

CLAIMS

[Claim 1] A polishing apparatus comprising:

a polishing table configured to support a polishing pad;

5 a polishing head configured to press a workpiece, having a pattern formed thereon, against the polishing pad and polish a surface of the workpiece;

an imaging device disposed in the polishing table and configured to generate an image including at least the pattern of the workpiece;

an image analysis system configured to determine a geometric element of the pattern of the workpiece based on the image; and

10 a pattern magnifying device configured to visually magnify the pattern of the workpiece,

wherein the pattern magnifying device comprises a lattice having a reference pattern formed therein, the reference pattern having a predefined shape and dimensions, and

15 the image analysis system is configured to determine the geometric element of the pattern of the workpiece based on a moire pattern appearing on the image due to superimposition of the pattern of the workpiece and the reference pattern.

[Claim 2] The polishing apparatus according to claim 1, wherein the image
20 analysis system is configured to measure a line width of the moire pattern appearing on the image and calculate a pitch of the pattern of the workpiece from the line width of the moire pattern and a geometric element of the reference pattern.

[Claim 3] The polishing apparatus according to claim 1, wherein

25 the image analysis system is configured to:

obtain the image from the imaging device;

compare the moire pattern on the image with reference moire patterns
on a plurality of reference images;

determine a reference image having a reference moire pattern that most matches the moire pattern on the image; and

determine a geometric element of a pattern associated with the determined reference image.

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[Claim 4] The polishing apparatus according to any one of claims 1 to 3, further comprising:

a first prism and a second prism disposed in the polishing table; and

a light source facing the first prism,

10 wherein the imaging device faces the second prism,

the first prism is arranged so as to split light emitted by the light source into a first light that passes through the lattice to the workpiece and a second light that is reflected by the lattice, and

15 the second prism is arranged so as to superimpose the first light reflected by the workpiece and the second light reflected by the lattice, and to direct the first light and the second light, which are superimposed, to the imaging device.

[Claim 5] The polishing apparatus according to any one of claims 1 to 3, further comprising a beam splitter and a light source disposed in the polishing table,

20 wherein the light source and the lattice are arranged symmetrically with respect to the beam splitter,

the imaging device faces the beam splitter, and

25 the beam splitter is arranged so as to split light emitted by the light source into a first light reflected by the beam splitter and a second light passing through the beam splitter, direct the first light to the workpiece, and direct the second light to the lattice.

[Claim 6] The polishing apparatus according to any one of claims 1 to 5, wherein the reference pattern is a concentric pattern or a radial pattern.

[Claim 7] A polishing method comprising:

rotating a polishing table together with a polishing pad;

pressing a workpiece, having a pattern formed thereon, against the polishing pad

5 to polish a surface of the workpiece;

generating an image including at least the pattern of the workpiece by an imaging device disposed in the polishing table; and

determining a geometric element of the pattern of the workpiece based on the image,

10 wherein a pattern magnifying device configured to visually magnify the pattern of the workpiece is disposed in the polishing table,

the pattern magnifying device comprises a lattice having a reference pattern formed therein, the reference pattern having a predefined shape and dimensions, and

the determining the geometric element of the pattern of the workpiece based on
15 the image comprises determining the geometric element of the pattern of the workpiece based on a moire pattern appearing on the image due to superimposition of the pattern of the workpiece and the reference pattern.

[Claim 8] The polishing method according to claim 7, wherein the determining the

20 geometric element of the pattern of the workpiece based on the image comprises measuring a line width of the moire pattern appearing on the image, and calculating a pitch of the pattern of the workpiece from the line width of the moire pattern and a geometric element of the reference pattern.

25 [Claim 9] The polishing method according to claim 7, wherein

the determining the geometric element of the pattern of the workpiece based on the image comprises:

obtaining the image from the imaging device;

comparing the moire pattern on the image with reference moire patterns
on a plurality of reference images;

determining a reference image having a reference moire pattern that
most matches the moire pattern on the image; and

5 determining a geometric element of a pattern associated with the
determined reference image.

[Claim 10] The polishing method according to any one of claims 7 to 9, wherein
the reference pattern is a concentric pattern or a radial pattern.

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[Claim 11] A polishing apparatus comprising:

a polishing table configured to support a polishing pad;

a polishing head configured to press a workpiece, having a pattern formed
thereon, against the polishing pad and polish a surface of the workpiece;

15 a lattice disposed in the polishing table and having a reference pattern formed
therein;

an imaging device disposed in the polishing table and configured to generate an
image including the pattern of the workpiece and the reference pattern;

20 an image analysis system configured to determine a polishing end point of the
workpiece based on a moire pattern appearing on the image due to superimposition of the
pattern of the workpiece and the reference pattern.

[Claim 12] The polishing apparatus according to claim 11, wherein the image
analysis system is configured to determine the polishing end point of the workpiece based
25 on a sharpness of the moire pattern on the image.

[Claim 13] The polishing apparatus according to claim 12, wherein the image
analysis system is configured to determine the polishing end point of the workpiece at

which the sharpness of the moire pattern no longer changes.

[Claim 14] The polishing apparatus according to claim 13, wherein the image analysis system is configured to calculate an index numerical value indicating the sharpness of the moire pattern, calculate a rate of change in the index numerical value,
5 detect a point in time at which the rate of change exceeds a first threshold value, and then determine the polishing end point at which the rate of change falls below a second threshold value.

10 [Claim 15] The polishing apparatus according to claim 14, wherein the index numerical value is a numerical value expressed by a modulation transfer function.

[Claim 16] A polishing method comprising:
 rotating a lattice and a polishing table together with a polishing pad, the lattice
15 having a reference pattern formed therein;
 pressing a workpiece, having a pattern formed thereon, against the polishing pad to polish a surface of the workpiece;
 generating, by an imaging device, an image of the pattern of the workpiece and the reference pattern which are superimposed, the imaging device being disposed in the
20 polishing table; and
 determining a polishing end point of the workpiece based on a moire pattern appearing on the image.

[Claim 17] The polishing method according to claim 16, wherein the determining
25 the polishing end point of the workpiece based on the moire pattern appearing on the image comprises determining the polishing end point of the workpiece based on a sharpness of the moire pattern on the image.

[Claim 18] The polishing method according to claim 17, wherein the determining the polishing end point of the workpiece based on the sharpness of the moire pattern on the image comprises determining the polishing end point of the workpiece at which the sharpness of the moire pattern no longer changes.

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[Claim 19] The polishing method according to claim 18, wherein the determining the polishing end point of the workpiece at which the sharpness of the moire pattern no longer changes comprises calculating an index numerical value indicating the sharpness of the moire pattern, calculating a rate of change in the index numerical value, detecting a
10 point in time at which the rate of change exceeds a first threshold value, and then determining the polishing end point at which the rate of change falls below a second threshold value.

[Claim 20] The polishing method according to claim 19, wherein the index
15 numerical value is a numerical value expressed by a modulation transfer function.