

Claims

1. A system configured to detect defects on a specimen, comprising: an inspection system configured for scanning energy over a physical version of a specimen while detecting energy from the specimen to thereby generate images for the specimen, wherein the inspection system generates the images for the specimen with two or more modes defined by values of parameters of the inspection system used for generating the images for the specimen, wherein the inspection system comprises an illumination subsystem configured to direct the energy to the specimen, a scanning subsystem configured to cause the energy to be scanned over the specimen, and one or more detection channels comprising a detector configured to detect the energy from the specimen, wherein the two or more modes have one or more different parameters of the illumination subsystem, one or more different parameters of the one or more detection channels, or a combination thereof, and wherein at least two dies are formed on the physical version of the specimen with different values of one or more parameters of a fabrication process performed on the specimen; a storage medium configured for storing the images for the specimen generated by the inspection system, wherein the stored images are generated using the two or more modes of the inspection system; and one or more computer subsystems configured for: comparing portions of the stored images generated at locations on the specimen at which patterns having the same as-designed characteristics are formed with at least two of the different values of the one or more parameters of the fabrication process, wherein the portions of the stored images that are compared are not constrained by locations of the dies on the specimen, locations of the patterns within the dies, or locations of the patterns on the specimen, and wherein the portions of the stored images that are compared comprise the portions of the stored images generated using only one of the two or more modes; and detecting defects at the locations based on results of said comparing, wherein said comparing and said detecting are separately performed for the portions of the stored images generated at the locations on the specimen with only another of the two or more modes.
2. The system of claim 1, wherein the storage medium and the one or more computer subsystems are not part of the inspection system and do not have any capability for handling the physical version of the specimen.
3. The system of claim 1, wherein the storage medium and the one or more computer subsystems are further configured as a virtual inspection system.
4. The system of claim 1, wherein the images stored by the storage medium comprise all of the images generated for the specimen by the inspection system during the scanning and the detecting.
5. The system of claim 1, wherein the one or more computer subsystems are further configured for determining a process window for the fabrication process based on the detected defects.
6. The system of claim 1, wherein the one or more computer subsystems are further configured for determining which of the detected defects are systematic defects.
7. The system of claim 1, wherein the one or more computer subsystems are further

configured for identifying hot spots in a design for the specimen based on the detected defects.

8. The system of claim 1, wherein the one or more computer subsystems are further configured for comparing the generated images, while the energy is being scanned over the physical version of the specimen and the energy is being detected from the specimen, generated at two of the locations, detecting additional defects based on results of comparing the generated images, and, for one of the additional defects, searching a design for the specimen for other locations of the patterns having the same as-designed characteristics as the patterns formed at the two of the locations.

9. The system of claim 8, wherein the one or more computer subsystems are further configured for determining one or more statistics for the patterns based on the stored images generated at the two of the locations and the other locations.

10. The system of claim 8, wherein the one or more computer subsystems are further configured for determining a severity of the one of the additional defects based on the stored images generated at the two of the locations and the other locations.

11. The system of claim 8, wherein the one or more computer subsystems are further configured for determining a process window for the fabrication process based on the stored images generated at the two of the locations and the other locations.

12. The system of claim 1, wherein the one or more computer subsystems are further configured for, based on the stored images, determining how different instances of the patterns having the same as-designed characteristics formed on the physical version of the specimen change as the different values of the one or more parameters used to form the different instances change.

13. The system of claim 1, wherein the one or more computer subsystems are further configured for identifying the portions of the stored images by aligning a design for the specimen to the stored images.

14. The system of claim 1, wherein the physical version of the specimen comprises a top layer and one or more underlying layers formed underneath the top layer, and wherein the one or more computer subsystems are further configured for aligning a design for the top layer of the specimen to one of the portions of the stored images corresponding to one of the defects and determining if the one of the defects is related to the top layer or the one or more underlying layers based on results of said aligning.

15. The system of claim 1, wherein the one or more computer subsystems are further configured for determining a relationship between one or more characteristics of hypothetical images generated for the physical version of the specimen by the inspection system and one or more characteristics of the patterns formed on the physical version of the specimen, determining the one or more characteristics of one or more of the portions of the stored images or one or more additional portions of the stored images, and identifying one or more pattern failure modes on the physical version of the specimen by inputting the one or more determined characteristics of the one or more of the portions of the stored images or the one

or more additional portions of the stored images into the relationship and comparing output of the relationship to as-designed characteristics of the patterns.

16. The system of claim 1, wherein the locations on the specimen for which the portions of the stored images are compared comprise locations in the same reticle field printed on the specimen.

17. The system of claim 1, wherein the one or more computer subsystems are further configured for comparing additional portions of the stored images generated at additional locations on the specimen at which patterns having the same as-designed characteristics are formed with the same values of the one or more parameters of the fabrication process and detecting defects at the additional locations based on results of comparing the additional portions.

18. The system of claim 1, wherein said comparing and said detecting are further separately performed for each of the patterns having different as-designed characteristics formed on the specimen.

19. The system of claim 1, wherein the patterns are included in a set of patterns whose printability on the specimen is uncertain, and wherein said comparing and said detecting are further separately performed for one or more additional patterns included in the set.

20. The system of claim 1, wherein the one or more computer subsystems are further configured for determining one or more parameters for defect sampling based on a complete distribution of a characteristic of portions of the stored images generated at locations on the specimen at which patterns having the same as-designed characteristics are formed with the same values of the one or more parameters.

21. The system of claim 1, wherein the one or more computer subsystems are further configured for grouping the detected defects based on the as-designed characteristics of the patterns in which the detected defects are located to thereby group the detected defects located in the patterns having the same as-designed characteristics into the same group and the detected defects located in the patterns having different as-designed characteristics into different groups and identifying patterns of interest on the specimen based on results of said grouping.

22. The system of claim 21, wherein the one or more computer subsystems are further configured for identifying every instance of the patterns of interest in a design for the specimen.

23. The system of claim 1, wherein the specimen comprises a wafer.

24. The system of claim 1, wherein the energy scanned over the specimen comprises light, and wherein the energy detected from the specimen comprises light.

25. The system of claim 1, wherein the energy scanned over the specimen comprises electrons, and wherein the energy detected from the specimen comprises electrons.

26. A non-transitory computer-readable medium, storing program instructions executable on a computer system for performing a computer-implemented method for detecting defects on a specimen, wherein the computer-implemented method comprises: generating images for a physical version of a specimen with an inspection system by scanning energy over the physical version of the specimen while detecting energy from the specimen to thereby generate the images for the specimen, wherein the inspection system generates the images for the specimen with two or more modes defined by values of parameters of the inspection system used for generating the images for the specimen, wherein the inspection system comprises an illumination subsystem configured to direct the energy to the specimen, a scanning subsystem configured to cause the energy to be scanned over the specimen, and one or more detection channels comprising a detector configured to detect the energy from the specimen, wherein the two or more modes have one or more different parameters of the illumination subsystem, one or more different parameters of the one or more detection channels, or a combination thereof, and wherein at least two dies are formed on the physical version of the specimen with different values of one or more parameters of a fabrication process performed on the specimen; storing the images for the specimen generated by the inspection system with a storage medium, wherein the stored images are generated using the two or more modes of the inspection system; comparing portions of the stored images generated at locations on the specimen at which patterns having the same as-designed characteristics are formed with at least two of the different values of the one or more parameters of the fabrication process, wherein the portions of the stored images that are compared are not constrained by locations of the dies on the specimen, locations of the patterns within the dies, or locations of the patterns on the specimen, and wherein the portions of the stored images that are compared comprise the portions of the stored images generated using only one of the two or more modes; and detecting defects at the locations based on results of said comparing, wherein said comparing and said detecting are separately performed for the portions of the stored images generated at the locations on the specimen with only another of the two or more modes.

27. A method for detecting defects on a specimen, comprising: generating images for a physical version of a specimen with an inspection system by scanning energy over the physical version of the specimen while detecting energy from the specimen to thereby generate the images for the specimen, wherein the inspection system generates the images for the specimen with two or more modes defined by values of parameters of the inspection system used for generating the images for the specimen, wherein the inspection system comprises an illumination subsystem configured to direct the energy to the specimen, a scanning subsystem configured to cause the energy to be scanned over the specimen, and one or more detection channels comprising a detector configured to detect the energy from the specimen, wherein the two or more modes have one or more different parameters of the illumination subsystem, one or more different parameters of the one or more detection channels, or a combination thereof, and wherein at least two dies are formed on the physical version of the specimen with different values of one or more parameters of a fabrication process performed on the specimen; storing the images for the specimen generated by the inspection system with a storage medium, wherein the stored images are generated using the two or more modes of the inspection system; comparing portions of the stored images generated at locations on the specimen at which patterns having the same as-designed characteristics are formed with at least two of the different values of the one or more parameters of the fabrication process, wherein the portions of the stored images that are

compared are not constrained by locations of the dies on the specimen, locations of the patterns within the dies, or locations of the patterns on the specimen, and wherein the portions of the stored images that are compared comprise the portions of the stored images generated using only one of the two or more modes; and detecting defects at the locations based on results of said comparing, wherein said comparing and said detecting are separately performed for the portions of the stored images generated at the locations on the specimen with only another of the two or more modes, and wherein said comparing and said detecting are performed by a computer system.