CLAIMS

1. A spectroscopic metrology system comprising:

an illumination source configured to generate an amount of illumination light including wavelengths less than 150 nanometers meters;

an illumination optics subsystem configured to direct the amount of illumination light from the illumination source to a measurement spot on a surface of a specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof;

a reflective collection optics subsystem configured to collect an amount of collected light from the measurement spot on the surface of the specimen, the reflective collection optics subsystem including a collection mask disposed at or near a pupil plane of the reflective collection optics subsystem and a plurality of reflective relay optical elements, the plurality of reflective relay optical elements configured to image the amount of collected light from the collection mask to a dispersive element of the spectroscopic metrology system with a field demagnification greater than 1.0;

at least one detector having a planar, two-dimensional surface sensitive to incident light, the at least one detector configured to detect the amount of collected light dispersed by the dispersive element and generate output signals indicative of the detected light; and

a computing system configured to generate an estimated value of a parameter of interest of the specimen under measurement based on an analysis of the output signals.

2. The metrology system of Claim 1, wherein an illumination Numerical Aperture (NA) of the illumination optics subsystem at the measurement spot is at least 0.1.

3. The metrology system of Claim 1, wherein a collection Numerical Aperture (NA) of the reflective collection optics subsystem at the measurement spot is less than 0.05.

4. The metrology system of Claim 1, the plurality of reflective relay optical elements configured to image the amount of collected light from the collection mask to the dispersive element with a field demagnification greater than 2.0.

5. The metrology system of Claim 1, wherein the collection mask includes a plurality of apertures, each aperture configured to transmit the amount of collected light associated with a different angle of incidence from the specimen under measurement.

6. The metrology system of Claim 1, wherein the illumination source is a combined illumination source including a laser sustained plasma (LSP) illumination source and a supercontinuum laser illumination source.

7. The metrology system of Claim 1, wherein the at least one detector includes two or more detectors, wherein each of the two or more detectors detects a portion of the amount of collected light over different spectral ranges.

8. The metrology system of Claim 7, wherein each of the two or more detectors detects each portion of the amount of collected light over different spectral ranges simultaneously.

9. The metrology system of Claim 1, wherein the at least one detector includes two or more different surface areas each having different photosensitivity, wherein the two or more different surface areas are aligned with a direction of wavelength dispersion across the surface of the at least one detector.

10. The metrology system of Claim 1, wherein the specimen under measurement includes a three dimensional NAND structure or a dynamic random access memory structure.

11. A method comprising:

directing an amount of broadband illumination light including wavelengths less than 150 nanometers from an illumination source to a measurement spot on a surface of a specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof;

collecting an amount of collected light from the measurement spot on the surface of the specimen in response to the amount of illumination light, the collecting involving a collection mask disposed at or near a pupil plane of a reflective collection optics subsystem;

imaging the amount of collected light from the collection mask to a dispersive element, the imaging involving a plurality of reflective relay optical elements configured to image the amount of collected light from the

collection mask to the dispersive element with a field demagnification greater than 1.0;

dispersing the amount of collected light onto at least one detector; and

detecting measurement spectra associated with the amount of collected light with the at least one detector.

12. The method of Claim 11, wherein an illumination Numerical Aperture (NA) of the illumination optics subsystem at the measurement spot is at least 0.1.

13. The method of Claim 11, wherein a collection Numerical Aperture (NA) of the reflective collection optics subsystem at the measurement spot is less than 0.05.

14. The method of Claim 11, the plurality of reflective relay optical elements configured to image the amount of collected light from the collection mask to the dispersive element with a field demagnification greater than 2.0.

15. The method of Claim 11, wherein the collection mask includes a plurality of apertures, each aperture configured to transmit the amount of collected light associated with a different angle of incidence from the specimen under measurement.

16. The method of Claim 11, wherein the illumination source is a combined illumination source including a laser sustained plasma (LSP) illumination source and a supercontinuum laser illumination source.

17. The method of Claim 11, wherein the at least one detector includes two or more detectors, wherein each of the two or more detectors detects a portion of the amount of collected light over different spectral ranges.

18. The method of Claim 17, wherein each of the two or more detectors detects each portion of the amount of collected light over different spectral ranges simultaneously.

19. The method of Claim 11, wherein the at least one detector includes two or more different surface areas each having different photosensitivity, wherein the two or more different surface areas are aligned with a direction of wavelength dispersion across the surface of the at least one detector.

20. A spectroscopic metrology system comprising:

an illumination source configured to generate an amount of illumination light including wavelengths less than 150 nanometers meters;

an illumination optics subsystem configured to direct the amount of illumination light from the illumination source to a measurement spot on a surface of a specimen under measurement at one or more angles of incidence, one or more azimuth angles, or a combination thereof;

a reflective collection optics subsystem configured to collect an amount of collected light from the measurement spot on the surface of the specimen, the reflective collection optics subsystem including a collection mask disposed at or near a pupil plane of the reflective collection optics subsystem and a plurality of reflective

relay optical elements, the plurality of reflective relay optical elements configured to image the amount of collected light from the collection mask to a dispersive element of the spectroscopic metrology system with a field demagnification greater than 1.0;

at least one detector having a planar, two-dimensional surface sensitive to incident light, the at least one detector configured to detect the amount of collected light dispersed by the dispersive element and generate output signals indicative of the detected light; and

a non-transitory, computer-readable medium storing instructions that, when executed by one or more processors, causes the one or more processors to:

generate an estimated value of a parameter of interest of the specimen under measurement based on an analysis of the output signals.