Claims

1. A metrology target comprising a first cell, wherein the first cell comprises:

a first portion of a first set of pattern elements formed along a first measurement direction in a first sample layer, wherein the first set of pattern elements comprises segmented pattern elements having a first pitch;

a first portion of a second set of pattern elements formed along the first measurement direction in a second sample layer, wherein the second set of pattern elements comprises segmented pattern elements having a second pitch; and

a first portion of a third set of pattern elements formed along the first measurement direction in the first sample layer, wherein the third set of pattern elements comprises segmented pattern elements having a third pitch, wherein at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the first portions of the first, second, and third sets of pattern elements as the sample is in motion correlate to overlay between the first and second sample layers along the first measurement direction.

2. The metrology target of Claim 1, further comprising a second cell, wherein the second cell comprises:

a second portion of the first set of pattern elements, wherein the second portion of the first set of pattern elements is formed along a second measurement direction in the first sample layer;

a second portion of the second set of pattern elements, wherein the second portion of the second set of pattern elements is formed along the second measurement direction in the second sample layer; and

a second portion of the third set of pattern elements, wherein the second portion of the third set of pattern elements is formed along the second measurement direction in the first sample layer, wherein at least one of intensity or phase variations of diffraction orders of an illumination beam incident on the second portions of the first, second, and third sets of pattern elements as the

sample is in motion correlate to overlay between the first and second sample layers along the second measurement direction.

3. The metrology target of Claim 2, wherein the metrology target is compatible with a scatterometry-based overlay (SCOL) metrology mode.

4. The metrology target of Claim 3, wherein the metrology target is compatible with one or more on-the-fly metrology modes.

5. The metrology target of Claim 1, wherein the sample comprises a semiconductor wafer.

6. A system comprising:

one or more controllers having one or more processors communicatively coupled to one or more metrology sub-systems, wherein the one or more processors are configured to execute a set of program instructions maintained in memory, wherein the set of program instructions is configured to cause the one or more processors to:

receive, from one or more detectors at one or more pupil planes of the one or more metrology sub-systems, one or more signals indicative of at least one of intensity or phase variations associated with diffraction orders of an illumination beam on one or more metrology targets on a sample, wherein the one or more metrology targets of the sample include a first cell, the first cell comprising:

a first portion of a first set of pattern elements formed along a first measurement direction in a first sample layer, wherein the first set of pattern elements comprises segmented pattern elements having a first pitch;

a first portion of a second set of pattern elements formed along the first measurement direction in a second sample layer, wherein the second set of pattern elements comprises segmented pattern elements having a second pitch; and

a first portion of a third set of pattern elements formed along the first measurement direction in the first sample layer, wherein the third set of pattern elements comprises segmented pattern elements having a third pitch; and

generate an overlay error measurement between the first and second sample layers along the first measurement direction based on the signals received from the one or more metrology sub-systems associated with at least one of intensity or phase variations of diffraction orders of the illumination beam by the first portions of the first, second, and third sets of pattern elements as the sample is in motion.

7. The system of claim 6, wherein the one or more metrology targets of the sample further comprise a second cell, wherein the second cell comprises:

a second portion of the first set of pattern elements, wherein the second portion of the first set of pattern elements is formed along a second measurement direction in the first sample layer;

a second portion of the second set of pattern elements, wherein the second portion of the second set of pattern elements is formed along the second measurement direction in the second sample layer; and

a second portion of the third set of pattern elements in the first sample layer, wherein the second portion of the third set of pattern elements is formed along the second measurement direction, wherein the set of program instructions is further configured to cause the one or more processors to:

generate an overlay error measurement between the first and second sample layers along the second measurement direction based on the signals received from the one or more metrology sub-systems associated with at least one of intensity or phase variations of diffraction orders of the illumination beam by the second portions of the first, second, and third sets of pattern elements as the sample is in motion.

8. The system of claim 6, wherein the one or more metrology sub-systems comprise:

an illumination source configured to generate the illumination beam;

one or more illumination elements configured to direct theillumination beam from the illumination source onto the sample;

one or more projection elements configured to collect illumination emanating from the sample and direct the illumination to the one or more detectors for generation of the signals.

9. The system of Claim 8, wherein the one or more metrology sub-systems comprise one or more scatterometry-based overlay (SCOL) metrology sub-systems.

10. The system of Claim 9, wherein the first overlay measurement, the second overlay measurement, and the third overlay measurement are acquired on-the-fly.

11. The system of Claim 6, wherein the sample comprises a semiconductor wafer.

12. A method of measuring overlay comprising:

illuminating a sample having one or more metrology targets;

detecting one or more signals indicative of at least one of intensity or phase variations associated with diffraction orders of an illumination beam on one or more metrology targets on a sample, wherein the one or more metrology targets of the sample include a first cell, the first cell comprising:

a first portion of a first set of pattern elements formed along a first measurement direction in a first sample layer, wherein the first set of pattern elements comprises segmented pattern elements having a first pitch;

a first portion of a second set of pattern elements formed along the first measurement direction in a second sample layer, wherein the second set of pattern elements comprises segmented pattern elements having a second pitch; and

a first portion of a third set of pattern elements formed along the first measurement direction in the first sample layer, wherein the third set of pattern elements comprises segmented pattern elements having a third pitch; and

generating an overlay error measurement between the first and second sample layers along the first measurement direction based on the signals received from the one or more metrology sub-systems associated with at least one of intensity or phase variations of diffraction orders of the illumination beam by the first portions of the first, second, and third sets of pattern elements as the sample is in motion.

13. The method of claim 12, wherein the one or more metrology targets of the sample further comprise a second cell, wherein the second cell comprises:

a second portion of the first set of pattern elements, wherein the second portion of the first set of pattern elements is formed along a second measurement direction in the first sample layer;

a second portion of the second set of pattern elements, wherein the second portion of the second set of pattern elements is formed along the second measurement direction in the second sample layer; and

a second portion of the third set of pattern elements, wherein the second portion of the third set of pattern elements is formed along the second measurement direction in the third sample layer, wherein the method further comprises:

generating an overlay error measurement between the first and second sample layers along the second measurement direction based on the signals received from the one or more metrology sub-systems associated with at least one of intensity or phase variations of diffraction orders of the illumination beam by the second portions of the first, second, and third sets of pattern elements as the sample is in motion.

14. The method of Claim 13, wherein the one or more metrology targets are compatible with a scatterometry-based overlay (SCOL) metrology mode.

15. The method of Claim 14, wherein the first overlay measurement, the second overlay measurement, and the third overlay measurement are acquired on-the-fly.

16. The method of Claim 12 wherein the sample comprises a semiconductor wafer.

17. A method of forming a metrology target comprising:

forming a first cell, the first cell comprising:

a first portion of a first set of pattern elements formed along a first measurement direction in a first sample layer, wherein the first set of pattern elements comprises segmented pattern elements having a first pitch;

a first portion of a second set of pattern elements formed along the first measurement direction in a second sample layer, wherein the second set of pattern elements comprises segmented pattern elements having a second pitch; and

a first portion of a third set of pattern elements formed along the first measurement direction in the first sample layer, wherein the third set of pattern elements comprises segmented pattern elements having a third pitch, wherein at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the first portions of the first, second, and third sets of pattern elements as the sample is in motion correlate to overlay between the first and second sample layers along the first measurement direction.

18. The method of claim 17, further comprising:

forming a second cell, the second cell comprising:

a second portion of the first set of pattern elements, wherein the second portion of the first set of pattern elements is formed along a second measurement direction in the first sample layer;

a second portion of the second set of pattern elements, wherein the second portion of the second set of pattern elements is formed along the second measurement direction in the second sample layer; and

a second portion of the third set of pattern elements, wherein the second portion of the third set of pattern elements is formed along the second measurement direction in the first sample layer, wherein at least one of intensity or phase variations of diffraction orders of an illumination beam incident on the second portions of the first, second, and third sets of pattern elements as the sample is in motion correlate to overlay between the first and second sample layers along the second measurement direction.

19. The metrology target of Claim 1, wherien the at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the first portions of the first, second, and third sets of pattern elements as the sample is in motion that correlate to overlay between the first and second sample layers along the first measurement direction comprise:

at least one of +1 diffraction orders or -1 diffraction orders.

20. The metrology target of Claim 2, wherien the at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the second portions of the first, second, and third sets of pattern elements as the sample is in motion that correlate to overlay between the first and second sample layers along the second measurement direction comprise:

at least one of +1 diffraction orders or -1 diffraction orders.

21. The system of Claim 6, wherien the at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the first portions of the first, second, and third sets of pattern elements as the sample is in motion that correlate to overlay between the first and second sample layers along the first measurement direction comprise:

at least one of +1 diffraction orders or -1 diffraction orders.

22. The system of Claim 7, wherien the at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the second portions of the first, second, and third sets of pattern elements as the sample is in motion that correlate to overlay between the first and second sample layers along the second measurement direction comprise:

at least one of +1 diffraction orders or -1 diffraction orders.

23. The method of Claim 12, wherien the at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the first portions of the first, second, and third sets of pattern elements as the sample is in motion that correlate to overlay between the first and second sample layers along the first measurement direction comprise:

at least one of +1 diffraction orders or -1 diffraction orders.

24. The method of Claim 13, wherien the at least one of intensity or phase variations of diffraction orders of an illumination beam incident by the second portions of the first, second, and third sets of pattern elements as the sample is in motion that correlate to overlay between the first and second sample layers along the second measurement direction comprise:

at least one of +1 diffraction orders or -1 diffraction orders.