the center location determined for each of the two or more reference point targets; and
directing the stage to adjust the rotational position of the wafer to align the wafer with the stage coordinate system based on the determined orientation of the wafer.

18. The method of claim 17, wherein the determining a center location of the respective reference point target based on the plurality of center location candidates comprises:

determining the center location of the respective reference point target based on the plurality of center location candidates via a voting scheme, wherein the voting scheme identifies the center location as the center location candidate identified by a majority of the identified sub-patterns.

19. The method of claim 18, further comprising: applying a selected tolerance when executing the voting scheme, wherein the selected tolerance comprises an allowable variance of the center location candidates.

20. The method of claim 17, wherein an area of each reference point target is substantially equal to a field of view of an imaging sub-system.

21. The method of claim 17, wherein a first reference point target is in a first field of the wafer and a second reference point target is in a second field of the wafer.

22. The method of claim 17, wherein each sub-pattern of the two or more reference point patterns has the same shape and different orientation from the other sub-patterns.

23. The method of claim 22, wherein each sub-pattern comprises a three-ray pattern and is rotated by twelve degrees relative to a neighboring sub-pattern.

24. The method of claim 22, wherein each sub-pattern comprises a cross pattern and is rotated by nine degrees relative to a neighboring sub-pattern.

25. The method of claim 22, wherein each sub-pattern comprises a triangle pattern and is rotated by twelve degrees relative to a neighboring sub-pattern.

26. The method of claim 17, wherein each sub-pattern of the two or more reference point patterns has a different shape.

27. The method of claim 17, wherein at least one of the sub-patterns comprise at least one of a cross, circle, star, triangle, ray, or arrow.

28. The method of claim 17, wherein the reference point targets are lithographically formed on the wafer.

29. The method of claim 17, further comprising: implementing a two-phase acquisition process utilizing at least three reference point targets, wherein a center sub-pattern of each of the reference point targets is different from the outer sub-patterns of each of the reference point targets.

30. The system of claim 1, wherein a size of each sub-pattern is substantially a same size as a field of view (FOV) of the wafer alignment system.

31. The system of claim 30, wherein the array comprises an m x n array, wherein m and n are equal to or greater than 1.

32. The system of claim 31, wherein the array comprises at least one of a 2x2 array, a 3 x 3 array, or a 4 x 4 array.