~~CLAIMS~~

~~What is claimed is:~~

Claims

~~1.~~ 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 -1st diffraction order and a first component of a 0th diffraction order and a second measurement signal comprising a +1st diffraction order and ~~a~~second component of the 0th diffraction order, wherein the -1st diffraction order of the first measurement signal and the +1st 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, ~~and~~

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

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

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

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

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

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

~~6.~~ 6. The method of claim 1, wherein ~~the~~ 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 any one of claims 1-6, further comprising attenuating at least one of the 0th diffraction orders.~~

~~8.~~ 7. The method of claim 1, wherein the at least one metrology metric comprises an overlay of the metrology target, calculated from ~~**Equation 3.**~~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 +1st diffraction order and the -1st diffraction order.

~~9.~~ 8. The method of claim 1, further comprising reducing a size of the metrology target by half, by reducing a periodic ~~structures pitches~~structure pitch of the metrology target by a factor of two with respect to a given metrology target design.

~~10.~~ 9. The method of claim 1, wherein the first and second measurements are carried out at 0° and 180° degrees of wafer orientation.

~~11.~~ 10. The method of ~~any one of claims~~ claim 1~~-10~~, wherein the deriving is carried out ~~at least partially~~ by at least one computer processor.

~~12.~~ 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 ~~at least partially~~ the method of ~~any one of claims~~claim 1~~-10~~.

~~13.~~ 12. A metrology module comprising the computer program product of claim ~~12~~11.

~~14. Metrology measurements performed by the method of any one of claims 1-10.~~

~~15.~~ 13. A metrology tool comprising:

an illumination arm configured to ~~illuminating a~~illuminate a metrology target in a Littrow configuration to yield a first measurement signal comprising a -1st diffraction order and a first component of a 0th diffraction order and a second measurement signal comprising a +1st diffraction order and a second component of the 0th diffraction order, wherein the -1st diffraction order of the first measurement signal and the +1st 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, ~~and~~wherein the collection arm comprises at least one 0th diffraction order attenuator, and

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

~~16.~~ 14. The metrology tool of claim ~~15~~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.

~~17.~~ 15. The metrology tool of claim ~~15~~13, wherein the illumination arm and the collection arm are configured to ~~carry out~~illuminate the ~~illuminating~~metrology target and perform the ~~performing of the~~first and second measurements simultaneously in two measurement directions.

~~18.~~ 16. The metrology tool of claim ~~15~~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.

~~19.~~ 17. The metrology tool of claim ~~15, wherein the collection arm comprises at least one 0th diffraction order attenuator.~~

~~20. The metrology tool of claim 15, wherein a size of the metrology target is reduced by half and has periodic structures pitches of the target which are reduced by a factor of two, with respect to a given metrology target design.~~

~~21.~~ ~~The metrology tool of claim 15~~13, wherein the first and second measurements are carried out at 0° and 180° degrees of wafer orientation.

~~22.~~ 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 ~~corresponding first and~~a second ~~measurements, and~~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.

~~23.~~ 19. The method of claim ~~22~~18, wherein ~~the~~ 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.

~~24. The method of claims 22 or 23, further comprising attenuating at least one of first and second components of the 0th diffraction order.~~

~~25.~~ 20. The method of claim ~~22~~18, wherein the at least one metrology metric comprises an overlay of the metrology target, calculated from ~~**Equation 3.**~~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 +1st diffraction order and the -1st diffraction order.

~~26.~~ 21. The method of ~~any one of claims 22-25~~claim 18, further comprising calibrating the first and second measurements for layer-dependent telecentricity.

~~27.~~ 22. The method of ~~any one of claims 22-26~~claim 18, further comprising deriving focus information from telecentricity parameters of the first and second measurements.

~~28.~~ 23. The method of ~~any one of claims 22-27~~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.

~~29.~~ 24. The method of ~~any one of claims 22-28,~~claim 18, wherein the deriving is carried out ~~at least partially~~ by at least one computer processor.

~~30.~~ 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 ~~at least partially~~ the method of ~~any one of claims 22-28~~claim 18.

~~31.~~ 26. A metrology module comprising the computer program product of claim ~~30~~25.

~~32. Metrology measurements performed by the method of any one of claims 22-28.~~

~~33.~~ 27. A metrology tool comprising:

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

a collection arm comprising an image splitter configured to split the reflected 0th diffraction order into a first component which is captured with the -1st diffraction order to yield a first measurement and a second component which is captured with the +1st diffraction order~~,~~ to yield ~~corresponding first and~~a second ~~measurements, and~~

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

~~34. The metrology tool of claim 33, wherein the illumination arm and the collection arm are configured to carry out the illuminating and the performing of the measurements simultaneously in two measurement directions.~~

~~35. The metrology tool of claim 33~~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

~~The metrology tool of claim 33~~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.

~~36.~~