CLAIMS

What is claimed is:

1. An adjustable shadow mask implantation system comprising:

an ion source configured to provide ions; and

an shadow mask assembly configured to selectively allow ions from the ion source to pass therethrough to a substrate where they are implanted, wherein the shadow mask assembly is configured to adjust between a first position and a second position,

wherein the shadow mask assembly enables ion implantation of multiple substantially parallel lines absent any lines with an intersecting orientation with respect to the multiple substantially parallel lines when set in the first position, and

wherein the shadow mask assembly enables ion implantation of multiple substantially parallel lines and a line with an intersecting orientation with respect to the multiple substantially parallel lines when set in the second position.

2. The system of Claim 1, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

3. The system of Claim 1, wherein the shadow mask assembly comprises:

a first exposure region having multiple elongated openings substantially parallel to a first axis; and

a second exposure region having an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure region and the second exposure region.

4. The system of Claim 3, wherein the first exposure region comprises:

a first occlusion mask having a first set of elongated openings substantially parallel to a first axis; and

a second occlusion mask having a second set of elongated openings substantially parallel to the first axis,

wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form the multiple elongated openings of the first exposure region, the multiple elongated openings of the first exposure region being smaller than each one of the elongated openings in the first set of the first occlusion mask and the second set of the second occlusion mask.

5. The system of Claim 3, wherein the shadow mask assembly further comprises a homogeneous exposure region configured to enable a blanket homogeneous implantation of the substrate from the ions.

6. The system of Claim 1, further comprising:

a moveable substrate holder configured to move the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller operationally coupled to the moveable substrate holder, wherein the controller is configured to adjust the velocity to a first level for the first position and to a second level for the second position.

7. The system of Claim 6, wherein the second level is a lower velocity than the first level.

8. The system of Claim 6, wherein the moveable substrate holder is configured to rotate the substrate through the path of the ions passing through the shadow mask assembly.

9. The system of Claim 8, wherein the shadow mask assembly comprises:

a first exposure member having multiple elongated openings substantially parallel to a first axis, wherein the length of the multiple elongated openings is greater the farther away they are from the point of rotation about which the substrate is rotated; and

a second exposure member having an elongated opening configured in an intersecting orientation relative to the first axis, wherein the elongated opening gets wider as it extends away from the point of rotation about which the substrate is rotated,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure member and the second exposure member.

10. The system of Claim 9, wherein the multiple elongated openings are curved.

11. A method of ion implantation comprising:

flowing ions through a shadow mask assembly to a substrate;

adjusting the shadow mask assembly to a first position, wherein the substrate is selectively implanted with multiple substantially parallel lines of ions absent any lines of ions with an intersecting orientation with respect to the multiple substantially parallel lines; and

adjusting the shadow mask assembly to a second position, wherein the substrate is selectively implanted with multiple substantially parallel lines of ions and a line of ions with an intersecting orientation with respect to the multiple substantially parallel lines.

12. The method of Claim 11, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

13. The method of Claim 11, wherein the shadow mask assembly comprises:

a first exposure region having multiple elongated openings substantially parallel to a first axis; and

a second exposure region having an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure region and the second exposure region.

14. The method of Claim 13, wherein the first exposure region comprises:

a first occlusion mask having a first set of elongated openings substantially parallel to a first axis; and

a second occlusion mask having a second set of elongated openings substantially parallel to the first axis,

wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form the multiple elongated openings of the first exposure region, the multiple elongated openings of the first exposure region being smaller than each one of the elongated openings in the first set of the first occlusion mask and the second set of the second occlusion mask.

15. The method of Claim 13, further comprising flowing ions through a homogeneous exposure region of the shadow mask assembly, thereby providing a blanket homogeneous implantation of the substrate from the ions.

16. The method of Claim 11, further comprising:

a substrate holder moving the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller adjusting the velocity to a first level for the first position and to a second level for the second position.

17. The method of Claim 16, wherein the second level is a lower velocity than the first level.

18. The method of Claim 16, wherein the moveable substrate holder rotates the substrate through the path of the ions passing through the shadow mask assembly.

19. The method of Claim 18, wherein the shadow mask assembly comprises:

a first exposure member having multiple elongated openings substantially parallel to a first axis, wherein the length of the multiple elongated openings is greater the farther away they are from the point of rotation about which the substrate is rotated; and

a second exposure member having an elongated opening configured in an intersecting orientation relative to the first axis, wherein the elongated opening gets wider as it extends away from the point of rotation about which the substrate is rotated,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure member and the second exposure member.

20. The method of Claim 19, wherein the multiple elongated openings are curved.

21. The method of Claim 11, wherein the ions are flown through the shadow mask assembly to the substrate from an ion source, the ion source comprising at least two different ion species having different masses and doping types.

22. The method of Claim 11, further comprising applying a voltage selectively to spaced apart regions on a side of the substrate opposite the shadow mask assembly, wherein the selective application of voltage promotes the selective implantation of ions.

23. The method of Claim 11, wherein the shadow mask assembly is part of a first grid assembly, the first grid assembly comprising a first grid plate and a second grid plate, each grid plate of the first grid assembly having a plurality of apertures configured to allow ions to pass therethrough, the first grid plate of the first grid assembly being positively biased by a power supply, the second grid plate of the first grid assembly being negatively biased by the power supply, the method comprising the ions flowing through the first grid assembly for selective implantation of the substrate.

24. The method of Claim 23, wherein a second grid plate is coupled to the first grid assembly via a voltage divider, the second grid assembly comprising a first grid plate and a second grid plate, each grid plate of the second grid assembly having a plurality of apertures configured to allow ions to pass therethrough, the first grid plate of the second grid assembly being positively biased by the power supply, the second grid plate of the second grid assembly being negatively biased by the power supply, the method comprising the ions flowing through the second grid assembly for implantation of the substrate.

25. A shadow mask implantation system comprising:

an ion source configured to provide ions;

a first occlusion mask having a first set of elongated openings substantially parallel to a first axis; and

a second occlusion mask having a second set of elongated openings substantially parallel to the first axis,

wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form a resulting set of elongated openings through which ions from the ion source are selectively allowed to pass therethrough to a substrate where they are implanted, each elongated opening of the resulting set being smaller than each elongated opening of the first and second sets.

26. The system of Claim 25, wherein the thickness of each elongated opening of the resulting set is equal to or less than half the thickness of each elongated opening of the first and second sets.

27. The system of Claim 25, wherein the thickness of each elongated opening of the resulting set is equal to or less than 50 microns.

28. The system of Claim 25, further comprising a shadow mask assembly having a first exposure region and a second exposure region, wherein:

the first occlusion mask and the second occlusion mask form the first exposure region comprising the resulting set of elongated openings substantially parallel to the first axis;

the second exposure region has an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis;

the shadow mask assembly is configured to adjust between a first position and a second position by adjusting the distance between the first exposure region and the second exposure region;

the shadow mask assembly enables ion implantation of multiple substantially parallel lines absent any lines with an intersecting orientation with respect to the multiple substantially parallel lines when set in the first position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings; and

the shadow mask assembly enables ion implantation of multiple substantially parallel lines and a line with an intersecting orientation with respect to the multiple substantially parallel lines when set in the second position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings.

29. The system of Claim 28, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

30. The system of Claim 28, further comprising:

a moveable substrate holder configured to move the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller operationally coupled to the moveable substrate holder, wherein the controller is configured to adjust the velocity to a first level for the first position and to a second level for the second position, the second level being a lower velocity than the first level.

31. A method of ion implantation comprising:

flowing ions through a shadow mask assembly to a substrate, wherein the shadow mask assembly comprises a first occlusion mask having a first set of elongated openings substantially parallel to a first axis and a second occlusion mask having a second set of elongated openings substantially parallel to the first axis, wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form a resulting set of elongated openings through which ions from the ion source are selectively allowed to pass therethrough to the substrate, each elongated opening of the resulting set being smaller than each elongated opening of the first and second sets; and

implanting the ions into the substrate, thereby forming multiple substantially parallel lines of ion implantations corresponding to the resulting set of elongated openings.

32. The method of Claim 31, wherein the thickness of each elongated opening of the resulting set is equal to or less than half the thickness of each elongated opening of the first and second sets.

33. The method of Claim 31, wherein the thickness of each elongated opening of the resulting set is equal to or less than 50 microns.

34. The method of Claim 31, wherein:

a shadow mask assembly has a first exposure region and a second exposure region;

the first occlusion mask and the second occlusion mask form the first exposure region comprising the resulting set of elongated openings substantially parallel to the first axis;

the second exposure region has an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis;

the shadow mask assembly is configured to adjust between a first position and a second position by adjusting the distance between the first exposure region and the second exposure region;

the shadow mask assembly enables ion implantation of multiple substantially parallel lines absent any lines with an intersecting orientation with respect to the multiple substantially parallel lines when set in the first position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings; and

the shadow mask assembly enables ion implantation of multiple substantially parallel lines and a line with an intersecting orientation with respect to the multiple substantially parallel lines when set in the second position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings.

35. The method of Claim 34, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

36. The method of Claim 34, further comprising:

a moveable substrate holder moving the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller adjusting the velocity to a first level for the first position and to a second level for the second position, the second level being a lower velocity than the first level.

CLAIMS:

1. An adjustable shadow mask implantation system comprising:

an ion source configured to provide ions; and

an shadow mask assembly configured to selectively allow ions from the ion source to pass therethrough to a substrate where they are implanted, wherein the shadow mask assembly is configured to adjust between a first position and a second position,

wherein the shadow mask assembly enables ion implantation of multiple substantially parallel lines absent any lines with an intersecting orientation with respect to the multiple substantially parallel lines when set in the first position, and

wherein the shadow mask assembly enables ion implantation of multiple substantially parallel lines and a line with an intersecting orientation with respect to the multiple substantially parallel lines when set in the second position.

2. The system of claim 1, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

3. The system of claim 1, wherein the shadow mask assembly comprises:

a first exposure region having multiple elongated openings substantially parallel to a first axis; and

a second exposure region having an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure region and the second exposure region.

4. The system of claim 3, wherein the first exposure region comprises:

a first occlusion mask having a first set of elongated openings substantially parallel to a first axis; and

a second occlusion mask having a second set of elongated openings substantially parallel to the first axis,

wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form the multiple elongated openings of the first exposure region, the multiple elongated openings of the first exposure region being smaller than each one of the elongated openings in the first set of the first occlusion mask and the second set of the second occlusion mask.

5. The system of claim 3, wherein the shadow mask assembly further comprises a homogeneous exposure region configured to enable a blanket homogeneous implantation of the substrate from the ions.

6. The system of claim 1, further comprising:

a moveable substrate holder configured to move the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller operationally coupled to the moveable substrate holder, wherein the controller is configured to adjust the velocity to a first level for the first position and to a second level for the second position.

7. The system of claim 6, wherein the second level is a lower velocity than the first level.

8. The system of claim 6, wherein the moveable substrate holder is configured to rotate the substrate through the path of the ions passing through the shadow mask assembly.

9. The system of claim 8, wherein the shadow mask assembly comprises:

a first exposure member having multiple elongated openings substantially parallel to a first axis, wherein the length of the multiple elongated openings is greater the farther away they are from the point of rotation about which the substrate is rotated; and

a second exposure member having an elongated opening configured in an intersecting orientation relative to the first axis, wherein the elongated opening gets wider as it extends away from the point of rotation about which the substrate is rotated,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure member and the second exposure member.

10. The system of claim 9, wherein the multiple elongated openings are curved.

11. A method of ion implantation comprising:

flowing ions through a shadow mask assembly to a substrate;

adjusting the shadow mask assembly to a first position, wherein the substrate is selectively implanted with multiple substantially parallel lines of ions absent any lines of ions with an intersecting orientation with respect to the multiple substantially parallel lines; and

adjusting the shadow mask assembly to a second position, wherein the substrate is selectively implanted with multiple substantially parallel lines of ions and a line of ions with an intersecting orientation with respect to the multiple substantially parallel lines.

12. The method of claim 11, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

13. The method of claim 11, wherein the shadow mask assembly comprises:

a first exposure region having multiple elongated openings substantially parallel to a first axis; and

a second exposure region having an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure region and the second exposure region.

14. The method of claim 13, wherein the first exposure region comprises:

a first occlusion mask having a first set of elongated openings substantially parallel to a first axis; and

a second occlusion mask having a second set of elongated openings substantially parallel to the first axis,

wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form the multiple elongated openings of the first exposure region, the multiple elongated openings of the first exposure region being smaller than each one of the elongated openings in the first set of the first occlusion mask and the second set of the second occlusion mask.

15. The method of claim 13, further comprising flowing ions through a homogeneous exposure region of the shadow mask assembly, thereby providing a blanket homogeneous implantation of the substrate from the ions.

16. The method of claim 11, further comprising:

a substrate holder moving the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller adjusting the velocity to a first level for the first position and to a second level for the second position.

17. The method of claim 16, wherein the second level is a lower velocity than the first level.

18. The method of claim 16, wherein the moveable substrate holder rotates the substrate through the path of the ions passing through the shadow mask assembly.

19. The method of claim 18, wherein the shadow mask assembly comprises:

a first exposure member having multiple elongated openings substantially parallel to a first axis, wherein the length of the multiple elongated openings is greater the farther away they are from the point of rotation about which the substrate is rotated; and

a second exposure member having an elongated opening configured in an intersecting orientation relative to the first axis, wherein the elongated opening gets wider as it extends away from the point of rotation about which the substrate is rotated,

wherein the shadow mask assembly is configured to adjust between the first position and the second position by adjusting the distance between the first exposure member and the second exposure member.

20. The method of claim 19, wherein the multiple elongated openings are curved.

21. The method of claim 11, wherein the ions are flown through the shadow mask assembly to the substrate from an ion source, the ion source comprising at least two different ion species having different masses and doping types.

22. The method of claim 11, further comprising applying a voltage selectively to spaced apart regions on a side of the substrate opposite the shadow mask assembly, wherein the selective application of voltage promotes the selective implantation of ions.

23. The method of claim 11, wherein the shadow mask assembly is part of a first grid assembly, the first grid assembly comprising a first grid plate and a second grid plate, each grid plate of the first grid assembly having a plurality of apertures configured to allow ions to pass therethrough, the first grid plate of the first grid assembly being positively biased by a power supply, the second grid plate of the first grid assembly being negatively biased by the power supply, the method comprising the ions flowing through the first grid assembly for selective implantation of the substrate.

24. The method of claim 23, wherein a second grid plate is coupled to the first grid assembly via a voltage divider, the second grid assembly comprising a first grid plate and a second grid plate, each grid plate of the second grid assembly having a plurality of apertures configured to allow ions to pass therethrough, the first grid plate of the second grid assembly being positively biased by the power supply, the second grid plate of the second grid assembly being negatively biased by the power supply, the method comprising the ions flowing through the second grid assembly for implantation of the substrate.

25. A shadow mask implantation system comprising:

an ion source configured to provide ions;

a first occlusion mask having a first set of elongated openings substantially parallel to a first axis; and

a second occlusion mask having a second set of elongated openings substantially parallel to the first axis,

wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form a resulting set of elongated openings through which ions from the ion source are selectively allowed to pass therethrough to a substrate where they are implanted, each elongated opening of the resulting set being smaller than each elongated opening of the first and second sets; and further comprising a shadow mask assembly having a first exposure region and a second exposure region, wherein:

the first occlusion mask and the second occlusion mask form the first exposure region comprising the resulting set of elongated openings substantially parallel to the first axis;

the second exposure region has an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis;

the shadow mask assembly is configured to adjust between a first position and a second position by adjusting the distance between the first exposure region and the second exposure region;

the shadow mask assembly enables ion implantation of multiple substantially parallel lines absent any lines with an intersecting orientation with respect to the multiple substantially parallel lines when set in the first position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings; and

the shadow mask assembly enables ion implantation of multiple substantially parallel lines and a line with an intersecting orientation with respect to the multiple substantially parallel lines when set in the second position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings.

26. The system of claim 25, wherein the thickness of each elongated opening of the resulting set is equal to or less than half the thickness of each elongated opening of the first and second sets.

27. The system of claim 25, wherein the thickness of each elongated opening of the resulting set is equal to or less than 50 microns.

28. The system of claim 25, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

29. The system of claim 25, further comprising:

a moveable substrate holder configured to move the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller operationally coupled to the moveable substrate holder, wherein the controller is configured to adjust the velocity to a first level for the first position and to a second level for the second position, the second level being a lower velocity than the first level.

30. A method of ion implantation comprising:

flowing ions through a shadow mask assembly to a substrate, wherein the shadow mask assembly comprises a first occlusion mask having a first set of elongated openings substantially parallel to a first axis and a second occlusion mask having a second set of elongated openings substantially parallel to the first axis, wherein the first occlusion mask and the second occlusion mask are configured such that the first set of elongated openings overlap with, but are offset from, the second set of elongated openings to form a resulting set of elongated openings through which ions from the ion source are selectively allowed to pass therethrough to the substrate, each elongated opening of the resulting set being smaller than each elongated opening of the first and second sets; and

implanting the ions into the substrate, thereby forming multiple substantially parallel lines of ion implantations corresponding to the resulting set of elongated openings; wherein:

a shadow mask assembly has a first exposure region and a second exposure region;

the first occlusion mask and the second occlusion mask form the first exposure region comprising the resulting set of elongated openings substantially parallel to the first axis;

the second exposure region has an elongated opening substantially parallel to a second axis, wherein the second axis is substantially perpendicular to the first axis;

the shadow mask assembly is configured to adjust between a first position and a second position by adjusting the distance between the first exposure region and the second exposure region;

the shadow mask assembly enables ion implantation of multiple substantially parallel lines absent any lines with an intersecting orientation with respect to the multiple substantially

parallel lines when set in the first position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings; and

the shadow mask assembly enables ion implantation of multiple substantially parallel lines and a line with an intersecting orientation with respect to the multiple substantially parallel lines when set in the second position, the multiple substantially parallel lines corresponding to the resulting set of elongated openings.

31. The method of claim 30, wherein the thickness of each elongated opening of the resulting set is equal to or less than half the thickness of each elongated opening of the first and second sets.

32. The method of claim 30, wherein the thickness of each elongated opening of the resulting set is equal to or less than 50 microns.

33. The method of claim 30, wherein the multiple parallel lines are substantially perpendicular to the line with the intersecting orientation.

34. The method of claim 30, further comprising:

a moveable substrate holder moving the substrate at a velocity through the path of the ions passing through the shadow mask assembly; and

a controller adjusting the velocity to a first level for the first position and to a second level for the second position, the second level being a lower velocity than the first level.