CLAIMS

1. An overlay metrology tool comprising:

an illumination source;

one or more illumination optics configured to illuminate an overlay target on a sample with one or more illumination beams from the illumination source,

wherein the overlay target includes periodic features along one or more measurement directions; and

wherein each of the one or more illumination beams travels along one of one or more illumination paths;

one or more collection optics configured to direct diffracted light from the periodic features of the overlay target to a detector along a collection path;

an adjustable pupil mask located at a pupil plane, wherein the pupil plane is coplanar with a collection pupil plane located along the collection path, wherein the adjustable pupil mask includes one or more control zones distributed across one or more portions of the pupil plane, wherein the one or more control zones are individually addressable to provide an adjustable pupil transmissivity distribution, wherein the adjustable pupil transmissivity distribution provides selective control of the passage of diffracted light in the respective one or more portions of the pupil plane to the detector, wherein the one or more control zones provide operability of the overlay metrology tool according to two or more measurement modes utilizing different pupil transmissivity distributions; and

a controller communicatively coupled to the adjustable pupil mask, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

direct the adjustable pupil mask to provide a selected pupil transmissivity distribution corresponding to a selected overlay metrology recipe, wherein the selected pupil transmissivity distribution corresponds to a selected configuration of the one or more control zones providing transmission of a selected set of diffraction orders from the target to the detector associated with one of the two or more metrology modes; and

determine overlay measurements along the one or more measurement directions associated with one of the one or more metrology modes based on measurement data from the detector.

2. The overlay metrology tool of claim 1, further comprising:

an objective lens, wherein the one or more illumination optics illuminate the overlay target with the one or more illumination beams through the objective lens, wherein the one or more collection optics direct the diffracted light collected by the objective lens to the detector, wherein the pupil plane including the adjustable pupil mask is also coplanar with an illumination pupil plane located along one of the one or more illumination paths.

3. The overlay metrology tool of claim 2, wherein the one or more control zones are individually addressable to illuminate the overlay target with a selected number of the one or more illumination beams, wherein at least some of the one or more control zones are placed in portions of the pupil plane corresponding to the one or more illumination beams to provide selective control of the one or more illumination beams on the sample.

4. The overlay metrology tool of claim 2, wherein the illumination source comprises a quadrupole illumination source providing symmetric illumination beams along two orthogonal directions in the pupil plane, wherein the one or more control zones include two control zones arranged to form an annulus in the pupil plane, wherein each of the two control zones corresponds to half of the annulus, wherein each of the two control zones is oriented to pass light from two orthogonal illumination beams of the one or more illumination beams, to pass one or more non-zero diffracted orders of light from the sample in response to the light from the two orthogonal illumination beams, and to block or optically attenuate zero-order diffraction from the sample in response to the light from the two orthogonal illumination beams.

5. The overlay metrology tool of claim 4, wherein transmissivities of the two control zones may be sequentially alternated to provide sequential measurements of the overlay target with opposing illumination beams.

6. The overlay metrology tool of claim 2, wherein the one or more illumination optics include one or more fibers having output ends disposed at the pupil plane.

7. The overlay metrology tool of claim 2, wherein the pupil plane is also coplanar with an internal pupil plane of the objective lens.

8. The overlay metrology tool of claim 2, wherein the pupil plane is also coplanar with a relayed plane conjugate to an internal pupil plane of the objective lens.

9. The overlay metrology tool of claim 1, wherein one of the one or more illumination beams is arranged to illuminate the overlay target at normal incidence, wherein the one or more control zones include a circular control zone centered in the pupil plane, wherein the circular control zone is oriented to pass one or more non-zero diffracted orders of light from the sample in response to the light from the illumination beam at normal incidence, and to block or optically attenuate zero-order diffraction from the illumination beam at normal incidence.

10. The overlay metrology tool of claim 1, wherein the one or more control zones include an annular control zone, wherein the annular control zone is oriented to pass one or more non-zero diffracted orders of light from the sample in response to the light from each of the one or more illumination beams, and to block or optically attenuate zero-order diffraction from the sample in response to the light from each of the one or more illumination beams.

11. The overlay metrology tool of claim 1, further comprising:

an objective lens, wherein the one or more collection optics direct the diffracted light collected by the objective lens to the detector, wherein the one or more illumination optics direct the one or more illumination beams from the illumination source to the sample at oblique angles using one or more focusing lenses proximate to the objective lens.

12. The overlay metrology tool of claim 1, wherein at least one of the one or more control zones comprises:

a mechanical shutter.

13. The overlay metrology tool of claim 1, wherein at least one of the one or more control zones comprises:

an electro-optical attenuator.

14. The overlay metrology tool of claim 1, wherein at least one of the one or more control zones comprises:

a spatial light modulator providing an adjustable transmissivity.

15. The overlay metrology tool of claim 1, wherein the detector comprises:

a static imaging detector to image one or more locations on a static sample.

16. The overlay metrology tool of claim 1, wherein the detector comprises:

a scanning detector to image one or more locations on a moving sample.

17. An overlay metrology tool comprising:

an illumination source;

one or more illumination optics configured to illuminate an overlay target on a sample with one or more illumination beams from the illumination source,

wherein the overlay target includes periodic features along one or more measurement directions; and

wherein each of the one or more illumination beams travels along one of one or more illumination paths;

one or more collection optics configured to direct diffracted light from the overlay target to a detector along a collection path;

an adjustable pupil mask located at a pupil plane, wherein the pupil plane is coplanar with a collection pupil plane located along the collection path, wherein the adjustable pupil mask includes one or more control zones distributed across one or more portions of the pupil plane, wherein the one or more control zones are individually addressable to provide an adjustable pupil transmissivity distribution, wherein the adjustable pupil transmissivity distribution provides selective control of the passage of diffracted light in the respective one or more portions of the pupil plane to the detector, wherein the one or more control zones provide operability of the overlay metrology tool according to two or more measurement modes utilizing different pupil transmissivity distributions; and

a controller communicatively coupled to the adjustable pupil mask, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive overlay metrology recipes for a plurality of overlay targets on the sample associated with selected measurement modes of the two or more measurement modes;

direct the adjustable pupil mask to adjust the pupil transmissivity distribution according to the respective overlay metrology recipes associated with the selected measurement modes of the two or more measurement modes for measurements of the plurality of overlay targets on the sample; and

determine overlay measurements along the one or more measurement directions associated with the selected measurement modes of the two or more metrology modes for the plurality of overlay targets on the sample based on measurement data from the detector.

18. The overlay metrology tool of claim 17, wherein the plurality of overlay targets includes two or more target designs, wherein the two or more target designs comprise:

at least one imaging target design providing an overlay measurement based on an image requiring a first overlay metrology recipe; and

at least one scatterometry target design providing an overlay measurement based on a distribution of diffracted light requiring a second overlay metrology recipe.

19. The overlay metrology tool of claim 17, wherein the plurality of overlay targets includes at least one target requiring two or more measurements with different overlay metrology recipes.

20. The overlay metrology tool of claim 17, wherein the detector comprises:

a static imaging detector to image one or more locations on a static sample, wherein at least one of the overlay metrology recipes provides for a measurement when the sample is static.

21. The overlay metrology tool of claim 17, wherein the detector comprises:

a scanning detector to image one or more locations on a moving sample, wherein at least one of the overlay metrology recipes provides for a measurement when the sample is moving.

22. The overlay metrology tool of claim 17, further comprising:

an objective lens, wherein the one or more illumination optics illuminate the overlay target with the one or more illumination beams through the objective lens, wherein the one or more collection optics direct the diffracted light collected by the objective lens to the detector, wherein the pupil plane including the adjustable pupil mask is also coplanar with an illumination pupil plane located along one of the one or more illumination paths.

23. The overlay metrology tool of claim 22, wherein the one or more control zones are individually addressable to illuminate the overlay target with a selected number of the one or more illumination beams, wherein at least some of the one or more control zones are placed in portions of the pupil plane corresponding to the one or more illumination beams to provide selective control of the one or more illumination beams on the sample.

24. The overlay metrology tool of claim 22, wherein the illumination source comprises a quadrupole illumination source providing symmetric illumination beams along

two orthogonal directions in the pupil plane, wherein the one or more control zones include two control zones arranged to form an annulus in the pupil plane, wherein each of the two control zones corresponds to half of the annulus, wherein each of the two control zones is oriented to pass light from two orthogonal illumination beams of the one or more illumination beams, to pass one or more non-zero diffracted orders of light from the sample in response to the light from the two orthogonal illumination beams, and to block or optically attenuate zero-order diffraction from the sample in response to the light from the two orthogonal illumination beams.

25. The overlay metrology tool of claim 24, wherein transmissivities of the two control zones may be sequentially alternated to provide sequential measurements of the overlay target with opposing illumination beams.

26. The overlay metrology tool of claim 22, wherein the one or more illumination optics include one or more fibers having output ends disposed at the pupil plane.

27. The overlay metrology tool of claim 22, wherein the pupil plane is also coplanar with an internal pupil plane of the objective lens.

28. The overlay metrology tool of claim 22, wherein the pupil plane is also coplanar with a relayed plane conjugate to an internal pupil plane of the objective lens.

29. The overlay metrology tool of claim 17, wherein one of the one or more illumination beams is arranged to illuminate the overlay target at normal incidence, wherein the one or more control zones include a circular control zone centered in the pupil plane, wherein the circular control zone is oriented to pass one or more non-zero diffracted orders of light from the sample in response to the light from the illumination beam at normal incidence, and to block or optically attenuate zero-order diffraction from the illumination beam at normal incidence.

30. The overlay metrology tool of claim 17, wherein the one or more control zones include an annular control zone, wherein the annular control zone is oriented to pass one or more non-zero diffracted orders of light from the sample in response to the light from each of the one or more illumination beams, and to block or optically attenuate zero-order diffraction from the sample in response to the light from each of the one or more illumination beams.

31. The overlay metrology tool of claim 17, further comprising an objective lens, wherein the one or more collection optics direct the diffracted light collected by the objective lens to the detector, wherein the one or more illumination optics direct the one or more illumination beams from the illumination source to the sample at oblique angles using one or more focusing lenses proximate to the objective lens.

32. The overlay metrology tool of claim 17, wherein at least one of the one or more control zones comprises:

a mechanical shutter.

33. The overlay metrology tool of claim 17, wherein at least one of the one or more control zones comprises:

an electro-optical attenuator.

34. The overlay metrology tool of claim 17, wherein at least one of the one or more control zones comprises:

a spatial light modulator providing an adjustable transmissivity.

35. A method comprising:

receiving overlay metrology recipes for one or more overlay targets on a sample;

directing an adjustable pupil mask to adjust a pupil transmissivity distribution according to the respective overlay metrology recipes for measurements of the one or more overlay targets on the sample with an overlay metrology tool, wherein the overlay metrology tool comprises:

one or more illumination optics configured to illuminate an overlay target with one or more illumination beams from an illumination source,

wherein the overlay target includes periodic features along one or more measurement directions; and

wherein each of the one or more illumination beams travels along one of one or more illumination paths;

one or more collection optics configured to direct diffracted light from the overlay target to a detector along a collection path; and

the adjustable pupil mask located at a pupil plane, wherein the pupil plane is coplanar with a collection pupil plane located along the collection path, wherein the adjustable pupil mask includes one or more control zones distributed across one or more portions of the pupil plane, wherein the one or more control zones are individually addressable to provide an adjustable pupil transmissivity distribution,

wherein the adjustable pupil transmissivity distribution provides selective control of the passage of diffracted light in the respective one or more portions of the pupil plane to the detector, wherein the one or more control zones provide operability of the overlay metrology tool according to two or more measurement modes utilizing different pupil transmissivity distributions; and

determining overlay measurements along the one or more measurement directions associated with one of the one or more metrology modes for the one or more overlay targets on the sample based on measurement data from the detector.