

CLAIMS

1. A substrate imaging apparatus comprising:
 - a rotary holding unit that holds and rotates a substrate;
 - 5 a mirror member having a reflecting surface that opposes an end face of the substrate and a peripheral portion of a back surface of the substrate held by the rotary holding unit, the reflecting surface being inclined with respect to a rotation axis of the rotary holding unit;
 - a first camera having an imaging device that receives both first light and
10 reflected light through a first lens, the first light coming from a front surface of the substrate held by the rotary holding unit, and the reflected light being second light which comes from the end face of the substrate held by the rotary holding unit and is then reflected by the reflecting surface;
 - a first light source disposed above the front surface of the substrate held by the
15 rotary holding unit;
 - a first half mirror disposed between the first light source and the front surface of the substrate held by the rotary holding unit, and configured to transmit light coming from the first light source therethrough toward the substrate held by the rotary holding unit and reflect the first light and the reflected light toward the first camera;
 - 20 a component member having a light path hole through which the first light and the reflected light travel before reaching the first lens, wherein a focus adjusting lens is disposed in the light path hole; and
 - the focus adjusting lens configured to adjust an image forming position, at which an image of the end face the substrate is formed, onto the imaging device;
 - 25 wherein the focus adjusting lens is interposed in an optical path of the second light traveling from the reflecting surface of the mirror member to the first lens such that the first light does not pass through the focus adjusting lens but the reflected light passes through the focus adjusting lens,
 - wherein the first camera and the first half mirror are arranged in a horizontal
30 direction.

2. The substrate imaging apparatus according to claim 1, wherein the first light is light coming from a peripheral portion of the front surface of the substrate.
3. The substrate imaging apparatus according to claim 1, wherein the reflecting
5 surface is a curved surface that is recessed away from the end face of the substrate held by the rotary holding unit.
4. The substrate imaging apparatus according to claim 3, wherein the reflecting surface has a radius of curvature within a range from 10 mm to 30 mm.
- 10 5. The substrate imaging apparatus according to claim 1, further comprising a second camera having an imaging device that receives a third light coming from a back surface of the substrate held by the rotary holding unit through a second lens.
- 15 6. The substrate imaging apparatus according to claim 5, further comprising:
a second light source disposed below the back surface of the substrate held by the rotary holding unit; and
a second half mirror disposed between the second light source and the back surface of the substrate, and configured to transmit light coming from the second light
20 source therethrough and reflect the third light;
wherein the second camera and the second half mirror are arranged in a horizontal direction.
7. The substrate imaging apparatus according to claim 6, wherein the first camera
25 is configured to image an imaging range which does not overlap an irradiation range irradiated with light from the second light source, as viewed from the above.
8. A substrate imaging apparatus comprising:
a rotary holding unit that holds and rotates a substrate;
30 a mirror member having a reflecting surface that opposes an end face of the substrate and a peripheral portion of a back surface of the substrate held by the rotary

holding unit, the reflecting surface being inclined with respect to a rotation axis of the rotary holding unit;

5 a first camera having an imaging device that receives both first light and reflected light through a first lens, the first light coming from a front surface of the substrate held by the rotary holding unit, and the reflected light being second light which comes from the end face of the substrate held by the rotary holding unit and is then reflected by the reflecting surface;

a first light source disposed above the front surface of the substrate held by the rotary holding unit;

10 a first half mirror disposed between the first light source and the front surface of the substrate held by the rotary holding unit, and configured to transmit light coming from the first light source therethrough toward the substrate held by the rotary holding unit and reflect the first light and the reflected light toward the first camera;

15 a third camera having an imaging device that receives fourth light coming from the front surface of the substrate held by the rotary holding unit through a third lens;

a third light source disposed below the front surface of the substrate held by the rotary holding unit; and

20 a third half mirror disposed between the third light source and the front surface of the substrate, and configured to transmit a light coming from the third light source therethrough and reflect the fourth light;

wherein the first camera and the first half mirror are arranged in a horizontal direction;

wherein the third camera and the third half mirror are arranged in a horizontal direction.

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9. The substrate imaging apparatus according to claim 8, further comprising a drive unit configured to move the rotary holding unit in a horizontal direction,

wherein the third camera is configured to image the front surface of the substrate held by the rotary holding unit that is being moved by the drive unit.

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10. The substrate imaging apparatus according to claim 8, further comprising:

a drive unit configured to move the rotary holding unit in a horizontal direction,

wherein the third camera is configured to image the front surface of the substrate held by the rotary holding unit that is being moved by the drive unit,

wherein the third half mirror extends in a crossing direction that crosses, as viewed from above, a direction in which the substrate held by the rotary holding unit is moved by the drive unit, and

wherein the third half mirror has a length, measured in the crossing direction, greater than a diameter of the substrate.

11. The substrate imaging apparatus according to claim 9, further comprising a housing containing the mirror member and the drive unit,

wherein the housing has a loading and unloading port through which the substrate is loaded and unloaded to and from the housing,

wherein the mirror member is disposed in the housing on a side farther from the loading and unloading port, and

wherein the drive unit is configured to move the rotary holding unit such that the substrate held by the rotary holding unit moves between a location near the loading and unloading port and a location near the mirror member.

12. A substrate imaging apparatus comprising:

a rotary holding unit that holds and rotates a substrate;

a mirror member having a reflecting surface that opposes an end face of the substrate and a peripheral portion of a back surface of the substrate held by the rotary holding unit, the reflecting surface being inclined with respect to a rotation axis of the rotary holding unit;

a first camera having an imaging device that receives both first light and reflected light through a first lens, the first light coming from a front surface of the substrate held by the rotary holding unit, and the reflected light being second light which comes from the end face of the substrate held by the rotary holding unit and is then reflected by the reflecting surface;

a first light source disposed above the front surface of the substrate held by the rotary holding unit;

a first half mirror disposed between the first light source and the front surface of the substrate held by the rotary holding unit, and configured to transmit light coming from the first light source therethrough toward the substrate held by the rotary holding unit and reflect the first light and the reflected light toward the first camera; and

5 a focus adjusting lens configured to adjust an image forming position, at which an image of the end face the substrate is formed, onto the imaging device;

wherein the focus adjusting lens is interposed in an optical path of the second light traveling from the reflecting surface of the mirror member to the first lens such that the first light does not pass through the focus adjusting lens but the reflected light
10 passes through the focus adjusting lens,

wherein the focus adjusting lens is a bifocal lens which has two portions with different refractive powers,

wherein the first camera and the first half mirror are arranged in a horizontal direction.

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13. The substrate imaging apparatus according to claim 12, wherein the first light is coming from a peripheral portion of the front surface of the substrate.

14. The substrate imaging apparatus according to claim 12, wherein the reflecting
20 surface is a curved surface that is recessed away from the end face of the substrate held by the rotary holding unit.

15. The substrate imaging apparatus according to claim 14, wherein the reflecting surface has a radius of curvature within a range from 10 mm to 30 mm.

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16. The substrate imaging apparatus according to claim 12, further comprising a second camera having an imaging device that receives a third light coming from a back surface of the substrate held by the rotary holding unit through a second lens.

30 17. The substrate imaging apparatus according to claim 16, further comprising:
a second light source disposed below the back surface of the substrate held by the rotary holding unit; and

a second half mirror disposed between the second light source and the back surface of the substrate, and configured to transmit light coming from the second light source therethrough and reflect the third light;

5 wherein the second camera and the second half mirror are arranged in a horizontal direction.

18. The substrate imaging apparatus according to claim 17, wherein the first camera is configured to image an imaging range which does not overlap an irradiation range irradiated with light from the second light source, as viewed from above.