Claims

1. A surface inspection system comprising:

an illumination source configured to generate a beam of illumination light;

a beam splitting element configured to split the beam of illumination light into a leading illumination beam and a primary illumination beam;

an illumination objective configured to project the leading illumination beam and the primary illumination beam onto a surface of a wafer at a leading measurement spot and a primary measurement spot, respectively;

an imaging objective configured to image an amount of light scattered from the leading measurement spot and image an amount of light scattered from the primary measurement spot to separate locations at a wafer image plane of the imaging objective;

a collection beam splitter configured to split the imaged amount of light scattered from the leading measurement spot and the imaged amount of light scattered from the primary measurement spot between a main measurement channel directed toward an imaging detector and a laser power management (LPM) channel directed toward one or more LPM detectors, wherein the collection beam splitter includes an aperture that subdivides a field of view of the collection beam splitter into at least one region aligned with a direction of illumination, wherein the aperture directs a higher percentage of light in the at least one region toward the one or more LPM detectors than any other region within the field of view, the one or more LPM detectors

configured to generate an output signal indicative of the amount of light scattered from the leading measurement spot; and

a computing system configured to:

receive the output signal indicative of the amount of light scattered from the leading measurement spot; and

communicate a command signal to an illumination power control element that causes the illumination power control element to adjust an optical power of the beam of illumination light based on the output signal.

2. The surface inspection system of claim **1**, further comprising:

a wafer positioning system operable to move the wafer in a scanning motion such that the leading measurement spot and the primary measurement spot move across the surface of the wafer along an inspection path.

3. The surface inspection system of claim **2**, wherein the leading measurement spot is located ahead of the primary measurement spot in the inspection path and is separated from the primary measurement spot by a predetermined separation distance.

4. The surface inspection system of claim **1**, wherein the output signal indicative of the amount of light scattered from the leading measurement spot is a single valued signal.

5. The surface inspection system of claim **1**, wherein the output signal indicative of the amount of light scattered from the leading measurement spot is indicative of an image of the light scattered from the leading measurement spot.

6. The surface inspection system of claim **1**, wherein the illumination power control element is an acousto-optic modulator.

7. The surface inspection system of claim **1**, further comprising:

a haze filter located in an optical path between the imaging objective and the one or more LPM detectors at or near a pupil plane of the imaging objective.

8. The surface inspection system of claim **1**, wherein the collection beam splitter includes an aperture that directs a larger proportion of backscattered light and forward scattered light into the LPM channel than other light scattered from the leading measurement spot.

9. The surface inspection system of claim **1**, further comprising:

an obscuration element located in an optical path of the LPM channel, the obscuration element configured to selectively block the imaged amount of light scattered from the primary measurement spot or the imaged amount of light scattered from the leading measurement spot in the LPM channel at or near a wafer image plane in front of an LPM detector of the one or more LPM detectors.

10. The surface inspection system of claim **1**, wherein a first LPM detector of the one or more LPM detectors generates an output signal indicative of the amount of light scattered from the leading measurement spot and a second LPM detector of the one or more LPM detectors generates an output signal indicative of the amount of light scattered from the primary measurement spot.

11. The surface inspection system of claim **1**, wherein an array detector of the one or more LPM detectors generates a first output signal indicative of the amount of light scattered from the leading measurement spot and a second output signal indicative of the amount of light scattered from the primary measurement spot.

12. The surface inspection system of claim **1**, wherein the command signal to the illumination power control element causes the illumination power control element to reduce the optical power of the beam of illumination light for a reduced power time interval after the output signal indicative of the amount of light scattered from the leading measurement spot exceeds a predetermined threshold value.

13. The surface inspection system of claim **12**, wherein the reduced power time interval includes an amount of time the leading measurement spot exceeds the predetermined threshold value.

14. The surface inspection system of claim **12**, wherein the reduced power time interval is initiated at a fixed time after the output signal indicative of the amount of light scattered from the leading measurement spot exceeds a predetermined threshold value, wherein the fixed time is a function of a separation distance between the leading measurement spot and the primary measurement spot.

15. A method comprising:

illuminating a surface of a specimen with a primary illumination beam at a primary measurement spot and a leading illumination beam at a leading measurement spot;

imaging an amount of light scattered from the leading measurement spot and imaging an amount of light scattered from the primary measurement spot to separate locations at a wafer image plane of an imaging objective;

splitting the imaged amount of light scattered from the leading measurement spot and the imaged amount of light scattered from the primary measurement spot between a main measurement channel directed toward an imaging detector and a laser power management (LPM) channel directed toward one or more LPM detectors, wherein the splitting involves subdividing a collection field of view into at least one region aligned with a direction of illumination, and directing a higher percentage of light in the at least one region toward the one or more LPM detectors than any other region within the field of view; and

adjusting an optical power of the primary illumination beam and the leading illumination beam based an amount of light scattered from the leading measurement spot detected by a LPM detector of the one or more LPM detectors.

16. The method of claim 15, further comprising:

moving the specimen in a scanning motion such that the leading measurement spot and the primary measurement spot move across the surface of the speciment along an inspection path, wherein the leading measurement spot is located ahead of the primary measurement spot in the inspection path and is separated from the primary measurement spot by a predetermined separation distance.

17. The method of claim 15, further comprising:

selectively blocking the imaged amount of light scattered from the primary measurement spot or the imaged amount of light scattered from the leading measurement spot in the LPM channel at or near a wafer image plane in front of an LPM detector of the one or more LPM detectors.

18. The method of claim 15, wherein the optical power of the primary illumination beam and the optical power of the leading illumination beam are reduced for a reduced power time interval initiated after the output signal indicative of the amount of light scattered from the leading measurement spot exceeds a predetermined threshold value.

19. An apparatus comprising:

an illumination subsystem configured to project a leading illumination beam and a primary illumination beam onto a surface of a wafer at a leading measurement spot and a primary measurement spot, respectively;

an imaging objective configured to image an amount of light scattered from the leading measurement spot and image an amount of light scattered from the primary measurement spot to separate locations at a wafer image plane of the imaging objective;

a collection beam splitter configured to split the imaged amount of light scattered from the leading measurement spot and the imaged amount of light scattered from the primary measurement spot between a main measurement channel directed toward an imaging detector and a laser power management (LPM) channel directed toward one or more LPM detectors, wherein the collection beam splitter includes an aperture that subdivides a field of view of the collection beam splitter into at least one region aligned with a direction of illumination, wherein the aperture directs a higher percentage of light in the at least one region toward the one or more LPM detectors than any other region within the field of view, the one or more LPM detectors configured to generate an output signal indicative of the amount of light scattered from the leading measurement spot; and

a computing system comprising:

one or more processors; and

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

receive the output signal indicative of the amount of light scattered from the leading measurement spot; and

communicate a command signal to an illumination power control element that causes the illumination power control element to adjust an optical power of the beam of illumination light based on the output signal.

20. The apparatus of claim **19**, wherein the optical power of the primary illumination beam and the optical power of the leading illumination beam are reduced for a reduced power time interval initiated after the output signal indicative of the amount of light scattered from the leading measurement spot exceeds a predetermined threshold value.