WHAT IS CLAIMED IS:

1. An overlay measurement apparatus comprising:

a polarized light source configured to illuminate a substrate with a polarized light beam;

an optical system configured to capture light that is scattered by the substrate caused by the polarized light beam, the optical system comprising,

a first non-polarizing beam splitter configured to receive the polarized light beam from the polarized light source, direct the light to the substrate via a projection system, and receive a reflected light beam from the substrate via the projection system, the reflected light beam comprising a zeroth order diffraction component;

a second non-polarizing beam splitter configured to receive a transmitted light beam from the first non-polarizing beam splitter, wherein the beam splitter axes of the first and second non-polarizing beam splitters are mutually perpendicular;

a crossed polarizer configured to receive the split light beams from the second non-polarizing beam splitter and transmit an in-plane image and crossed-polarized image to a detector configured to detect the crossed polarized image and to produce a signal therefrom; and

a processing unit configured to receive the signal from the detector and to process the crossed polarized image for overlay metrology measurement using asymmetry data derived from the crossed polarized image,

wherein the overlay measurement apparatus is configured to base an overlay measurement only on the asymmetry data derived from the crossed polarized image.

2. The overlay measurement apparatus of claim 1, wherein the optical system further comprises a blocking element configured to block the in-plane image.

3. The overlay measurement apparatus of claim 1, wherein the crossed polarizer comprises a Wollaston prism.

4. The overlay measurement apparatus of claim 1, wherein:

the substrate comprises a grating; and

the zeroth order diffraction component originates from conical diffraction of the polarized light beam from the grating.

5. The overlay measurement apparatus of claim 1, wherein the detector comprises a camera.

6. The overlay measurement apparatus of claim 1, wherein the detector comprises a CCD camera.

7. The overlay measurement apparatus of claim 6, wherein the CCD camera has a minimum resolution of 12 bits.

8. The overlay measurement apparatus of claim 6, wherein the CCD camera comprises a back-illuminated CCD device.

9. A lithographic apparatus, comprising:

an illumination system configured to produce a beam of radiation;

a support configured to support a patterning device that is configured to pattern the beam of radiation;

a projection system configured to projected the patterned beam onto a substrate; and

an overlay measurement apparatus according to claim 1.

10. A device manufacturing method comprising:

illuminating a substrate with a polarized light beam;

capturing light scattered by the substrate caused by the polarized light beam;

transmitting an orthogonal polarization component that is orthogonal to a polarization direction of the polarized light beam; and

measuring an intensity of the orthogonal polarization component,

wherein asymmetry data derived from only the crossed polarized image is used to perform an overlay metrology measurement.

11. The method of claim 10, further comprising:

capturing a zeroth order diffraction component of the light which is scattered by the sample; and

splitting the captured light into an in-plane image and crossed-polarized image.

12. The method of claim 11, further comprising blocking the in-plane image.

13. The method of claim 11, further comprising generating the zeroth order diffraction component from conical diffraction of the polarized light beam from a grating on the substrate.

14. The method of claim 10, further comprising using a CCD camera to perform the measuring.

15. The method of claim 14, wherein the CCD camera has a minimum resolution of 12 bits.

16. The method of claim 14, further comprising using a back-illuminated CCD device as the CCD camera.

What is claimed is:

1. An overlay measurement apparatus comprising:
a polarized light source configured to illuminate a substrate with a polarized light beam;

an optical system configured to capture light reflected by the substrate from the polarized light beam, the optical system comprising:
a first non-polarizing beam splitter configured to receive the polarized light beam from the polarized light source, direct the polarized light beam to the substrate via a projection system, and receive a reflected light beam from the substrate via the projection system, the reflected beam comprising a zeroth order diffraction component;

a second non-polarizing beam splitter configured to receive the reflected light beam from the first non-polarizing beam splitter;

a crossed polarizer configured to receive a portion of reflected light beam from the second non-polarizing beam splitter and transmit an in-plane image and crossed-polarized image;

a blocking element configured to block the in-plane image;

a detector configured to measure an intensity of crossed-polarized image and produce a signal therefrom; and

a processing unit configured to receive the signal from the detector and to process crossed-polarized image for overlay metrology measurement using asymmetry data derived from crossed-polarized image.

2. The overlay measurement apparatus of claim 1, wherein the crossed polarizer comprises a Wollaston prism.

3. The overlay measurement apparatus of claim 1, wherein:
the substrate comprises a grating; and

the zeroth order diffraction component originates from conical diffraction of the polarized light beam from the grating.

4. The overlay measurement apparatus of claim 1, wherein the detector comprises a camera.

5. The overlay measurement apparatus of claim 1, Wherein the detector comprises a CCD camera.

6. The overlay measurement apparatus of claim 5, wherein the CCD camera has a minimum resolution of 12 bits.

7. The overlay measurement apparatus of claim 5, wherein the CCD camera comprises a back-illuminated CCD device.

8. A lithographic apparatus, comprising:
an illumination system configured to produce a beam of radiation;

a support configured to support a patterning device that is configured to pattern the beam of radiation;

a projection system configured to project the patterned beam onto a substrate; and

an overlay measurement system comprising:
a polarized light source configured to illuminate the substrate with a polarized light beam;

an optical system configured to capture light reflected by the substrate from the polarized light beam, the optical system comprising:
a first non-polarizing beam splitter configured to receive the polarized light beam from the polarized source, direct the polarized light beam to the substrate via the protection system, and receive a reflected light beam from the substrate via the projection system, the reflected light beam comprising a zeroth order diffraction component;

a second non-polarizing beam splitter configured to receive the reflected light beam from the first non-polarizing beam splitter;

a crossed polarizer configured to receive the a portion of reflected light beam from the second non-polarizing beam splitter and transmit an in-plane image and crossed-polarized image;

a blocking element configured to block the in-plane image;

a detector configured to measure the intensity of crossed-polarized image and produce a signal therefrom; and

a processing unit configured to receive the signal from the detector and to process crossed-polarized image for overlay metrology measurement using asymmetry data derived from crossed-polarized image.

9. The overlay measurement apparatus of claim 8, wherein the crossed polarizer comprises a Wollaston prism.

10. The overlay measurement apparatus of claim 8, wherein:
the substrate comprises a grating; and

the zeroth order diffraction component originates from conical diffraction of the polarized light beam from the grating.

11. A method of measuring overlay comprising:
illuminating a sample with a polarized light beam;

capturing light scattered by the sample from the polarized light beam;

transmitting an orthogonal polarization component that is orthogonal to a polarization direction of the polarized light beam;

splitting the captured light into an in-plane image and crossed-polarized image;

blocking the in-plane image;

measuring an intensity of the crossed-polarized image; and

performing an overlay metrology measurement using asymmetry data derived from the crossed-polarized image.

12. The method of claim 11, further comprising:
wherein the sample is a substrate;

wherein capturing of the light which is scattered by the sample comprises capturing a zeroth order diffraction component.

13. The method of claim 12, further comprising generating the zeroth order diffraction component from conical diffraction of the polarized light beam from a grating on the substrate.

14. The method of claim 11, wherein the measuring the intensity of the crossed-polarized image comprises measuring with a CCD camera.

15. The method of claim 14, wherein the CCD camera has a minimum resolution of 12 bits.

16. The method of claim 11, wherein the measuring the intensity of the cross-polarized image comprises measuring with a back-illuminated CCD device.