

## CLAIMS

What is claimed:

1. A metrology target comprising:

a first working zone including one or more instances of a first pattern, wherein the first working zone is rotationally symmetric; and

a second working zone including one or more instances of a second pattern, wherein the second working zone is rotationally symmetric, wherein at least one of the first pattern or the second pattern is a Moiré pattern formed from a first grating structure with a first pitch along a measurement direction on a first sample layer and a second grating structure with a second pitch along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein a center of rotational symmetry of the first working zone and a center of rotational symmetry of the second working zone overlap when an overlay error between the first sample layer and the second layer is zero, wherein a difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone along the measurement direction is indicative of an overlay error between the first sample layer and the second sample layer along the measurement direction.

2. The metrology target of claim 1, wherein the first grating structure and the second grating structure fully overlap.

3. The metrology target of claim 1, wherein at least one of the first working zone or the second working zone is symmetric to rotations of at least one of 90° or 180°.

4. The metrology target of claim 1, wherein at least one of the first working zone or the second working zone includes features placed diagonally around the center of rotational symmetry.

5. The metrology target of claim 1, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with the first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with the second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a third grating structure with a third pitch ( $p_3$ ) along the measurement direction on the first sample layer and a fourth grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on the second sample layer, wherein the fourth pitch is different than the third pitch.

6. The metrology target of claim 5, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the first working zone has a first conditional Moiré factor  $M_1 = p_1/(p_1-p_2)$ , wherein the second working zone has a second conditional Moiré factor  $M_2 = p_3/(p_3-p_4)$ , wherein the overlay error along the measurement direction corresponds to the difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone adjusted by a Moiré gain of  $M_g = M_1 - M_2$ .

7. The metrology target of claim 6, wherein  $M_1$  and  $M_2$  have opposite signs.

8. The metrology target of claim 5, wherein the first pitch equals the fourth pitch, wherein the second pitch equals the third pitch.

9. The metrology target of claim 1, wherein at least one instance of the first pattern is separated from at least one instance of the second pattern by an exclusion zone to mitigate cross-talk.

10. The metrology target of claim 9, wherein the exclusion zone is at least 0.25 microns.

11. The metrology target of claim 1, wherein the first working zone includes two instances of the first pattern, wherein the second working zone includes two instances of the second pattern.

12. The metrology target of claim 1, wherein the first working zone includes two instances of the first pattern, wherein the second working zone includes one instance of the second pattern.

13. The metrology target of claim 12, wherein the first pattern includes the Moiré pattern formed from the first grating structure and the second grating structure.

14. The metrology target of claim 12, wherein the second pattern includes the Moiré pattern formed from the first grating structure and the second grating structure.

15. The metrology target of claim 1, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with the first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with the second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

a second working zone including one or more instances of a reference structure along the measurement direction on the first sample layer.

16. The metrology target of claim 15, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the overlay error along the measurement direction corresponds to the difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone adjusted by a Moiré gain of  $M_g = p_1/(p_1 - p_2)$ .

17. The metrology target of claim 15, wherein the reference structure comprises:

a grating structure with a third pitch.

18. The metrology target of claim 15, wherein the reference structure comprises:

- a first feature on a first side of the Moiré pattern; and
- a second feature on a second side of the Moiré pattern opposite the first sign.

19. The metrology target of claim 1, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a the first sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on the second sample layer, wherein the fourth pitch is different than the third pitch, wherein the target further comprises:

a third working zone including one or more instances of a third Moiré pattern, wherein the third Moiré pattern includes a grating structure with a fifth pitch ( $p_5$ ) along the measurement direction on a the second sample layer and a grating structure with a sixth pitch ( $p_6$ ) along the measurement direction on a third sample layer, wherein the sixth pitch is different than the fifth pitch, wherein a difference between the center of rotational symmetry of the first working zone and a center of rotational symmetry of the third working zone along the measurement direction is indicative of an overlay error between the first sample layer and the third sample layer along the measurement direction.

20. The metrology target of claim 1, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a the second sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on a third sample layer, wherein the fourth pitch is different than the third pitch, wherein the target further comprises:

a third working zone including one or more instances of a third Moiré pattern, wherein the third Moiré pattern includes a grating structure with a fifth pitch ( $p_5$ ) along the measurement direction on a the first sample layer and a grating structure with a sixth pitch ( $p_6$ ) along the measurement direction on the third sample layer, wherein the sixth pitch is different than the fifth pitch, wherein a difference between the center of rotational symmetry of the second working zone and a center of rotational symmetry of the third working zone along the measurement direction is indicative of an overlay error between the second sample layer and the third sample layer along the measurement direction.

21. The metrology target of claim 1, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a the second sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on a third sample layer, wherein the fourth pitch is different than the third pitch, wherein the target further comprises:

a third working zone including one or more instances of a third Moiré pattern, wherein the third Moiré pattern includes a grating structure with a fifth pitch ( $p_5$ ) along the measurement direction on a the first sample layer and a grating structure with a sixth pitch ( $p_6$ ) along the measurement direction on the third sample layer, wherein the sixth pitch is different than the fifth pitch, wherein a difference between the center of rotational symmetry of the first working zone and a center of rotational symmetry of the second

working zone along the measurement direction is indicative of an overlay error between the first sample layer and the second sample layer along the measurement direction.

22. The metrology target of claim 1, further comprising:

- a first additional working zone including one or more instances of a first pattern, wherein the first additional working zone is rotationally symmetric; and

- a second additional working zone including one or more instances of a second additional pattern, wherein the second additional working zone is rotationally symmetric, wherein a center of rotational symmetry of the first additional working zone and a center of rotational symmetry of the second additional working zone overlap when the overlay error between the first sample layer and the second layer is zero, wherein a difference between the center of rotational symmetry of the first additional working zone and the center of rotational symmetry of the second additional working zone along the measurement direction is indicative of an overlay error between the first sample layer and the second sample layer along the additional measurement direction.

23. The metrology target of claim 22, wherein at least one of the first additional pattern or the second additional pattern is a Moiré pattern formed from a first additional grating structure with a first additional pitch along an additional measurement direction on the first sample layer and a second additional grating structure with a second additional pitch along the additional measurement direction on the second sample layer, wherein the second additional pitch is different than the first additional pitch.

24. A metrology system comprising:

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

- receive an image of a metrology target on the sample, the metrology target comprising:

- a first working zone including one or more instances of a first pattern, wherein the first working zone is rotationally symmetric; and

a second working zone including one or more instances of a second pattern, wherein the second working zone is rotationally symmetric, wherein at least one of the first pattern or the second pattern is a Moiré pattern formed from a first grating structure with a first pitch along a measurement direction on a first sample layer and a second grating structure with a second pitch along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch;

determine a difference between axes of symmetry of the first working zone and the second working zone along the measurement direction in the image; and

calculate an overlay error along the measurement direction with associated with the first sample layer and the second sample layer by adjusting the difference between the axes of symmetry of the first working zone and the second working zone along the measurement direction with a Moiré gain based on the pitches of the Moiré pattern.

25. The metrology system of claim 24, wherein determining the difference between the axes of symmetry of the first working zone and the second working zone along the measurement direction in the image comprises:

generating a first measurement signal based on an intensity of the image along the measurement direction for the first working zone;

determining a first axis of symmetry of the first working zone based on the first measurement signal;

generating a second measurement signal based on an intensity of the image along the measurement direction for the second working zone;

determining a second axis of symmetry of the second working zone based on the second measurement signal; and

determining the difference between the first axis of symmetry and the second axis of symmetry.

26. The metrology system of claim 25, further comprising:

filtering the first measurement signal to isolate a Moiré fringe signal associated with a Moiré period of the first Moiré pattern prior to determining the first axis of symmetry; and

filtering the second measurement signal to isolate a Moiré fringe signal associated with a Moiré period of the second Moiré pattern prior to determining the second axis of symmetry.

27. The metrology system of claim 24, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with the first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with the second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a third grating structure with a third pitch ( $p_3$ ) along the measurement direction on the first sample layer and a fourth grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on the second sample layer, wherein the fourth pitch is different than the third pitch.

28. The metrology system of claim 27, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the first working zone has a first conditional Moiré factor  $M_1 = p_1/(p_1 - p_2)$ , wherein the second working zone has a second conditional Moiré factor  $M_2 = p_3/(p_3 - p_4)$ , wherein the overlay error along the measurement direction corresponds to the difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone adjusted by a Moiré gain of  $M_g = M_1 - M_2$ .

29. The metrology system of claim 28, wherein  $M_1$  and  $M_2$  have opposite signs.

30. The metrology system of claim 24, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with the first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with the second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

a second working zone including one or more instances of a reference structure along the measurement direction on the first sample layer.

31. The metrology system of claim 30, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the overlay error along the measurement direction corresponds to the difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone adjusted by a Moiré gain of  $M_g = p_1/(p_1 - p_2)$ .

32. The metrology system of claim 24, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a the first sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on the second sample layer, wherein the fourth pitch is different than the third pitch, wherein the target further comprises:

a third working zone including one or more instances of a third Moiré pattern, wherein the third Moiré pattern includes a grating structure with a fifth pitch ( $p_5$ ) along the measurement direction on a the second sample layer and a grating structure with a sixth pitch ( $p_6$ ) along the measurement direction on a third sample layer, wherein the sixth pitch is different than the fifth pitch, wherein the one or more processors are further configured to execute program instructions causing the one or more processors to:

determine a difference between axes of symmetry of the first working zone and the third working zone along the measurement direction in the image; and

calculate an overlay error along the measurement direction with associated with the first sample layer and the third sample layer by adjusting the difference between the axes of symmetry of the first working zone and the third working zone along the measurement direction with a Moiré gain based on the pitches of the first Moiré pattern and the second Moiré pattern.

33. The metrology system of claim 24, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a the second sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on a third sample layer, wherein the fourth pitch is different than the third pitch, wherein the target further comprises:

a third working zone including one or more instances of a third Moiré pattern, wherein the third Moiré pattern includes a grating structure with a fifth pitch ( $p_5$ ) along the measurement direction on a the first sample layer and a grating structure with a sixth pitch ( $p_6$ ) along the measurement direction on the third sample layer, wherein the sixth pitch is different than the fifth pitch, wherein the sixth pitch is different than the fifth pitch, wherein the one or more processors are further configured to execute program instructions causing the one or more processors to:

determine a difference between axes of symmetry of the second working zone and the third working zone along the measurement direction in the image; and

calculate an overlay error along the measurement direction with associated with the second sample layer and the third sample layer by adjusting the difference between the axes of symmetry of the second working zone and the third working zone along the

measurement direction with a Moiré gain based on the pitches of the second Moiré pattern and the third Moiré pattern.

34. The metrology system of claim 24, wherein the first pattern comprises:

one or more instances of a first Moiré pattern, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein the second pattern comprises:

one or more instances of a second Moiré pattern, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a the second sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on a third sample layer, wherein the fourth pitch is different than the third pitch, wherein the target further comprises:

a third working zone including one or more instances of a third Moiré pattern, wherein the third Moiré pattern includes a grating structure with a fifth pitch ( $p_5$ ) along the measurement direction on a the first sample layer and a grating structure with a sixth pitch ( $p_6$ ) along the measurement direction on the third sample layer, wherein the sixth pitch is different than the fifth pitch, wherein the sixth pitch is different than the fifth pitch, wherein the one or more processors are further configured to execute program instructions causing the one or more processors to:

determine a difference between axes of symmetry of the second working zone and the third working zone along the measurement direction in the image; and

calculate an overlay error along the measurement direction with associated with the second sample layer and the third sample layer by adjusting the difference between the axes of symmetry of the first working zone and the second working zone along the measurement direction with a Moiré gain based on the pitches of the first Moiré pattern and the second Moiré pattern.

35. A metrology target comprising:

a first working zone including one or more instances of a first Moiré pattern, wherein the first working zone is rotationally symmetric, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a reference sample layer; and

a second working zone including one or more instances of a second Moiré pattern, wherein the second working zone is rotationally symmetric, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a second sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on the reference sample layer, wherein a center of rotational symmetry of the first working zone and a center of rotational symmetry of the second working zone overlap when an overlay error between the first sample layer and the second layer is zero, wherein a difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone along the measurement direction is indicative of an overlay error between the first sample layer and the second sample layer along the measurement direction.

36. The metrology target of claim 35, wherein  $p_3 = n \cdot p_1$  and  $p_4 = n \cdot p_2$ , wherein  $n$  is a positive number.

37. The metrology target of claim 36, wherein  $n=1$ .

38. The metrology target of claim 36, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the overlay error along the measurement direction corresponds to the difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone adjusted by a Moiré gain of  $M_g = p_2/(p_1 - p_2)$ .

39. A metrology system comprising:

a controller configured to be coupled to an imaging system, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive an image of a metrology target on the sample, the metrology target comprising:

a first working zone including one or more instances of a first Moiré pattern, wherein the first working zone is rotationally symmetric, wherein the first Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a reference sample layer; and

a second working zone including one or more instances of a second Moiré pattern, wherein the second working zone is rotationally symmetric, wherein the second Moiré pattern includes a grating structure with a third pitch ( $p_3$ ) along the measurement direction on a second sample layer and a grating structure with a fourth pitch ( $p_4$ ) along the measurement direction on the reference sample layer, wherein a center of rotational symmetry of the first working zone and a center of rotational symmetry of the second working zone overlap when an overlay error between the first sample layer and the second layer is zero;

determine a difference between axes of symmetry of the first working zone and the second working zone along the measurement direction in the image; and

calculate an overlay error along the measurement direction with associated with the first sample layer and the second sample layer by adjusting the difference between the axes of symmetry of the first working zone and the second working zone along the measurement direction with a Moiré gain based on the pitches of the Moiré pattern.

40. The metrology system of claim 39, wherein determining the difference between the axes of symmetry of the first working zone and the second working zone along the measurement direction in the image comprises:

generating a first measurement signal based on an intensity of the image along the measurement direction for the first working zone;

determining a first axis of symmetry of the first working zone based on the first measurement signal;

generating a second measurement signal based on an intensity of the image along the measurement direction for the second working zone;

determining a second axis of symmetry of the second working zone based on the second measurement signal; and

determining the difference between the first axis of symmetry and the second axis of symmetry.

41. The metrology system of claim 39, further comprising:

filtering the first measurement signal to isolate a Moiré fringe signal associated with a Moiré period of the first Moiré pattern prior to determining the first axis of symmetry; and

filtering the second measurement signal to isolate a Moiré fringe signal associated with a Moiré period of the second Moiré pattern prior to determining the second axis of symmetry.

42. The metrology system of claim 39, wherein  $p_3 = n \cdot p_1$  and  $p_4 = n \cdot p_2$ , wherein  $n$  is a positive number.

43. The metrology system of claim 42, wherein  $n=1$ .

44. The metrology system of claim 42, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the wherein the Moiré gain is  $M_g = p_2/(p_1-p_2)$ .

45. A metrology target comprising:

a working zone including one or more instances of a Moiré pattern, wherein the working zone is rotationally symmetric, wherein the Moiré pattern includes a grating

structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch, wherein an overlay error along the measurement direction associated with the first sample layer and the second sample layer corresponds to a difference between axes of symmetry of the first working zone imaged with a first optical configuration of an imaging system and a second optical configuration of the imaging system, wherein Moiré fringes are detectable with the first optical configuration, wherein at least one of the grating structure with the first pitch or the grating structure with the second pitch are detectable with the second optical configuration.

46. The metrology target of claim 45, wherein the grating structure with the first pitch is detectable with the second optical configuration, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the overlay error along the measurement direction corresponds to the difference between the center of rotational symmetry of the first working zone and the center of rotational symmetry of the second working zone adjusted by a Moiré gain of  $M_g = p_1/(p_1 - p_2)$ .

47. The metrology target of claim 45, wherein a particular optical configuration of the two different optical configurations includes a wavelength of illumination, a polarization of the illumination, an angle of the illumination, or a focal position of the metrology target with respect to a detector.

48. The metrology target of claim 45, wherein the working zone includes a single instance of the Moiré pattern.

49. The metrology target of claim 45, wherein the working zone includes at least two instances of the Moiré pattern.

50. The metrology target of claim 49, wherein the at least two instances of the Moiré pattern are separated by one or more fabricated features.

51. A metrology system comprising:

an imaging system comprising:

an illumination source to generate illumination;

one or more illumination optics to direct illumination from the illumination source to a metrology target, the metrology target comprising:

a working zone including one or more instances of a Moiré pattern, wherein the working zone is rotationally symmetric, wherein the Moiré pattern includes a grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch;

a detector to generate an image of the metrology target based on the illumination from the illumination source, wherein an optical configuration of the imaging system is configurable, wherein the optical configuration includes a wavelength of the illumination, a polarization of the illumination incident on the metrology target, an angle of the illumination incident on the metrology target, or a focal position of the metrology target with respect to the detector;

a controller configured to be coupled to an imaging system, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive a first image of the metrology target on the sample using a first optical configuration;

determine a first axis of symmetry of the working zone along the measurement direction based on the first image;

receive a second image of the metrology target on the sample using a second optical configuration different than the first optical configuration;  
determine a second axis of symmetry of the working zone along the measurement direction based on the second image;  
determine an optical overlay measurement based on a difference between the first axis of symmetry and the second axis of symmetry; and  
calculate an overlay error along the measurement direction with associated with the first sample layer and the second sample layer by adjusting the difference between the axes of symmetry in the first image and the second image adjusted by a Moiré gain based on pitches of the Moiré pattern.

52. The metrology system of claim 50, wherein the grating structure with the first pitch is detectable with the second optical configuration, wherein the overlay error along the measurement direction corresponds to a shift of the second layer with respect to the first layer, wherein the Moiré gain is  $M_g = p_1/(p_1-p_2)$ .

53. The metrology system of claim 50, wherein the first image and the second image are generated sequentially.

54. The metrology system of claim 50, wherein the first image and the second image are generated simultaneously.

55. The metrology system of claim 50, further comprising:

filtering the first measurement signal to isolate a Moiré fringe signal associated with a Moiré period of the first Moiré pattern prior to determining the first axis of symmetry;  
and

filtering the second measurement signal to isolate a signal associated one of the grating structure with the first pitch or the grating structure with the second pitch prior to determining the second axis of symmetry.

56. A method for designing a Moiré metrology target comprising:
- receiving a design of a metrology target, the metrology target comprising:
    - a working zone including one or more non-overlapping instances of a Moiré pattern, wherein the Moiré pattern includes a first grating structure with a first pitch ( $p_1$ ) along a measurement direction on a first sample layer and a second grating structure with a second pitch ( $p_2$ ) along the measurement direction on a second sample layer, wherein the second pitch is different than the first pitch;
  - receiving an optical configuration of an imaging system for imaging the metrology target; and
  - performing a design of experiments to select a set of target design parameters of the metrology target that provides a Moiré fringe pattern meeting selected design criteria when imaged by the imaging system, wherein the set of target design parameters includes the first pitch and the second pitch.
57. The method of claim 56, wherein the selected design criteria for the Moiré fringe pattern comprise:
- at least one of a contrast of a Moiré fringe pattern, overlay accuracy, measurement repeatability, a Moiré fringe period, or generation of a selected Moiré fringe order.
58. The method of claim 56, wherein the set of target design parameters further includes at least one of a critical dimension of the first grating structure, a critical dimension of the second grating structure, a segmentation period of the first grating structure, a segmentation period of the second grating structure, a size of the first grating structure, or a size of the second grating structure.
59. The method of claim 56, wherein the cross-talk is simulated using at least one of a Maxwell-based simulation or a Kirchoff approximation.
60. The method of claim 56, wherein the imaging system comprises:
- an illumination source to generate illumination;

one or more illumination optics to direct illumination from the illumination source to the metrology target; and

a detector to generate an image of the metrology target based on the illumination from the illumination source, wherein an optical configuration of the imaging system is configurable, wherein the optical configuration includes a wavelength of the illumination, a polarization of the illumination incident on the metrology target, an angle of the illumination incident on the metrology target, or a focal position of the metrology target with respect to the detector, wherein the set of target design parameters further includes the optical configuration of the imaging system.

61. The method of claim 56, wherein the design of experiments comprises:

simulating images of the metrology target with a plurality of candidate sets of target design parameters; and

selecting a set of target design parameters from the plurality of candidate sets of target design parameters based on the selected design criteria.

62. The method of claim 61, wherein simulating images of the metrology target with the plurality of candidate sets of target design parameters comprises:

simulating images of the metrology target with a plurality of candidate sets of target design parameters using Maxwell-based simulations.

63. The method of claim 56, wherein the design of experiments comprises:

fabricating test metrology targets with a plurality of candidate sets of target design parameters;

imaging the test metrology targets;

analyzing the images of the test metrology targets with the selected design criteria;

and

selecting a set of target design parameters from the plurality of candidate sets of target design parameters based on the analysis of the images of the test metrology targets.

64. The method of claim 56, wherein the design of experiments comprises:

- simulating images of the metrology target with a plurality of candidate sets of target design parameters;

- narrowing the plurality of candidate sets of target design parameters to N sets of target design parameters based on the selected design criteria;

- fabricating test metrology targets with the N sets of target design parameters with a plurality of candidate sets of measurement tool parameters;

- imaging the test metrology targets;

- analyzing the images of the test metrology targets with the selected design criteria;

and

- selecting a set of target design parameters and a set of measurement tool parameters based on the analysis of the images of the test metrology targets.