CLAIMS

1. A misregistration metrology method for measurement of misregistration in the manufacture of multilayered semiconductor devices, said multilayered semiconductor devices including a first periodic structure having a first pitch along a first axis,

said first periodic structure being formed together with a first layer of said multilayered semiconductor device, a second periodic structure having a second pitch along a second axis,

said second axis not being parallel to said first axis, said second periodic structure being formed together with said first layer of said multilayered semiconductor device and a third periodic structure having a third pitch along a third axis, said third axis not being parallel to said first axis and said third axis not being parallel to said second axis,

said third periodic structure being formed together with a second layer of said multilayered semiconductor device, said third periodic structure and said first and second periodic structures overlying one another;

said misregistration metrology method comprising:

generating a single image of said first periodic structure, said second periodic structure and said third periodic structure, thereby providing an aggregate signal;

extracting a first component from said aggregate signal, said first component being due to said first periodic structure;

extracting a second component from said aggregate signal, said second component being due to said second periodic structure;

extracting a third component from said aggregate signal, said third component being due to said third periodic structure;

analyzing said first component, said second component and said third component, thereby to ascertain misregistration between said first layer and said second layer;

generating clean first periodic structure data, clean second periodic structure data, and clean third periodic structure data, each comprising a linear set of periodic functions along with an offset,

wherein said analyzing said first component, said second component and said third component, thereby to ascertain misregistration between said first layer and said second layer comprises:

identifying a first reference location whereat at least one of maxima and minima of said clean first periodic structure data and said clean second periodic structure data intersect;

identifying a second reference location whereat at least one of maxima and minima of said clean third periodic structure data most closely intersects said first reference location; and

calculating a difference between said first reference location and said second reference location, thereby to ascertain misregistration between said first layer and said second layer.

2. The misregistration metrology method according to claim 1, wherein each of said sets of periodic functions include one periodic function for each harmonic.

3. The misregistration metrology method according to claim 2, wherein said one periodic function for each harmonic includes information relating to pitch, a weighting factor, and a phase shift.

4. The misregistration metrology method according to claim 3, wherein said offset, said weighting factor, and said phase shift are each fitted to raw data using a least squares error minimization method.

5. The misregistration metrology method according to claim 1,

wherein said clean first periodic structure data is represented by equation 1:

$$f_1(x) = c_1 + \sum_{k=1}^{n_1} a_{1,k} \sin\left(k \frac{2\pi}{P_1} x + \varphi_{1,k}\right) \qquad \text{(Eq. 1)}$$

where

$f_1(x)$ is said clean first periodic structure data,

c_1 is a first offset,

k is an index indicating a harmonic considered,

n_1 is a first total number of first harmonics considered,

$a_{1,k}$ is a first weighting factor,

P_1 is said first pitch of said first periodic structure,

x is a linear position in a profile, and

$\varphi_{1,k}$ is a first phase shift;

wherein said clean second periodic structure data is represented by equation 2:

$$f_2(x) = c_2 + \sum_{k=1}^{n_2} a_{2,k} \sin\left(k \frac{2\pi}{P_2} x + \varphi_{2,k}\right) \qquad \text{(Eq. 2)}$$

where

$f_2(x)$ is said clean second periodic structure data,

c_2 is a second offset,

k is said index indicating said harmonic considered,

n_2 is a second total number of second harmonics considered,

$a_{2,k}$ is a second weighting factor,

P_2 is said second pitch of said second periodic structure,

x is said linear position in said profile, and

$\varphi_{2,k}$ is a second phase shift; and

wherein said clean third periodic structure data is represented by equation 3:

$$f_3(x) = c_3 + \sum_{k=1}^{n_3} a_{3,k} \sin\left(k \frac{2\pi}{P_3} x + \varphi_{3,k}\right) \qquad \text{(Eq. 3)}$$

where

$f_3(x)$ is said clean third periodic structure data,

c_3 is a third offset,

k is said index indicating said harmonic considered,

n_3 is a third total number of harmonics considered,

$a_{3,k}$ is a third weighting factor,

P_3 is said third pitch,

x is said linear position in said profile, and

$\varphi_{3,k}$ is a third phase shift.

6. The misregistration metrology method according to claim 1 and wherein said single image is generated using a scanning electron microscope using a field of view having a length and an area.

7. The misregistration metrology method according to claim 6 and wherein said aggregate signal includes contributions from said area.

8. The misregistration metrology method according to any of claims 1 – 7 and wherein said extracting of said first component from said aggregate signal comprises considering only a portion of said aggregate signal that lies along said first axis.

9. The misregistration metrology method according to any of claims 1 – 8 and wherein said extracting of said second component from said aggregate signal comprises considering only a portion of said aggregate signal that lies along said second axis.

10. The misregistration metrology method according to any of claims 1 – 9 and wherein said extracting of said third component from said aggregate signal comprises considering only a portion of said aggregate signal that lies along said third axis.

11. The misregistration metrology method according to any of claims 6 – 7 and wherein said first pitch, said second pitch and said third pitch are each between 1/1000 and 1/4 of said length of said field of view of said wafer imaging tool.

12. The misregistration metrology method according to any of claims 6 – 7 and wherein said first pitch, said second pitch and said third pitch are each between 1/500 and 1/20 of said length of said field of view of said wafer imaging tool.

13. A misregistration metrology system for measurement of misregistration in the manufacture of multilayered semiconductor devices,

said multilayered semiconductor devices including a first periodic structure having a first pitch along a first axis, said first periodic structure being formed together with a first layer of said multilayered semiconductor device, a second periodic structure having a second pitch along a second axis, said second axis not being parallel to said first axis, said second periodic structure being formed together with said first layer of said multilayered semiconductor device and a third periodic structure having a third pitch along a third axis, said third axis not being parallel to said first axis and said third axis not being parallel to said second axis, said third periodic structure being formed together with a second layer of said multilayered semiconductor device, said third periodic structure and said first and second periodic structures overlying one another;

said misregistration metrology system comprising:

a wafer imaging tool operative to generate a single image of said first periodic structure, said second periodic structure and said third periodic structure, thereby providing an aggregate signal; and

a misregistration analyzer operative to:

extract a first component from said aggregate signal, said first component being due to said first periodic structure;

extract a second component from said aggregate signal, said second component being due to said second periodic structure;

extract a third component from said aggregate signal, said third component being due to said third periodic structure;

analyze said first component, said second component and said third component, thereby to ascertain misregistration between said first layer and said second layer;

generate clean first periodic structure data, clean second periodic structure data, and clean third periodic structure data, each comprising a linear set of periodic functions along with an offset,

wherein said analyzing said first component, said second component and said third component, thereby to ascertain misregistration between said first layer and said second layer comprises:

identifying a first reference location whereat at least one of maxima and minima of said clean first periodic structure data and said clean second periodic structure data intersect;

identifying a second reference location whereat at least one of maxima and minima of said clean third periodic structure data most closely intersects said first reference location; and

calculating a difference between said first reference location and said second reference location, thereby to ascertain misregistration between said first layer and said second layer.

14. The misregistration metrology system according to claim 13, wherein each of said sets of periodic functions include one periodic function for each harmonic.

15. The misregistration metrology system according to claim 14, wherein said one periodic function for each harmonic includes information relating to pitch, a weighting factor, and a phase shift.

16. The misregistration metrology system according to claim 15, wherein said offset, said weighting factor, and said phase shift are each fitted to raw data using a least squares error minimization method.

17. The misregistration metrology system according to claim 13, wherein said clean first periodic structure data is represented by equation 1:

$$f_1(x) = c_1 + \sum_{k=1}^{n_1} a_{1,k} \sin\left(k \frac{2\pi}{P_1} x + \varphi_{1,k}\right) \qquad \text{(Eq. 1)}$$

where

$f_1(x)$ is said clean first periodic structure data,

c_1 is a first offset,

k is an index indicating a harmonic considered,

n_1 is a first total number of first harmonics considered,

$a_{1,k}$ is a first weighting factor,

P_1 is said first pitch of said first periodic structure,

x is a linear position in a profile, and

$\varphi_{1,k}$ is a first phase shift;

wherein said clean second periodic structure data is represented by equation 2:

$$f_2(x) = c_2 + \sum_{k=1}^{n_2} a_{2,k} \sin\left(k \frac{2\pi}{P_2} x + \varphi_{2,k}\right) \qquad \text{(Eq. 2)}$$

where

$f_2(x)$ is said clean second periodic structure data,

c_2 is a second offset,

k is said index indicating said harmonic considered,

n_2 is a second total number of second harmonics considered,

$a_{2,k}$ is a second weighting factor,

P_2 is said second pitch of said second periodic structure,

x is said linear position in said profile, and

$\varphi_{2,k}$ is a second phase shift; and

wherein said clean third periodic structure data is represented by equation 3:

$$f_3(x) = c_3 + \sum_{k=1}^{n_3} a_{3,k} \sin\left(k \frac{2\pi}{P_3} x + \varphi_{3,k}\right) \qquad \text{(Eq. 3)}$$

where

$f_3(x)$ is said clean third periodic structure data,

c_3 is a third offset,

k is said index indicating said harmonic considered,

n_3 is a third total number of harmonics considered,

$a_{3,k}$ is a third weighting factor,

P_3 is said third pitch,

x is said linear position in said profile, and

$\varphi_{3,k}$ is a third phase shift.

18. The misregistration metrology system according to claim 13 and wherein said wafer imaging tool comprises a scanning electron microscope using a field of view having a length and an area.

19. The misregistration metrology system according to claim 18 and wherein said aggregate signal includes contributions from said area.

20. The misregistration metrology system according to any of claims 13– 19 and wherein said extracting of said first component from said aggregate signal comprises considering only a portion of said aggregate signal that lies along said first axis.

21. The misregistration metrology system according to any of claims 13– 20 and wherein said extracting of said second component from said aggregate signal comprises considering only a portion of said aggregate signal that lies along said second axis.

22. The misregistration metrology system according to any of claims 13– 21 and wherein said extracting of said third component from said aggregate signal comprises considering only a portion of said aggregate signal that lies along said third axis.

23. The misregistration metrology system according to any of claims 18– 19 and wherein said first pitch, said second pitch and said third pitch are each between 1/1000 and 1/4 of said length of said field of view of said wafer imaging tool.

24. The misregistration metrology system according to any of claims 18– 19 and wherein said first pitch, said second pitch and said third pitch are each between 1/500 and 1/20 of said length of said field of view of said wafer imaging tool.