Claims

1. A method of measuring a metrology target by a metrology tool having an illumination arm and a collection arm, the method comprising:

    illuminating the metrology target, by the illumination arm, in a Littrow configuration to yield a first measurement signal comprising a -1^{st} diffraction order and a first component of a 0^{th} diffraction order and a second measurement signal comprising a $+1^{st}$ diffraction order and second component of the 0^{th} diffraction order, wherein the -1^{st} diffraction order of the first measurement signal and the $+1^{st}$ diffraction order of the second measurement signal are diffracted at 180° to a direction of the illumination,

    performing, by the collection arm, a first measurement of the first measurement signal and a second measurement of the second measurement signal,

    attenuating at least one of the first and second components of the 0^{th} diffraction orders, and

    deriving at least one metrology metric from the first and second measurements.

2. The method of claim 1, wherein illuminating the metrology target is carried out by spatial light modulation and/or by digital light processing.

3. The method of claim 1, wherein illuminating the metrology target is carried out at multiple wavelengths, implementing a flexible Littrow configuration.

4. The method of claim 1, wherein performing the first measurement and the second measurement is carried out by spatial light modulation and/or by digital light processing.

5. The method of claim 1, wherein illuminating the metrology target and performing the first measurement and the second measurement are carried out simultaneously in two measurement directions.

6. The method of claim 1, wherein illuminating the metrology target is carried out using a pair of shutters applied alternately to an illumination source having four poles, corresponding to simultaneously illuminating in two measurement directions.

7. The method of claim 1, wherein the at least one metrology metric comprises an overlay of the metrology target, calculated from an equation:

$$OVL = \frac{P}{4\pi}(\phi_+ - \phi_-) = x_0 + \frac{P}{2\pi}\delta\phi,$$

wherein OVL denotes the overlay of the metrology target, P denotes a pitch of the metrology target, $(\phi_+ - \phi_-)$ denotes a phase difference between the second measurement signal and the first measurement signal, x_0 denotes a position of a center of symmetry of the metrology target and $\delta\phi$ denotes a difference between the $+1^{st}$ diffraction order and the -1^{st} diffraction order.

8. The method of claim 1, further comprising reducing a size of the metrology target by half, by reducing a periodic structure pitch of the metrology target by a factor of two with respect to a given metrology target design.

9. The method of claim 1, wherein the first and second measurements are carried out at 0° and 180° degrees of wafer orientation.

10. The method of claim 1, wherein the deriving is carried out by at least one computer processor.

11. A computer program product comprising a non-transitory computer readable storage medium having a computer readable program embodied therewith and configured to carry out the method of claim 1.

12. A metrology module comprising the computer program product of claim 11.

13. A metrology tool comprising:

an illumination arm configured to illuminate a metrology target in a Littrow configuration to yield a first measurement signal comprising a -1^{st} diffraction order and a first component of a 0^{th} diffraction order and a second measurement signal comprising a $+1^{st}$ diffraction order and a second component of the 0^{th} diffraction order, wherein the -1^{st} diffraction order of the first measurement signal and the $+1^{st}$ diffraction order of the second measurement signal are diffracted at 180° to a direction of the illumination,

a collection arm configured to perform a first measurement of the first measurement signal and a second measurement of the second measurement signal, wherein the collection arm comprises at least one 0^{th} diffraction order attenuator, and

a processing unit configured to derive at least one metrology metric from the first and second measurements.

14. The metrology tool of claim 13, wherein at least one of the illumination arms and the collection arm comprises a spatial light modulator and/or a digital light processor configured to implement a flexible Littrow configuration corresponding to illumination by multiple wavelengths.

15. The metrology tool of claim 13, wherein the illumination arm and the collection arm are configured to illuminate the metrology target and perform the first and second measurements simultaneously in two measurement directions.

16. The metrology tool of claim 13, wherein the illumination arm comprises a pair of shutters applied alternately to an illumination source having four poles, corresponding to simultaneous illumination in two measurement directions.

17. The metrology tool of claim 13, wherein the first and second measurements are carried out at 0° and 180° degrees of wafer orientation.

18. A method of measuring a metrology target by a metrology tool having an illumination arm and a collection arm, the method comprising:

illuminating the metrology target, by the illumination arm, to yield a reflected 0^{th} diffraction order and -1^{st} and $+1^{st}$ diffraction orders,

splitting, in the collection arm, the reflected 0^{th} diffraction order into a first component which is captured with the -1^{st} diffraction order to yield a first measurement and a second component which is captured with the $+1^{st}$ diffraction order to yield a second measurement,

attenuating at least one of first and second components of the 0^{th} diffraction order, and

deriving at least one metrology metric from the first and second measurements.

19. The method of claim 18, wherein illuminating the metrology target and the splitting the reflected 0^{th} diffraction order are carried out simultaneously in two measurement directions for each of the first and second measurements.

20. The method of claim 18, wherein the at least one metrology metric comprises an overlay of the metrology target, calculated from an equation:

$$OVL = \frac{P}{4\pi}(\phi_+ - \phi_-) = x_0 + \frac{P}{2\pi}\delta\phi,$$

wherein OVL denotes the overlay of the metrology target, P denotes a pitch of the metrology target, $(\phi_+ - \phi_-)$ denotes a phase difference between a second measurement signal and a first measurement signal, x_0 denotes a position of a center of symmetry of the metrology target and $\delta\phi$ denotes a difference between the $+1^{st}$ diffraction order and the -1^{st} diffraction order.

21. The method of claim 18, further comprising calibrating the first and second measurements for layer-dependent telecentricity.

22. The method of claim 18, further comprising deriving focus information from telecentricity parameters of the first and second measurements.

23. The method of claim 18, further comprising obtaining focus sensitivity data using a non-Littrow, off-axis illumination and measuring the focus from a position shift in the metrology target.

24. The method of claim 18, wherein the deriving is carried out by at least one computer processor.

25. A computer program product comprising a non-transitory computer readable storage medium having a computer readable program embodied therewith and configured to carry out the method of claim 18.

26. A metrology module comprising the computer program product of claim 25.

27. A metrology tool comprising:

an illumination arm configured to illuminating a metrology target to yield a reflected 0^{th} diffraction order and -1^{st} and $+1^{st}$ diffraction orders,

a collection arm comprising an image splitter configured to split the reflected 0^{th} diffraction order into a first component which is captured with the -1^{st} diffraction order to yield a first measurement and a second component which is captured with the $+1^{st}$ diffraction order to yield a second measurement, wherein the collection arm comprises at least one 0^{th} diffraction order attenuator configured to attenuate at least one of first and second components of the 0^{th} diffraction order, and

a processing unit configured to derive at least one metrology metric from the first and second measurements.

28. The metrology tool of claim 27, wherein the illumination arm and the collection arm are configured to illuminate the metrology target and perform the first and second measurements simultaneously in two measurement directions.

29. The metrology tool of claim 27, wherein the processing unit is further configured to carry out at least one of: calibrating the first and second measurements for layer-dependent telecentricity, deriving focus information from telecentricity parameters of the first and second measurements, and/or obtaining focus sensitivity data using a non-Littrow, off-axis illumination and measuring the focus from a position shift in the metrology target.