Claims

1. A method of monitoring overlay in a manufacturing process in which successive layers are deposited one over another to form a stack and in which each layer includes a periodic structure to be aligned with a periodic structure in another layer, the method comprising: illuminating stacked periodic structures with illumination to form positive and negative first order diffraction patterns from the periodic structures; capturing an image of the stacked periodic structures including positive and negative diffraction patterns; and comparing the positive and negative diffraction patterns to calculate the overlay between successive layers, wherein diffraction patterns comprise interference fringes and said comparing comprises comparing the interference fringe positions to identify asymmetry between the positive and negative diffraction patterns, and wherein the interference fringe positions are determined by analyzing image intensity as a function of position in the image.

2. The method of claim 1, wherein said comparing comprises determining a characteristic frequency for each of the positive and negative diffraction patterns, and comparing the characteristic frequencies to identify an overlay between successive layers.

3. The method of claim 2 wherein the characteristic frequency is determined using a fast Fourier transform.

4. The method of claim 1 comprising determining an asymmetry factor for asymmetry in the positive and negative diffraction patterns not caused by overlay, and applying the asymmetry factor to the overlay calculation.

5. The method of claim 1 wherein said diffraction gratings are part of a multiple cell metrology target and said capturing comprises a single capture of a single cell in the metrology target.

6. The method of claim 1 in which the positive and negative diffraction patterns are first order diffraction patterns.

7. The method of claim 1 comprising comparing the calculated overlay with a predetermined threshold and generating an alert if the overlay exceeds the threshold.

8. Apparatus for monitoring overlay errors between stacked periodic structures comprising an illumination source, an image capturing device, and an analysis unit including at least one processor, wherein the processor is configured to analyse an image of stacked periodic structures including positive and negative diffraction patterns, compare the positive and negative diffraction patterns to calculate the overlay between successive layers, and identify asymmetry between the positive and negative first order diffraction patterns, wherein the diffraction patterns comprise interference fringes and the processor is configured to determine interference fringe positions by analyzing image intensity as a function of position in the image.

9. The apparatus of claim 8, wherein said comparing comprises determining a characteristic frequency for each of the positive and negative diffraction patterns, and comparing the characteristic frequencies to identify an overlay between successive layers.

10. The apparatus of claim 9 wherein the processor is configured to determine the characteristic frequency using a fast Fourier transform.

11. The apparatus of claim 8 wherein the processor is configured to determine an asymmetry factor for asymmetry in the positive and negative diffraction patterns not caused by overlay, and apply the asymmetry factor to the overlay calculation.

12. The apparatus of claim 8 wherein said diffraction gratings are part of a multiple cell metrology target and said processor is configured to perform said analyzing and comparing based on a single capture of a single cell in the metrology target.

13. A non-transitory computer readable medium comprising instructions which, when implemented in a processor in a computing system cause the system to: receive an image of a stacked periodic structure including positive and negative diffraction patterns comprising interference fringes; determine interference fringe positions by analyzing image intensity as a function of position in the image; compare the interference fringe positions in the positive and negative diffraction patterns; identify asymmetry between the positive and negative diffraction patterns; calculate an overlay between successive layers from the degree of asymmetry between the positive and negative diffraction patterns.

14. The non-transitory computer readable medium of claim 13 wherein said instructions cause the system to determine an asymmetry factor for asymmetry in the positive and negative diffraction patterns not caused by overlay, and apply the asymmetry factor to the overlay calculation.

15. The non-transitory computer readable medium of claim 13 wherein said instructions cause the system to determine a characteristic frequency for the respective positive and negative diffraction patterns.

16. The non-transitory computer readable medium of claim 15 wherein the overlay is determined to be proportional to the ratio of the characteristic frequencies.