CLAIMS

1. A metrology tool comprising:

an illumination source configured to generate an illumination beam;

a beam shaper including one or more adjustable optical elements configured to direct the illumination beam to a sample;

one or more measurement channels configured to receive reflected light from the sample through the beam shaper and generate one or more shearing interferograms on one or more detectors based on the reflected light, wherein the reflected light is in a collimated state when the one or more adjustable optical elements are in a default configuration and a top surface of the sample is orthogonal to an optical axis of the beam shaper; and

a controller communicatively coupled to the beam shaper and the one or more measurement channels, wherein the controller includes one or more processors configured to execute program instructions causing the one or more processors to:

adjust the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state;

generate an output surface profile measurement of the top surface of the sample based on the one or more shearing interferograms;

determine a mount offset distribution of the sample due to distortion associated with placement of the sample on a sample mount; and

compensate the output surface profile measurement to remove the mount offset distribution.

2. The metrology tool of claim 1, wherein the output surface profile measurement includes an induced offset distribution associated with the selected angular profile of the illumination beam on the sample.

3. The metrology tool of claim 1, wherein the output surface profile measurement is compensated to remove an induced offset distribution associated with the selected angular profile of the illumination beam on the sample.

4. The metrology tool of claim 1, wherein determining a mount offset distribution of the sample due to distortion associated with placement of the sample on a sample mount comprises:

calculating the mount offset distribution based on known properties of the sample and known contact points of the sample mount with the sample.

5. The metrology tool of claim 1, wherein determining a mount offset distribution of the sample due to distortion associated with placement of the sample on a sample mount comprises:

determining at least a portion of the mount offset distribution using a lookup table based on at least one of a shape or a thickness of the sample and known contact points of the sample mount with the sample.

6. The metrology tool of claim 1, wherein adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state comprises:

receiving a coarse surface profile measurement of at least one of the top surface of the sample or a bottom surface of the sample, wherein the coarse surface profile measurement has a larger measurement range than the one or more measurement channels; and

adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement.

7. The metrology tool of claim 6, wherein adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement comprises:

receiving a set of calibrated angular profiles of the illumination beam associated with a set of calibrated configurations of the one or more adjustable optical elements of the beam shaper;

selecting one angular profile of the set of calibrated angular profiles to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement; and

adjusting the configuration of the one or more adjustable optical elements to a calibrated configuration of the set of calibrated configurations to provide the selected angular profile.

8. The metrology tool of claim 6, wherein the coarse surface profile measurement is based on a measurement of at least one of a surface profile of the top surface of the sample or a thickness of the sample.

9. The metrology tool of claim 6, wherein the coarse surface profile measurement is based on a measurement of at least one of a surface profile of the bottom surface of the sample or a thickness of the sample.

10. The metrology tool of claim 9, wherein the thickness of the sample is at least one of known, measured, or assumed.

11. The metrology tool of claim 1, wherein adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state comprises:

sequentially adjusting the configuration of the one or more adjustable elements to a set of candidate configurations;

monitoring at least one of the one or more shearing interferograms or the output surface profile measurement;

identifying a configuration of the set of candidate configurations suitable for at least partially compensating for deviations of the reflected light from the collimated state; and

adjusting the configuration of the one or more adjustable optical elements to the identified configuration.

12. The metrology tool of claim 1, wherein the configuration of the one or more adjustable optical elements comprises:

positions of the one or more adjustable optical elements along the optical axis of the beam shaper.

13. The metrology tool of claim 1, wherein at least one of the one or more adjustable optical elements comprises:

a lens.

14. The metrology tool of claim 1, wherein at least one of the one or more adjustable optical elements comprises:

at least one of a field stop or a pupil stop.

15. The metrology tool of claim 1, wherein the illumination source is a laser.

16. The metrology tool of claim 15, wherein the laser is a Helium-Neon laser.

17. The metrology tool of claim 1, wherein adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state comprises:

providing one or more control signals to the beam shaper.

18. A metrology tool comprising:

a shearing interferometer comprising:

an illumination source configured to generate an illumination beam;

a beam shaper including one or more adjustable optical elements configured to direct the illumination beam to a sample; and

one or more measurement channels configured to receive reflected light from the sample through the beam shaper and generate one or more shearing interferograms on one or more detectors based on the reflected light, wherein the reflected light is in a collimated state when the one or more adjustable optical elements are in a default configuration and a top surface of the sample is orthogonal to an optical axis of the beam shaper;

a coarse surface profiler including one or more profiling sensors configured to generate a coarse surface profile measurement of the top surface of the sample, wherein the coarse surface profile measurement has a larger measurement range than the one or more measurement channels; and

a controller communicatively coupled to the beam shaper and the one or more measurement channels, wherein the controller includes one or more processors configured to execute program instructions causing the one or more processors to:

adjust the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement;

generate an output surface profile measurement of the top surface of the sample based on the one or more shearing interferograms;

determine a mount offset distribution of the sample due to distortion associated with placement of the sample on a sample mount; and

compensate the output surface profile measurement to remove the mount offset distribution.

19. The metrology tool of claim 18, wherein the one or more profiling sensors comprise:

at least one of an interferometric thickness sensor, a confocal thickness sensor, or a Shack-Hartmann sensor.

20. The metrology tool of claim 18, wherein the sample is mounted to a rotational translation stage, wherein the one or more profiling sensors include one or more profiling sensors mounted to a linear translation stage, wherein one or more profiling sensors provide a plurality of measurements as the sample is rotated on the rotational translation stage and the one or more profiling sensors are translated by the linear translation stage.

21. The metrology tool of claim 18, wherein the coarse surface profiler is integrated into a sample alignment system.

22. The metrology tool of claim 21, wherein the sample is a first test sample, wherein the sample alignment system is configured to operate as a buffer by generating the coarse surface profile measurement of the first test sample when an additional test sample is located on the shearing interferometer.

23. The metrology tool of claim 18, wherein adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state comprises:

receiving a coarse surface profile measurement of at least one of the top surface of the sample or a bottom surface of the sample, wherein the coarse surface profile measurement has a larger measurement range than the one or more measurement channels; and

adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement.

24. The metrology tool of claim 23, wherein adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular

profile of the illumination beam on the sample to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement comprises:

receiving a set of calibrated angular profiles of the illumination beam associated with a set of calibrated configurations of the one or more adjustable optical elements of the beam shaper;

selecting one angular profile of the set of calibrated angular profiles to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement; and

adjusting the configuration of the one or more adjustable optical elements to a calibrated configuration of the set of calibrated configurations to provide the selected angular profile.

25. The metrology tool of claim 23, wherein the coarse surface profile measurement is based on a measurement of at least one of a surface profile of the top surface of the sample or a thickness of the sample.

26. The metrology tool of claim 23, wherein the coarse surface profile measurement is based on a measurement of at least one of a surface profile of the bottom surface of the sample or a thickness of the sample.

27. A metrology method comprising:

measuring a coarse surface profile measurement of a top surface of a sample with a coarse surface profiler;

placing the sample in a shearing interferometer, wherein the shearing interferometer comprises:

an illumination source configured to generate an illumination beam;

a beam shaper including one or more adjustable optical elements configured to direct the illumination beam to the sample;

one or more measurement channels configured to receive reflected light from the sample through the beam shaper and generate one or more shearing interferograms on one or more detectors based on the reflected light, wherein the reflected light is in a collimated state when the one or more adjustable optical elements are in a default configuration and the top surface of the sample is orthogonal to an optical axis of the beam shaper;

adjusting the configuration of the one or more adjustable optical elements of the beam shaper to provide a selected angular profile of the illumination beam on

the sample to at least partially compensate for deviations of the reflected light from the collimated state based on the coarse surface profile measurement;

generating an output surface profile measurement of the top surface of the sample based on the one or more shearing interferograms;

determining a mount offset distribution of the sample due to distortion associated with placement of the sample on a sample mount; and

compensating the output surface profile measurement to remove the mount offset distribution.