

CLAIMS

1. A method of pattern formation comprising the steps of irradiating light from an effective light source to a mask, transferring the pattern of the mask onto a substrate, and forming the pattern on the substrate, wherein the amount of light emitted from a center portion of said effective light source is lowered by ^{2 to 90 percent} ~~a certain~~ amount with respect to the amount of light emitted from the peripheral portions of the effective light source.

~~2. The method of pattern formation as set forth in claim 1, wherein the amount of the light emitted from the center portion of the effective light source is lowered by 2 to 90 percent with respect to the peak value of the amount of light emitted from the peripheral portions of the effective light source.~~

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~~2.3.~~ The method of pattern formation as set forth in claim 1 ~~or 2~~, wherein the mask is a phase shifting mask.

~~3.4.~~ The method of pattern formation as set forth in claim 1, wherein the effective light source ^{means} ~~is~~ a fly's eye lens comprising an assembly of a plurality of lenses ^{and irradiating} ~~eye lens~~.

~~4.5.~~ The method of pattern formation as set forth in claim 1, wherein the region of the center portion of said effective light source where the amount of light is lowered is a region of 20 to 70 percent of the outer

diameter of the effective light source.

5 6. The method of pattern formation as set forth in claim 1, to the peak of the amount of light at the peripheral portions of said effective light source appears at a few points at rotary symmetrical positions at the peripheral portions of the effective light source.

6 7. The method of pattern formation as set forth in claim 1, wherein the amount of light incident upon the center portion of said effective light source is lowered in relation to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element.

7 8. The method of pattern formation as set forth in claim 1⁶, wherein the optical element is a beam splitter and/or prism lens.

8 9. The method of pattern formation as set forth in claim 1, wherein the mask is a phase shifting mask, the effective light source is a fly's eye lens comprising an assembly of a plurality of lenses, and the amount of light emitted from a center portion of said fly's eye lens is lowered by using a beam splitter and/or prism lens.

9 10. The method of pattern formation as set forth in claim 1, wherein the amount of the light incident upon the center portion of the effective light source is lowered with respect to the peak value of the amount of light

incident at the peripheral portions of the effective light source by using a filter having a high transmittance at the peripheral portions as against the center portion.

10. ~~11~~. The method of pattern formation as set forth in claim ³~~4~~, which lowers the amount of light emitted from the center portion of said fly's eye lens relative to the peak value of the amount of light emitted from the peripheral portions of the fly's eye lens by using a mechanical filter having opening portions corresponding to the individual lenses of the fly's-eye lens and having diameters of the related opening portions larger at the peripheral portions relative to the center portion.

11. ~~12~~. The method of pattern formation as set forth in claim 1, which lowers the amount of light incident upon the center portion of said effective light source relative to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element and optical parts arranged so that they can be made to approach or move away from each other in the light path axis direction.

12. ~~13~~. The method of pattern formation as set forth in claim ¹¹~~12~~, wherein the optical element is a prism.

13. ~~14~~. The method of pattern formation as set forth in claim 1, which lowers the amount of light emitted from the center portion of said effective light source relative to

the peak value of the amount of light emitted from the peripheral portions of the effective light source by dividing the beam incident upon said effective light source to two or more beams, irradiating the two or more divided beams onto said effective light source by using a movable mirror, and utilizing the difference in scanning speed at respective points of the surface of the effective light source dependent upon the surface shape of said movable mirror.

~~14.15.~~ The method of pattern formation as set forth in claim ~~4~~³, wherein the diameters of the individual lens of the fly's eye lens are larger at the center portion than the peripheral portions.

~~15.16.~~ The method of pattern formation as set forth in claim ~~15~~¹⁴, wherein, in the fly's eye lens, the diameters of the individual lens at the center portion are made 1.1 to 3 times the diameters of the individual lenses at the peripheral portions.

~~16.17.~~ The method of pattern formation as set forth in claim 1, which, when a single exposure time is T , passes the light through a first filter with a higher transmittance at the peripheral portions than the center portion for a time of $0.05 \times T$ to $0.95 \times T$ and passes the light through a second filter or not passes the light through any filters in the remaining exposure time,

thereby lowering the amount of light from the center portion of the effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source in just a single exposure time.

17.18. An apparatus for pattern formation irradiating light from an effective light source to a mask, transferring the pattern of the mask onto a substrate, and forming the pattern on the substrate, comprising a light intensity distribution correcting means for lowering the amount of light emitted from a center portion of said effective light source by ^{2 to 90 percent} ~~a certain amount~~ with respect to the amount of light emitted from the peripheral portions of the effective light source.

~~19. The apparatus for pattern formation as set forth in claim 18, wherein the light intensity distribution correcting means is a means for lowering the amount of the light emitted from the center portion of the effective light source by 2 to 90 percent with respect to the peak value of the amount of light emitted from the peripheral portions of the effective light source.~~

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18.20. The apparatus for pattern formation as set forth in claim ¹⁷19, wherein the mask is a phase shifting mask.

19.21. The apparatus for pattern formation as set forth in claim ¹⁷18, wherein the effective light source ^{means} ~~is~~ a fly's

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eye lens comprising an assembly of a plurality of lenses¹⁷ and irradiating eye lens

20. 22. The apparatus for pattern formation as set forth in claim ¹⁷18, wherein the region of the center portion of said effective light source where the amount of light is lowered by the light intensity distribution correcting means is a region of 20 to 40 percent of the outer diameter of the effective light source.

21. 23. The apparatus for pattern formation as set forth in claim ¹⁷18, wherein the peak of the amount of light at the peripheral portions of said effective light source appears at a few points at rotary symmetrical positions at the peripheral portions of the effective light source.

22. 24. The apparatus for pattern formation as set forth in claim ¹⁷18, wherein the light intensity distribution correcting means has an optical element which lowers the amount of light incident upon the center portion of the effective light source in relation to the peak value of the amount of light incident upon the peripheral portions of the effective light source.

23. 25. The apparatus for pattern formation as set forth in claim ²¹24, wherein the optical element is a beam splitter and/or a prism lens.

24. 26. The apparatus for pattern formation as set forth in claim ¹⁷18, wherein the light intensity distribution correcting means has a filter having a high transmittance

at the peripheral portions as against the center portion.

25. 27. The apparatus for pattern formation as set forth in claim ¹⁹24, wherein the light intensity distribution correcting means has a mechanical filter, which mechanical filter has opening portions corresponding to the individual lenses of the fly's-eye lens and has diameters of the related opening portions larger at the peripheral portions relative to the center portion.

26. 28. The apparatus for pattern formation as set forth in claim ¹⁷26, wherein the light intensity distribution correcting means has an optical element and optical parts arranged so that they can be made to approach or move away from this optical element in the light path axis direction.

27. 29. The apparatus for pattern formation as set forth in claim ²⁶28, wherein the optical element is a prism.

28. 30. The apparatus for pattern formation as set forth in claim ¹⁷28, wherein the light intensity distribution correcting means further has means for dividing the beam incident upon said effective light source to two or more beams, a movable mirror for irradiating the two or more divided beams onto said effective light source, and scan means for lowering the amount of light emitted from the center portion of said effective light source relative to the peak value of the amount of light emitted from the

peripheral portions of the effective light source by using the difference in scanning speed at respective points of the surface of the effective light source dependent upon the surface shape of said movable mirror.

29.31. The apparatus for pattern formation as set forth in claim ¹⁹21, wherein the diameters of the individual lens of the fly's-eye lens are larger at the center portion as against the peripheral portions.

30.32. The apparatus for pattern formation as set forth in claim ²⁹31, wherein, in the fly's-eye lens, the diameters of the individual lenses at the center portion are 1.1 to 3 times the diameters of the individual lenses at the peripheral portions.

31.33. The apparatus for pattern formation as set forth in claim ¹³18, wherein the light intensity distribution correcting means also has

a first filter with a higher transmittance at the peripheral portions than the center portion and

a switching means for switching between a state passing light through the first filter for a single exposure time and a state performing exposure without passing through the first filter.

32.34. The apparatus for pattern formation as set forth in claim ³¹33, which further has a second filter with a distribution of transmittance different from the first

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filter and causes the light to pass through the second filter in the state performing exposure without passing through the first filter.

³³
35. The apparatus for pattern formation as set forth in claim ³¹33 or ³²34, wherein the switching means has a rotary disk on which at least the first filter is mounted and a drive means for driving the rotation of the rotary disk.

³⁴36. The apparatus for pattern formation as set forth in claim ³¹33 or ³²34, wherein the switching means has at slide mechanism enabling at least the first filter to move slidably.

³⁵37. The apparatus for pattern formation as set forth in claim ³¹33 or ³²34, wherein the switching means has an optical shutter type optical material whose transmittance of light changes according to the voltage applied.

³⁶38. A method of production of a semiconductor device comprising the steps of irradiating light from an effective light source to a mask, transferring the pattern of the mask onto a substrate, and forming the pattern on the substrate, wherein the amount of light emitted from a center portion of said effective light source is lowered by ^{2 to 90 percent} ~~a certain amount~~ with respect to the amount of light emitted from the peripheral portions of the effective light source.

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39. The method of production of a semiconductor device as set forth in claim 38, wherein the amount of the light emitted from the center portion of the effective light source is lowered by 2 to 90 percent with respect to the peak value of the amount of light emitted from the peripheral portions of the effective light source.

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~~37.~~³⁷ 40. The method of production of a semiconductor device as set forth in claim ³⁶38, wherein the mask is a phase shifting mask.

~~38.~~³⁸ 41. The method of production of a semiconductor device as set forth in claim ³⁶38, wherein the effective light source ^{means} is a fly's eye lens comprising an assembly of ^{and irradiating eye lens} a plurality of lenses.

~~39.~~³⁹ 42. The method of production of a semiconductor device as set forth in claim ³⁶38, wherein the region of the center portion of said effective light source where the amount of light is lowered is a region of 20 to 40 percent of the outer diameter of the effective light source.

~~40.~~⁴⁰ 43. The method of production of a semiconductor device as set forth in claim ³⁵37, wherein the peak of the amount of light at the peripheral portions of said effective light source appears at a few points at rotary symmetrical positions at the peripheral portions of the effective light source.

~~41.~~⁴¹ 44. The method of production of a semiconductor

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device as set forth in claim ³⁶38, wherein the amount of light incident upon the center portion of said effective light source is lowered in relation to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element.

⁴²45. The method of production of a semiconductor device as set forth in claim ⁴¹44, wherein the optical element is a beam splitter and/or prism lens.

⁴⁶46. The method of production of a semiconductor device as set forth in claim ³⁶38, wherein the amount of the light incident upon the center portion of the effective light source is lowered with respect to the peak value of the amount of light incident at the peripheral portions of the effective light source by using a filter having a high transmittance at the peripheral portions as against the center portion.

⁴⁴47. The method of production of a semiconductor device as set forth in claim ³⁸41, which lowers the amount of light emitted from the center portion of said fly's eye lens relative to the peak value of the amount of light emitted from the peripheral portions of the fly's eye lens by using a mechanical filter having opening portions corresponding to the individual lenses of the fly's-eye lens and having diameters of the related opening portions larger at the peripheral portions relative to the center

portion.

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~~48~~. The method of production of a semiconductor device as set forth in claim ³⁶38, which lowers the amount of light incident upon the center portion of said effective light source relative to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element and optical parts arranged so that they can be made to approach or move away from this prism in the light path axis direction.

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~~49~~. The method of production of a semiconductor device as set forth in claim ⁴⁵48, wherein the optical element is a prism.

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~~50~~. The method of production of a semiconductor device as set forth in claim ³⁶38, which lowers the amount of light emitted from the center portion of said effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source by dividing the beam incident upon said effective light source to two or more beams, irradiating the two or more divided beams onto said effective light source by using a movable mirror, and utilizing the difference in scanning speed at respective points of the surface of the effective light source dependent upon the surface shape of said movable mirror.

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51. The method of production of a semiconductor device as set forth in claim ³⁸41, wherein the diameters of the individual lens of the fly's eye lens are larger at the center portion than the peripheral portions.

⁴⁹
52. The method of production of a semiconductor device as set forth in claim ⁴⁸51, wherein, in the fly's eye lens, the diameters of the individual lens at the center portion are made 1.1 to 3 times the diameters of the individual lenses at the peripheral portions.

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53. The method of production of a semiconductor device as set forth in claim ³⁶38, which, when a single exposure time is T, passes the light through a first filter with a higher transmittance at the peripheral portions than the center portion for a time of $0.05 \times T$ to $0.95 \times T$ and passes the light through a second filter or not passes the light through any filters in the remaining exposure time, thereby lowering the amount of light from the center portion of the effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source in just a single exposure time.

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PATTERN FORMATION METHOD AND METHOD AND APPARATUS FOR
PRODUCTION OF A SEMICONDUCTOR DEVICE USING SAID METHOD

ABSTRACT OF THE DISCLOSURE

A pattern formation method and method and apparatus for production of a semiconductor device using that method which irradiate light from a light source to a phase shifting mask through a fly's-eye lens comprised of an assembly of a plurality of lenses, transfer the pattern of the phase shifting mask onto the substrate, and form the pattern on the substrate, wherein the amount of light made incident upon the center portion of the fly's-eye lens is lowered by 2 to 90 percent, preferably 10 to 90 percent, further preferably 20 to 80 percent or 20 to 60 percent, relative to the amount of light incident upon the peripheral portion of the fly's-eye lens.

Figure 6

CLAIMS

1. A method of pattern formation comprising the steps of irradiating light from an effective light source to a mask, transferring the pattern of the mask onto a substrate, and forming the pattern on the substrate, wherein the amount of light emitted from a center portion of said effective light source is lowered by 2 to 90 percent with respect to the amount of light emitted from the peripheral portions of the effective light source.

2. The method of pattern formation as set forth in claim 1, wherein the mask is a phase shifting mask.

3. The method of pattern formation as set forth in claim 1, wherein the effective light source means a fly's eye lens comprising an assembly of a plurality of lenses and irradiating the effective light by passing a light through the fly's eye lens.

4. The method of pattern formation as set forth in claim 1, wherein the region of the center portion of said effective light source where the amount of light is lowered is a region of 20 to 70 percent of the outer diameter of the effective light source.

5. The method of pattern formation as set forth in claim 1, to the peak of the amount of light at the peripheral portions of said effective light source appears at a few points at rotary symmetrical positions at the peripheral portions of the effective light source.

6. The method of pattern formation as set forth in claim 1, wherein the amount of light incident upon the center portion of

said effective light source is lowered in relation to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element.

7. The method of pattern formation as set forth in claim 6, wherein the optical element is a beam splitter and/or prism lens.

8. The method of pattern formation as set forth in claim 1, wherein the mask is a phase shifting mask, the effective light source is a fly's eye lens comprising an assembly of a plurality of lenses, and the amount of light emitted from a center portion of said fly's eye lens is lowered by using a beam splitter and/or prism lens.

9. The method of pattern formation as set forth in claim 1, wherein the amount of the light incident upon the center portion of the effective light source is lowered with respect to the peak value of the amount of light incident at the peripheral portions of the effective light source by using a filter having a high transmittance at the peripheral portions as against the center portion.

10. The method of pattern formation as set forth in claim 3, which lowers the amount of light emitted from the center portion of said fly's eye lens relative to the peak value of the amount of light emitted from the peripheral portions of the fly's eye lens by using a mechanical filter having opening portions corresponding to the individual lenses of the fly's-eye lens and having diameters of the related opening portions larger at the peripheral portions relative to the center portion.

11. The method of pattern formation as set forth in claim 1, which lowers the amount of light incident upon the center

portion of said effective light source relative to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element and optical parts arranged so that they can be made to approach or move away from each other in the light path axis direction.

12. The method of pattern formation as set forth in claim 11, wherein the optical element is a prism.

13. The method of pattern formation as set forth in claim 1, which lowers the amount of light emitted from the center portion of said effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source by dividing the beam incident upon said effective light source to two or more beams, irradiating the two or more divided beams onto said effective light source by using a movable mirror, and utilizing the difference in scanning speed at respective points of the surface of the effective light source dependent upon the surface shape of said movable mirror.

14. The method of pattern formation as set forth in claim 3, wherein the diameters of the individual lens of the fly's eye lens are larger at the center portion than the peripheral portions.

15. The method of pattern formation as set forth in claim 14, wherein, in the fly's eye lens, the diameters of the individual lens at the center portion are made 1.1 to 3 times the diameters of the individual lenses at the peripheral portions.

16. The method of pattern formation as set forth in claim 1, which, when a single exposure time is T , passes the light through a first filter with a higher transmittance at the peripheral portions than the center portion for a time of 0.05

x T to 0.95 x T and passes the light through a second filter or not passes the light through any filters in the remaining exposure time, thereby lowering the amount of light from the center portion of the effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source in just a single exposure time.

17. An apparatus for pattern formation irradiating light from an effective light source to a mask, transferring the pattern of the mask onto a substrate, and forming the pattern on the substrate, comprising a light intensity distribution correcting means for lowering the amount of light emitted from a center portion of said effective light source by 2 to 90 percent with respect to the amount of light emitted from the peripheral portions of the effective light source.

18. The apparatus for pattern formation as set forth in claim 17, wherein the mask is a phase shifting mask.

19. The apparatus for pattern formation as set forth in claim 17, wherein the effective light source means a fly's eye lens comprising an assembly of a plurality of lenses and irradiating the effective light by passing a light through the fly's eye lens.

20. The apparatus for pattern formation as set forth in claim 17, wherein the region of the center portion of said effective light source where the amount of light is lowered by the light intensity distribution correcting means is a region of 20 to 40 percent of the outer diameter of the effective light source.

21. The apparatus for pattern formation as set forth in claim 17, wherein the peak of the amount of light at the

peripheral portions of said effective light source appears at a few points at rotary symmetrical positions at the peripheral portions of the effective light source.

22. The apparatus for pattern formation as set forth in claim 17, wherein the light intensity distribution correcting means has an optical element which lowers the amount of light incident upon the center portion of the effective light source in relation to the peak value of the amount of light incident upon the peripheral positions of the effective light source.

23. The apparatus for pattern formation as set forth in claim 22, wherein the optical element is a beam splitter and/or a prism lens.

24. The apparatus for pattern formation as set forth in claim 17, wherein the light intensity distribution correcting means has a filter having a high transmittance at the peripheral portions as against the center portion.

25. The apparatus for pattern formation as set forth in claim 19, wherein the light intensity distribution correcting means has a mechanical filter, which mechanical filter has opening portions corresponding to the individual lenses of the fly's-eye lens and has diameters of the related opening portions larger at the peripheral portions relative to the center portion.

26. The apparatus for pattern formation as set forth in claim 17, wherein the light intensity distribution correcting means has an optical element and optical parts arranged so that they can be made to approach or move away from this optical element in the light path axis direction.

27. The apparatus for pattern formation as set forth in

claim 26, wherein the optical element is a prism.

28. The apparatus for pattern formation as set forth in claim 17, wherein the light intensity distribution correcting means further has means for dividing the beam incident upon said effective light source to two or more beams, a movable mirror for irradiating the two or more divided beams onto said effective light source, and scan means for lowering the amount of light emitted from the center portion of said effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source by using the difference in scanning speed at respective points of the surface of the effective light source dependent upon the surface shape of said movable mirror.

29. The apparatus for pattern formation as set forth in claim 19, wherein the diameters of the individual lens of the fly's-eye lens are larger at the center portion as against the peripheral portions.

30. The apparatus for pattern formation as set forth in claim 29, wherein, in the fly's-eye lens, the diameters of the individual lenses at the center portion are 1.1 to 3 times the diameters of the individual lenses at the peripheral portions.

31. The apparatus for pattern formation as set forth in claim 17, wherein the light intensity distribution correcting means also has

a first filter with a higher transmittance at the peripheral portions than the center portion and

a switching means for switching between a state passing light through the first filter for a single exposure time and a state performing exposure without passing through the first filter.

32. The apparatus for pattern formation as set forth in claim 31, which further has a second filter with a distribution of transmittance different from the first filter and causes the light to pass through the second filter in the state performing exposure without passing through the first filter.

33. The apparatus for pattern formation as set forth in claim 31 or 32, wherein the switching means has a rotary disk on which at least the first filter is mounted and a drive means for driving the rotation of the rotary disk.

34. The apparatus for pattern formation as set forth in claim 31 or 32, wherein the switching means has a slide mechanism enabling at least the first filter to move slidably.

35. The apparatus for pattern formation as set forth in claim 31 or 32, wherein the switching means has an optical shutter type optical material whose transmittance of light changes according to the voltage applied.

36. A method of production of a semiconductor device comprising the steps of irradiating light from an effective light source to a mask, transferring the pattern of the mask onto a substrate, and forming the pattern on the substrate, wherein the amount of light emitted from a center portion of said effective light source is lowered by 2 to 90 percent with respect to the amount of light emitted from the peripheral portions of the effective light source.

37. The method of production of a semiconductor device as set forth in claim 36, wherein the mask is a phase shifting mask.

38. The method of production of a semiconductor device as set forth in claim 36, wherein the effective light source means

a fly's eye lens comprising an assembly of a plurality of lenses and irradiating the effective light by passing a light through the fly's eye lens.

39. The method of production of a semiconductor device as set forth in claim 36, wherein the region of the center portion of said effective light source where the amount of light is lowered is a region of 20 to 40 percent of the outer diameter of the effective light source.

40. The method of production of a semiconductor device as set forth in claim 35, wherein the peak of the amount of light at the peripheral portions of said effective light source appears at a few points at rotary symmetrical positions at the peripheral portions of the effective light source.

41. The method of production of a semiconductor device as set forth in claim 36, wherein the amount of light incident upon the center portion of said effective light source is lowered in relation to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element.

42. The method of production of a semiconductor device as set forth in claim 41, wherein the optical element is a beam splitter and/or prism lens.

43. The method of production of a semiconductor device as set forth in claim 36, wherein the amount of the light incident upon the center portion of the effective light source is lowered with respect to the peak value of the amount of light incident at the peripheral portions of the effective light source by using a filter having a high transmittance at the peripheral portions as against the center portion.

44. The method of production of a semiconductor device as set forth in claim 38, which lowers the amount of light emitted from the center portion of said fly's eye lens relative to the peak value of the amount of light emitted from the peripheral portions of the fly's eye lens by using a mechanical filter having opening portions corresponding to the individual lenses of the fly's-eye lens and having diameters of the related opening portions larger at the peripheral portions relative to the center portion.

45. The method of production of a semiconductor device as set forth in claim 36, which lowers the amount of light incident upon the center portion of said effective light source relative to the peak value of the amount of light incident upon the peripheral portions of the effective light source by using an optical element and optical parts arranged so that they can be made to approach or move away from this prism in the light path axis direction.

46. The method of production of a semiconductor device as set forth in claim 45, wherein the optical element is a prism.

47. The method of production of a semiconductor device as set forth in claim 36, which lowers the amount of light emitted from the center portion of said effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source by dividing the beam incident upon said effective light source to two or more beams, irradiating the two or more divided beams onto said effective light source by using a movable mirror, and utilizing the difference in scanning speed at respective points of the surface of the effective light source dependent upon the surface shape of said movable mirror.

48. The method of production of a semiconductor device as set forth in claim 38, wherein the diameters of the individual lens of the fly's eye lens are larger at the center portion than the peripheral portions.

49. The method of production of a semiconductor device as set forth in claim 48, wherein, in the fly's eye lens, the diameters of the individual lens at the center portion are made 1.1 to 3 times the diameters of the individual lenses at the peripheral portions.

50. The method of production of a semiconductor device as set forth in claim 36, which, when a single exposure time is T , passes the light through a first filter with a higher transmittance at the peripheral portions than the center portion for a time of $0.05 \times T$ to $0.95 \times T$ and passes the light through a second filter or not passes the light through any filters in the remaining exposure time, thereby lowering the amount of light from the center portion of the effective light source relative to the peak value of the amount of light emitted from the peripheral portions of the effective light source in just a single exposure time.

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PRODUCTION OF A SEMICONDUCTOR DEVICE USING SAID METHOD

ABSTRACT OF THE DISCLOSURE

A pattern formation method and method and apparatus for production of a semiconductor device using that method which irradiate light from a light source to a phase shifting mask through a fly's-eye lens comprised of an assembly of a plurality of lenses, transfer the pattern of the phase shifting mask onto the substrate, and form the pattern on the substrate, wherein the amount of light made incident upon the center portion of the fly's-eye lens is lowered by 2 to 90 percent, preferably 10 to 90 percent, further preferably 20 to 80 percent or 20 to 60 percent, relative to the amount of light incident upon the peripheral portion of the fly's-eye lens.

Figure 6