

CLAIMS

1. A method of measuring misregistration in the manufacture of semiconductor device wafers comprising:

providing a multilayered semiconductor device wafer comprising at least a first layer and a second layer, said wafer including at least one misregistration measurement target formed thereon, said target including a first periodic structure formed together with said first layer and having a first pitch and a second periodic structure formed together with said second layer and having a second pitch;

imaging said first layer and said second layer in a first orientation with a misregistration metrology tool employing light having at least one first wavelength that causes images of both said first periodic structure and said second periodic structure to appear in at least two planes that are mutually separated by a perpendicular distance greater than $0.2\text{ }\mu\text{m}$, wherein said image of said first periodic structure is a first Talbot image and said image of said second periodic structure is a second Talbot image;

analyzing results of said imaging of said first periodic structure and said second periodic structure in said first orientation, thereby generating first analysis results;

imaging said first layer and said second layer in a second orientation with said misregistration metrology tool employing light having said at least one first wavelength that causes images of both said first periodic structure and said second periodic structure to appear in said at least two planes, wherein said first orientation and said second orientation differ by 180 degrees;

analyzing results of said imaging of said first periodic structure and said second periodic structure in said second orientation, thereby generating second analysis results;

determining a first difference between the first analysis results and the second analysis results and comparing the first difference to a pre-determined threshold, wherein if the first difference exceeds the pre-determined threshold;

thereafter adjusting at least one parameter of said misregistration metrology tool based on said first and second analysis results, wherein said adjusting of the at least one parameter comprises a setting of a tool-induced-shift knob; and

thereafter measuring misregistration between said first layer and said second layer by repeating each of the steps from and including imaging said first layer

and said second layer in the first orientation to determine a second difference between the first analysis results and the second analysis results and comparing the second difference to the predetermined threshold.

2. The method of measuring misregistration in the manufacture of semiconductor device wafers according to claim 1 and wherein said at least one parameter is operative to offset an error in misregistration measurement that is due to poor telecentricity of said misregistration measurement.

~~3.—The method of measuring misregistration in the manufacture of semiconductor device wafers according to claim 1 or claim 2 and wherein said at least one parameter comprises a setting of a tool-induced-shift knob.~~

~~4.—The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1—3 and also comprising calculating a difference between said first analysis results and said second analysis results.~~

53. The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1 – 42 and wherein said at least one parameter is adjusted separately for misregistration measured along a first axis and for misregistration measured along a second axis.

~~6.—The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1—5 and wherein said first orientation and said second orientation differ by 180 degrees.~~

~~7.—The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1—6 and wherein said image of said first periodic structure is a Talbot image.~~

~~8.—The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1—6 and wherein said image of said first~~

~~periodic structure is a Talbot image and said image of said second periodic structure is a Talbot image.~~

94. The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1 – ~~8-3~~ and wherein said imaging said first layer and said second layer are performed by a single imager.

~~105.~~ The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1 – ~~8-3~~ and wherein said imaging said first layer is performed by a first imager and said imaging of said second layer is performed by a second imager.

~~11.—The method of measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 1—10 and wherein said multilayered semiconductor device wafer comprises at least a third layer and said at least one misregistration measurement target comprises at least a third periodic structure formed together with said at least third layer and having a third pitch and wherein said method also comprises:~~

~~——imaging said first layer and said third layer in a first orientation with said misregistration metrology tool employing light having at least one third wavelength that causes images of both said first layer and said third layer to appear in at least two planes that are mutually separated by a perpendicular distance greater than 0.2 μm ;~~

~~——analyzing results of said imaging of said first layer and said third layer in said first orientation, thereby generating first analysis results;~~

~~——imaging said first layer and said third layer in a second orientation with said misregistration metrology tool employing light having said at least one third wavelength that causes images of both said first layer and said third layer to appear in said at least two planes; and~~

~~——analyzing results of said imaging of said first layer and said third layer in said second orientation, thereby generating second analysis results.~~

126. A system for measuring misregistration in the manufacture of semiconductor device wafers, the system comprising:

at least one imager, imaging in both a first and second orientation at least a first layer and a second layer of a multilayered semiconductor device wafer, said wafer comprising at least one misregistration measurement target formed thereon, said target comprising a first periodic structure formed together with said first layer and having a first pitch and a second periodic structure formed together with said second layer and having a second pitch, said at least one imager employing light having at least one first wavelength that causes images of both said first periodic structure and said second periodic structure to appear in at least two planes that are mutually separated by a perpendicular distance greater than $0.2\text{ }\mu\text{m}$, wherein said image of said first periodic structure is a first Talbot image and said image of said second periodic structure is a second Talbot image; and

a parameter adjuster:

analyzing results of said imaging of said first layer and said second layer in said first orientation, thereby generating first analysis results;

analyzing results of said imaging of said first layer and said second layer in said second orientation, thereby generating second analysis results, wherein said first orientation and said second orientation differ by 180 degrees;

determining a first difference between the first analysis results and the second analysis results and comparing the first difference to a pre-determined threshold, wherein if the first difference exceeds the pre-determined threshold;

thereafter, and adjusting at least one parameter of said system based on said analysis results, wherein said adjusting of the at least one parameter comprises a setting of a tool-induced-shift knob; and

thereafter measuring misregistration between said first layer and said second layer by repeating each of the steps from and including imaging said first layer and said second layer in the first orientation to determine a second difference between the first analysis results and the second analysis results and comparing the second difference to the pre-determined threshold.

~~13~~7. The system for measuring misregistration in the manufacture of semiconductor device wafers according to claim ~~12~~6 and wherein said at least one parameter is operative to offset an error in misregistration measurement that is due to poor telecentricity of said system during misregistration measurement.

~~14.—The system for measuring misregistration in the manufacture of semiconductor device wafers according to claim 12 or claim 13 and wherein said at least one parameter comprises a setting of a tool-induced shift knob.~~

~~15.—The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12—14 and wherein said analyzer is also operative to calculate a difference between said first analysis results and said second analysis results.~~

~~16~~8. The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims ~~12~~6–~~15~~7 and wherein said parameter adjuster adjusts said at least one parameter separately for misregistration measured along a first axis and for misregistration measured along a second axis.

~~17.—The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12—16 and wherein said first orientation and said second orientation differ by 180 degrees.~~

~~18.—The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12—17 and wherein said image of said first periodic structure is a Talbot image.~~

~~19.—The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12—17 and wherein said image of said first periodic structure is a Talbot image and said image of said second periodic structure is a Talbot image.~~

209. The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12-6 – 19-8 and wherein said at least one imager comprises a single imager.

2110. The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12-6 – 19-8 and wherein said at least one imager comprises a first imager, imaging said first layer, and a second imager, imaging said second layer.

~~22.—The system for measuring misregistration in the manufacture of semiconductor device wafers according to any of claims 12—21 and wherein said multilayered semiconductor device wafer comprises at least a third layer and said at least one misregistration measurement target comprises at least a third periodic structure formed together with said at least third layer and having a third pitch and wherein:~~
~~——said imager images at least said first layer and said third layer of said multilayered semiconductor device wafer in both a first and second orientation, said imager employing light having at least one third wavelength that causes images of both said first periodic structure and said second periodic structure to appear in at least two planes that are mutually separated by a perpendicular distance greater than 0.2 μm ; and~~
~~——said parameter adjuster analyzes results of said imaging of said first periodic structure and said third periodic structure, thereby generating analysis results and adjusting at least one parameter of said system based on said analysis results.~~