CLAIMS

1. A metrology system comprising:

an imaging system comprising:

an illumination sub-system configured to illuminate an overlay target with at least one illumination lobe, the overlay target including at least a first working zone and a second working zone for overlay measurements along a measurement direction, wherein at least the first working zone includes a Moiré pattern formed from overlapping periodic structures along the measurement direction on two sample layers, wherein periods of the periodic structures on the two sample layers are different;

a collection sub-system configured to collect 0-order diffraction and one Moiré diffraction order associated with diffraction of each of the at least one illumination lobe by the first working zone, wherein the collection sub-system is further configured to collect 0-order diffraction and one additional diffraction order associated with diffraction of each of the at least one illumination lobe by the second working zone; and

a detector configured to generate an image of the overlay target using light collected by the collection sub-system; and

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

receive the image of the overlay target, wherein an apparent period of the first working zone in the image is based on Moiré interference;

determine an apparent overlay between the first working zone and the second working zone along the measurement direction based on the image; and

calculate an overlay between the two sample layers by dividing the apparent overlay by a Moiré gain to compensate for the Moiré interference.

2. The metrology system of claim 1, wherein the at least one illumination lobe is configured to illuminate the overlay target at an angle of about 90° with respect to the overlay target.

3. The metrology system of claim 2, wherein the at least one illumination lobe is configured to illuminate the overlay target at or near at least one of a central portion of the first working zone or the second working zone.

4. The metrology system of claim 1, wherein the at least one illumination lobe comprises two illumination lobes at two oblique illumination angles with respect to the overlay target.

5. The metrology system of claim 4, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes simultaneously.

6. The metrology system of claim 4, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes sequentially.

7. The metrology system of claim 4, wherein the two illumination lobes are oriented along the measurement direction.

8. The metrology system of claim 4, wherein the two illumination lobes are oriented at a non-zero angle with respect to the measurement direction.

9. The metrology system of claim 1, wherein the collection sub-system generates a first image of the overlay target based on the 0-order diffraction and one Moiré diffraction order associated with diffraction of each of the at least one illumination lobe by the first working zone, wherein the collection sub-system generates a second image of the overlay target based on the 0-order diffraction and one additional diffraction order associated with diffraction of each of the at least one illumination lobe by the second working zone, wherein the controller is further configured to determine the apparent overlay by averaging apparent overlays associated with the first image and the second image.

10. The metrology system of claim 9, wherein the at least one illumination lobe comprises two illumination lobes at two oblique illumination angles with respect to the overlay target.

11. The metrology system of claim 10, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes simultaneously, wherein the collection sub-system generates the first image and the second image simultaneously by separating collected light associated with the first working zone from collected light associated with the second working zone.

12. The metrology system of claim 10, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes sequentially.

13. The metrology system of claim 1, wherein the Moiré pattern of the first working zone is a first Moiré pattern, wherein the second working zone includes a second Moiré pattern formed from overlapping periodic structures along the measurement direction on the two sample layers, wherein periods of the periodic structures on the two sample layers in the second working zone are different, wherein the second Moiré pattern is different than the first Moiré pattern.

14. A metrology method comprising:

receiving an image of an overlay target on a sample based on illumination of the overlay target with at least one illumination lobe, the overlay target including at least a first working zone and a second working zone for overlay measurements along a measurement direction, wherein at least the first working zone includes a Moiré pattern formed from overlapping periodic structures along the measurement direction on two sample layers, wherein periods of the periodic structures on the two sample layers are different,

wherein the image is based on 0-order diffraction and one Moiré diffraction order associated with diffraction of each of the at least one illumination lobe by the first working zone, wherein the image is further based on 0-order diffraction and one additional diffraction order associated with diffraction of each of the at least one illumination lobe by the second working zone, wherein an apparent period of the first working zone in the image is based on Moiré interference;

determining an apparent overlay between the first working zone and the second working zone along the measurement direction based on the image; and

calculating an overlay between the two sample layers by dividing the apparent overlay by a Moiré gain to compensate for the Moiré interference.

15. The metrology method of claim 14, wherein the at least one illumination lobe is configured to illuminate the overlay target at an angle of about 90° with respect to the overlay target.

16. The metrology method of claim 15, wherein the at least one illumination lobe is configured to illuminate the overlay target at or near at least one of a central portion of the first working zone or the second working zone.

17. The metrology method of claim 14, wherein the at least one illumination lobe comprises two illumination lobes at two oblique illumination angles with respect to the overlay target.

18. A metrology system comprising:

an imaging system comprising:

an illumination sub-system configured to illuminate an overlay target with at least one illumination lobe, the overlay target including at least a first working zone and a second working zone for overlay measurements along a measurement direction, wherein at least the first working zone includes a Moiré pattern formed from overlapping periodic structures along the measurement direction on two sample layers, the two sample layers including a first sample layer and a second sample layer, wherein periods of the periodic structures on the two sample layers are different;

a collection sub-system configured to collect 1st-order diffraction from each of the two sample layers associated with the first working zone, wherein the collection sub-system is further configured to collect 1st-order diffraction from each of the two sample layers associated with the second working zone; and

a detector configured to generate an image of the overlay target using light collected by the collection sub-system; and

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

receive the image of the overlay target, wherein an apparent period of the first working zone in the image is based on Moiré interference at the detector;

filter the image to isolate the Moiré interference;

determine an apparent overlay between the first working zone and the second working zone along the measurement direction based on the image; and

calculate an overlay between the two sample layers by dividing the apparent overlay by a Moiré gain to compensate for the Moiré interference.

19. The metrology system of claim 18, wherein the at least one illumination lobe is configured to illuminate the overlay target at an angle of about 90° with respect to the overlay target.

20. The metrology system of claim 19, wherein the at least one illumination lobe is configured to illuminate the overlay target at or near at least one of a central portion of the first working zone or the second working zone.

21. The metrology system of claim 18, wherein the collection sub-system includes one or more blockers to block 0-order diffraction from at least one of the first working zone or the second working zone.

22. The metrology system of claim 18, wherein a numerical aperture of the collection sub-system is smaller than a numerical aperture of the illumination sub-system to prevent collection of 0-order diffraction from at least one of the first working zone or the second working zone.

23. The metrology system of claim 18, wherein the at least one illumination lobe comprises two illumination lobes at two oblique illumination angles with respect to the overlay target.

24. The metrology system of claim 23, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes simultaneously.

25. The metrology system of claim 23, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes sequentially.

26. The metrology system of claim 23, wherein the two illumination lobes are oriented along the measurement direction.

27. The metrology system of claim 23, wherein the two illumination lobes are oriented at a non-zero angle with respect to the measurement direction.

28. The metrology system of claim 18, wherein the collection sub-system generates a first image of the overlay target based on the 1st-order diffraction from each of the two sample layers associated with the first working zone, wherein the collection sub-system generates a second image of the overlay target based on the 1st-order diffraction from each of the two sample layers associated with the second working zone, wherein the controller is further configured to determine the apparent overlay by averaging apparent overlays associated with the first image and the second image.

29. The metrology system of claim 18, wherein the at least one illumination lobe comprises two illumination lobes at two oblique illumination angles with respect to the overlay target.

30. The metrology system of claim 29, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes simultaneously, wherein the collection sub-system generates a first image and a second image simultaneously by separating collected light associated with the first working zone from collected light associated with the second working zone.

31. The metrology system of claim 30, wherein the illumination sub-system illuminates the overlay target with the two illumination lobes sequentially.

32. A metrology method comprising:

receiving an image of an overlay target on a sample based on illumination of the overlay target with at least one illumination lobe, the overlay target including at least a first working zone and a second working zone for overlay measurements along a measurement direction, wherein at least the first working zone includes a Moiré pattern formed from overlapping periodic structures along the measurement direction on two sample layers, wherein periods of the periodic structures on the two sample layers are different,

wherein the image is based on 1st-order diffraction from each of the two sample layers associated with the first working zone, wherein the image is further based on 1st-order diffraction from each of the two sample layers associated with the second working zone, wherein an apparent period of the first working zone in the image is based on Moiré interference;

determining an apparent overlay between the first working zone and the second working zone along the measurement direction based on the image; and

calculating an overlay between the two sample layers by dividing the apparent overlay by a Moiré gain to compensate for the Moiré interference.

33. The metrology method of claim 32, wherein the at least one illumination lobe is configured to illuminate the overlay target at an angle of about 90° with respect to the overlay target.

34. The metrology method of claim 33, wherein the at least one illumination lobe is configured to illuminate the overlay target at or near at least one of a central portion of the first working zone or the second working zone.

35. The metrology method of claim 32, wherein the at least one illumination lobe comprises two illumination lobes at two oblique illumination angles.