

CLAIMS

What is claimed is:

- 5 1. A method of preparation of a sample of a substrate for sub-surface review using a scanning electron microscope apparatus, the method comprising:
- obtaining a first results file from an inspection apparatus, wherein the first results file includes locations of defects detected in a device being manufactured by the inspection apparatus;
- 10 re-detecting a defect at a location indicated in the first results file;
- marking the location of the defect with at least one discrete marking point having predetermined positioning relative to the location of the defect;
- receiving a design file with a design for the device;
- determining the location of the defect relative to the design for the device;
- 15 ascertaining a cut location and a cut angle in an at least a partly-automated manner using the design for the device; and
- revising the first results file to generate a second results file which includes the cut location and the cut angle.
- 20 2. The method of claim 1 further using a focused ion beam apparatus and further comprising:
- performing cutting at the cut location and the cut angle.
3. The method of claim 2 further comprising:
- 25 transferring the substrate and communicating the second results file from the scanning electron microscope apparatus to the focused ion beam apparatus,

wherein the scanning electron microscope apparatus and the focused ion beam apparatus are separate systems; and

aligning a coordinate system of the focused ion beam apparatus with a
30 coordinate system of the scanning electron microscope apparatus using locations and images of a die corner and alignment sites prior to ascertaining the cut location and the cut angle.

4. The method of claim 2, wherein the scanning electron microscope
35 apparatus and the focused ion beam apparatus are integrated in a single system.

5. The method of claim 2 further comprising:
performing imaging to obtain an image of the defect after the cutting is
performed; and
40 generating a third results file including the image of the defect.

6. The method of claim 5 further using a transmission electron microscope
apparatus and further comprising:
obtaining the third results file; and
45 performing imaging using the transmission electron microscope to obtain a cross-sectional image of the defect.

7. The method of claim 1, wherein the mark comprises a multiple-point mark
which has multiple discrete marking points.
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8. The method of claim 1, wherein the marking point comprises a geometrical pattern which has alternating darker and lighter marking regions around a center location.

55 9. The method of claim 1, wherein the defect is in an array and is located outside of a field of view from a corner of the array.

10. The method of claim 9, wherein the defect comprises a voltage-contrast defect.

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11. A system for preparing a sample for sub-surface review, the system comprising:

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an inspection apparatus configured to inspect a device for defects, select defects for sub-surface review, and output data on the selected defects to a first results file;

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a scanning electron microscope apparatus configured to re-detect a defect at a location indicated in the first results file, mark the location of the defect with at least one distinct marking point with predetermined positioning relative to the location of the defect, receive a design file with a design for the device, ascertain a cut location and a cut angle in at least a partly-automated manner using the design for the device, and revise the first results file to generate a second results file which includes the cut location and the cut angle.

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12. The system of claim 11 further comprising:

a focused ion beam apparatus configured to performing cutting at the cut location and the cut angle relative to the mark for the defect.

13. The system of claim 12, wherein the scanning electron microscope apparatus and the focused ion beam apparatus are separate systems, wherein
80 the substrate and the second results file are transferred from the scanning electron microscope apparatus to the focused ion beam apparatus, and wherein a coordinate system of the focused ion beam apparatus is aligned with a coordinate system of the scanning electron microscope apparatus using locations and images of a die corner and alignment sites prior to ascertaining the cut location and the cut angle.

85 14. The system of claim 12, wherein the scanning electron microscope apparatus and the focused ion beam apparatus are integrated in a single apparatus.

15. A method for marking a defect for review on a target substrate, the
90 method comprising:

obtaining a first results file from an inspection apparatus, wherein the first results file includes locations of defects detected in the target substrate by the inspection apparatus, wherein the defects detected include the defect for review;

re-detecting the defect for review at a location indicated in the first results file;

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marking the location of the defect with a mark that comprises at least one distinct marking point with predetermined positioning and separation relative to the defect for review.

100 16. The method of claim 15, wherein the mark comprises a multiple distinct marking points with predetermined positioning and separation relative to the defect for review.

105 17. The method of claim 15, wherein the distinct marking point comprises a geometrical pattern.

18. The method of claim 17, wherein the geometrical pattern comprises alternating darker and lighter marking regions around a center location.

CLAIMS

1. A method of preparation of a sample of a substrate for sub-surface review using a scanning electron microscope apparatus, the method comprising:

obtaining a first results file from an inspection apparatus, wherein the first results file includes locations of defects detected in a device being manufactured by the inspection apparatus;

re-detecting a defect at a location indicated in the first results file;

marking on the substrate the location of the defect with multiple discrete and separate marking points, each said marking point having predetermined positioning relative to the location of the defect that is given by a number of pixels and a predetermined direction;

receiving a design file with a design for the device;

determining the location of the defect relative to the design for the device;

ascertaining a cut location and a cut angle in an at least a partly-automated manner using the design for the device; and

revising the first results file to generate a second results file which includes the cut location and the cut angle.

2. The method of claim 1 further using a focused ion beam apparatus and further comprising:

performing cutting at the cut location and the cut angle.

3. The method of claim 2 further comprising:

transferring the substrate and communicating the second results file from the scanning electron microscope apparatus to the focused ion beam apparatus, wherein the scanning electron microscope apparatus and the focused ion beam apparatus are separate systems; and

aligning a coordinate system of the focused ion beam apparatus with a coordinate system of the scanning electron microscope apparatus using locations and images of a die corner and alignment sites prior to ascertaining the cut location and the cut angle.

4. The method of claim 2, wherein the scanning electron microscope apparatus and the focused ion beam apparatus are integrated in a single system.

5. The method of claim 2 further comprising:
performing imaging to obtain an image of the defect after the cutting is performed; and
generating a third results file including the image of the defect.

6. The method of claim 5 further using a transmission electron microscope apparatus and further comprising:
obtaining the third results file; and
performing imaging using the transmission electron microscope to obtain a cross-sectional image of the defect.

7. The method of claim 1, wherein the number of pixels is at a predetermined magnification and resolution.

8. The method of claim 1, wherein each of the multiple marking points comprises a geometrical pattern which has alternating darker and lighter marking regions around a center location, each said marking region being a polygon having a vertex at the center location.

9. The method of claim 1, wherein the defect is in an array and is located outside of a field of view from a corner of the array.

10. The method of claim 9, wherein the defect comprises a voltage-contrast defect.

11. The method of claim 1, wherein the marking is performed using carbon-burn marking.

12. A system for preparing a sample for sub-surface review, the system comprising:

- an inspection apparatus configured to inspect a device for defects, select defects for sub-surface review, and output data on the selected defects to a first results file;

- a scanning electron microscope apparatus configured to re-detect a defect at a location indicated in the first results file, mark on the sample the location of the defect with at least one distinct marking point with predetermined positioning relative to the location of the defect, receive a design file with a design for the device, ascertain a cut location and a cut angle in at least a partly-automated manner using the design for the device, and revise the first results file to generate a second results file which includes the cut location and the cut angle,

wherein said at least one distinct marking point comprises a geometrical pattern which has alternating darker and lighter marking regions around a center location, each said marking region being a polygon having a vertex at the center location.

13. The system of claim 12 further comprising:

- a focused ion beam apparatus configured to performing cutting at the cut location and the cut angle relative to the mark for the defect.

14. The system of claim 13, wherein the scanning electron microscope apparatus and the focused ion beam apparatus are separate systems, wherein the substrate and the second results file are transferred from the scanning electron microscope apparatus to the focused ion beam apparatus, and wherein a coordinate system of the focused ion beam apparatus is aligned with a coordinate system of the scanning electron microscope apparatus using locations and images of a die corner and alignment sites prior to ascertaining the cut location and the cut angle.

15. The system of claim **13**, wherein the scanning electron microscope apparatus and the focused ion beam apparatus are integrated in a single apparatus.

16. A method for marking a defect for review on a target substrate, the method comprising:

obtaining a first results file from an inspection apparatus, wherein the first results file includes locations of defects detected in the target substrate by the inspection apparatus, wherein the defects detected include the defect for review;

re-detecting the defect for review at a location indicated in the first results file; and

marking the location of the defect with a mark on the target substrate that comprises at least one distinct marking point with predetermined positioning and separation relative to the defect for review, wherein said at least one distinct marking point comprises a geometrical pattern which has alternating darker and lighter marking regions around a center location, each said marking region being a polygon having a vertex at the center location.

17. The method of claim **16**, wherein the mark comprises multiple distinct and separate marking points with predetermined positioning and separation relative to the defect for review.

18. The method of claim **16**, wherein the marking regions comprise triangles and quadrilaterals.

19. The method of claim **18**, wherein the marking regions comprise one dark triangle across from one dark quadrilateral and one light triangle across from one light quadrilateral.

20. The method of claim **16**, wherein the marking is performed using carbon-burn marking.