CLAIMS

What is claimed:

1. A metrology system comprising:

a controller couplable to a metrology sub-system, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive a plurality of image signals of a first metrology target disposed on a sample from the metrology sub-system;

determine a plurality of harmonic detectivity metric values by calculating a harmonic detectivity metric value for each of the plurality of image signals, wherein a respective harmonic detectivity metric value of a respective image signal is a function of harmonic signal intensity of the respective image signal, anharmonic noise of the respective image signal, and surface reflectivity of the first metrology target;

identify a set of optical measurement conditions of the metrology sub-system based on the plurality of harmonic detectivity metric values, wherein the set of optical measurement conditions define a recipe for optical metrology measurements of the metrology sub-system; and

provide the recipe to the metrology sub-system for execution of one or more optical metrology measurements of one or more additional metrology targets.

2. The metrology system of claim 1, wherein the respective harmonic detectivity metric value of the respective image signal is monotonically dependent on the harmonic signal intensity of the respective image signal, the anharmonic noise of the respective image signal, and the surface reflectivity of the first metrology target.

3. The metrology system of claim 2, wherein the respective harmonic detectivity metric value of the respective image signal is defined by:

$$Harmonic\ Detectivity\ Metric\ = \frac{Harmonic\ Signal\ Intensity}{\sqrt{Anharmonic\ Noise}\sqrt{Surface\ Reflectivity}}$$

4. The metrology system of claim 1, wherein the one or more processors are configured to determine each of the harmonic detectivity metric values at a different set of optical measurement conditions.

5. The metrology system of claim 1, wherein the one or more processors are configured to determine each of the harmonic detectivity metric values at a different set of focus and wavelength values.

6. The metrology system of claim 1, wherein the one or more processors are configured to display the set of harmonic detectivity metric values as a function of two or more optical measurement conditions.

7. The metrology system of claim 6, wherein the one or more processors are configured to display the set of harmonic detectivity metric values as a function of focus and wavelength.

8. The metrology system of claim 1, wherein the set of optical measurement conditions defining the recipe for optical metrology measurements of the metrology sub-system comprises:

for each of the one or more additional metrology targets, two or more of:

a wavelength of illumination;

a polarization of the illumination incident on the additional metrology target;

an angle of the illumination incident on the additional metrology target; or

a focal position of the additional metrology target with respect to a detector.

9. A metrology system comprising:

a metrology sub-system, wherein the metrology sub-system comprises:

an illumination source to generate illumination;

one or more illumination optics to direct the illumination from the illumination source to a metrology target disposed on a sample; and

a detector to generate an image of the metrology target based on the illumination from the illumination source, wherein an optical configuration of the metrology sub-system is configurable, wherein the optical configuration includes a wavelength of the illumination, a polarization of the illumination incident on the metrology target, an angle of the illumination incident on the metrology target, or a focal position of the metrology target with respect to the detector; and

a controller couplable to the metrology sub-system, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive a plurality of image signals of a first metrology target disposed on the sample from the metrology sub-system;

determine a plurality of harmonic detectivity metric values by calculating a harmonic detectivity metric value for each of the plurality of image signals, wherein a respective harmonic detectivity metric value of a respective image signal is a function of harmonic signal intensity of the respective image signal, anharmonic noise of the respective image signal, and surface reflectivity of the first metrology target;

identify a set of optical measurement conditions of the metrology sub-system based on the plurality of harmonic detectivity metric values, wherein the set of optical measurement conditions define a recipe for optical metrology measurements of the metrology sub-system; and

provide the recipe to the metrology sub-system for execution of one or more optical metrology measurements of one or more additional metrology targets.

10. The metrology system of claim 9, wherein the respective harmonic detectivity metric value of the respective image signal is monotonically dependent on the harmonic signal intensity of the respective image signal, the anharmonic noise of the respective image signal, and the surface reflectivity of the first metrology target.

11. The metrology system of claim 10, wherein the respective harmonic detectivity metric value of the respective image signal is defined by:

$$Harmonic\ Detectivity\ Metric\ = \frac{Harmonic\ Signal\ Intensity}{\sqrt{Anharmonic\ Noise}\sqrt{Surface\ Reflectivity}}$$

12. The metrology system of claim 9, wherein the one or more processors are configured to determine each of the harmonic detectivity metric values at a different set of optical measurement conditions.

13. The metrology system of claim 9, wherein the one or more processors are configured to determine each of the harmonic detectivity metric values at a different set of focus and wavelength values.

14. The metrology system of claim 9, wherein the one or more processors are configured to display the set of harmonic detectivity metric values as a function of two or more optical measurement conditions.

15. The metrology system of claim 14, wherein the one or more processors are configured to display the set of harmonic detectivity metric values as a function of focus and wavelength.

16. The metrology system of claim 9, wherein the set of optical measurement conditions defining the recipe for optical metrology measurements of the metrology sub-system comprises:

for each of the one or more additional metrology targets, two or more of:

a wavelength of illumination;

a polarization of the illumination incident on the additional metrology target;

an angle of the illumination incident on the additional metrology target; or

a focal position of the additional metrology target with respect to the detector.

17. A metrology system comprising:

a controller couplable to a first metrology sub-system and a second metrology sub-system, the controller including one or more processors configured to execute program instructions causing the one or more processors to:

receive a first set of image signals of one or more metrology targets disposed on a sample from the first metrology sub-system;

receive a second set of image signals of the one or more metrology targets disposed on the sample from the second metrology sub-system;

determine a first set of harmonic detectivity metric values for the image signals from the first metrology sub-system, wherein a respective harmonic detectivity metric value of the first set of harmonic detectivity metric values is a function of harmonic signal intensity of a first respective image signal of the first set of image signals, anharmonic noise of the first respective image signal, and surface reflectivity of the one or more metrology targets;

determine a second set of harmonic detectivity metric values for the image signals from the second metrology sub-system;

compare the first set of harmonic detectivity metric values for the first metrology sub-system to the second set of harmonic detectivity metric values for the second metrology sub-system; and

calibrate the second metrology sub-system based on the comparison of the first set of harmonic detectivity metric values for the first metrology sub-system to the second set of harmonic detectivity metric values for the second metrology sub-system.

18. The system of claim 17, wherein the one or more processors are further configured to:

adjust image-based overlay metrology data acquired with the second metrology sub-system based on the comparison of the one or more first harmonic detectivity metric values for the first metrology sub-system to the one or more second harmonic detectivity metric values for the second metrology sub-system.

19. The system of claim 18, wherein the one or more processors are further configured to:

combine image-based overlay metrology data from the first metrology sub-system with calibrated image-based overlay metrology data from the second metrology sub-system.

20. A method comprising:

receive a plurality of image signals of a first metrology target disposed on a sample;

determine a plurality of harmonic detectivity metric values by calculating a harmonic detectivity metric value for each of the plurality of image signals, wherein a respective harmonic detectivity metric value of a respective image signal is a function of harmonic signal intensity of the respective image signal, anharmonic noise of the respective image signal, and surface reflectivity of the first metrology target;

identify a set of optical measurement conditions of a metrology tool based on the plurality of harmonic detectivity metric values, wherein the set of optical measurement conditions define a recipe for optical metrology measurements of the metrology tool; and

provide the recipe to the metrology tool for execution of one or more optical metrology measurements of one or more additional metrology targets.