CLAIMS

What is claimed is:

1. A method for processing a substrate, comprising:

placing a substrate in a bevel processing chamber;

providing a passivation plasma confined in a peripheral region of the bevel processing chamber;

forming, using the passivation plasma, a passivation layer on the substrate only around a bevel region of the substrate; ~~and~~

stopping the passivation plasma;

providing a patterning plasma formed in an outer peripheral region of the processing chamber, by increasing plasma confinement such that the patterning plasma is formed in the outer peripheral region farther from a center of the substrate;

patterning the passivation layer using the patterning plasma, by removing the passivation layer on an outer edge portion of the bevel region, while maintaining the passivation layer on an inner portion of the bevel region;

stopping the patterning plasma;

cleaning the bevel edge of the substrate using the patterned passivation layer as a protective mask; and

removing the remaining passivation layer.

~~2. The method according to claim 1, wherein the passivation layer is a polymer film or an inorganic film.~~

~~3~~2. The method according to claim 1, wherein said providing the ~~passivation~~ patterning plasma ~~comprises~~ includes:

flowing a ~~passivation~~ patterning gas to the outer peripheral region;

generating the ~~passivation~~ patterning plasma from the ~~passivation~~ patterning gas; and

confining the ~~passivation~~ patterning plasma to the outer peripheral region.

~~4~~3. The method according to claim ~~3~~ 1, wherein said bevel processing chamber comprises:

a substrate support receiving the substrate, the substrate support having a diameter smaller than a diameter of the substrate;

a gas distribution plate opposing the substrate support;

a bottom edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a backside of the substrate;

a top edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a frontside of the substrate;

a bottom edge electrode surrounding the substrate support and electrically isolated therefrom; and

a top edge electrode opposing the bottom edge electrode, the top edge electrode surrounding the gas distribution plate and electrically isolated therefrom,

wherein said ~~confining~~ increasing the ~~passivation~~ plasma confinement includes at least one of:

~~controlling~~ reducing a distance between the gas distribution plate and a surface of the substrate facing the distribution plate; and

controlling the outer diameter of the top and bottom edge confinement ~~ceramic~~ rings,

and wherein the ~~passivation~~ patterning plasma is generated between the bottom edge electrode and the top edge electrode by providing an RF power.

~~5. The method according to any one of claims 1-4, further comprising:~~

~~processing the substrate with a subsequent process, the bevel edge region of the substrate being protected by the passivation layer during the subsequent process; and~~

~~removing the passivation layer.~~

~~6. The method according to any one of claims 1-4, further comprising:~~

~~providing a patterning plasma formed in an outer peripheral region of the processing chamber, by increasing plasma confinement such that the patterning plasma is formed in the outer peripheral region farther from a center of the substrate;~~

~~patterning the passivation layer using the patterning plasma, by removing the passivation layer on an outer edge portion of the bevel region, while maintaining the passivation layer on an inner portion of the bevel region;~~

~~stopping the patterning plasma;~~

~~cleaning the bevel edge of the substrate using the patterned passivation layer as a protective mask; and~~

~~removing the remaining passivation layer.~~

~~7. The method according to claim 6, wherein said providing the patterning plasma includes:~~

~~flowing a patterning gas to the outer peripheral region;~~

~~generating the pattering plasma from the patterning gas; and~~

~~confining the patterning plasma to the outer peripheral region.~~

~~8. The method according to claim 6, wherein said bevel processing chamber comprises:~~

~~a substrate support receiving the substrate, the substrate support having a diameter smaller than a diameter of the substrate;~~

~~a gas distribution plate opposing the substrate support;~~

~~a bottom edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a backside of the substrate;~~

~~a top edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a frontside of the substrate;~~

~~a bottom edge electrode surrounding the substrate support and electrically isolated therefrom; and~~

~~a top edge electrode opposing the bottom edge electrode, the top edge electrode surrounding the gas distribution plate and electrically isolated therefrom,~~

~~wherein said increasing the plasma confinement includes at least one of:~~

~~reducing a distance between the gas distribution plate and a surface of the substrate facing the distribution plate; and~~

~~controlling the outer diameter of the top and bottom edge confinement ceramic rings,~~

~~and wherein the patterning plasma is generated between the bottom edge electrode and the top edge electrode by providing an RF power.~~

~~9~~4. The method according to claim ~~6~~ 1, wherein said patterning exposes an underlying layer below the passivation layer in the outer edge portion, said cleaning the bevel edge including:

removing the exposed underlying layer made of an oxide film from the outer edge portion.

~~10~~5. The method according to claim ~~6~~ 1, wherein said cleaning the bevel edge includes:

providing a bevel edge cleaning plasma in the bevel processing chamber; cleaning the outer edge portion of the substrate using the bevel edge cleaning plasma; and

stopping the bevel edge cleaning plasma.

~~16~~ 15. The method according to claim ~~10~~ 5, wherein said providing the bevel edge cleaning plasma includes:

flowing a cleaning gas to the peripheral region; and

generating the bevel edge cleaning plasma from the cleaning gas by providing an RF power.

~~17~~ 16. The method according to claim ~~6~~ 1, wherein said removing the remaining passivation layer includes:

providing a stripping plasma by reducing the plasma confinement in the bevel processing chamber such that the stripping plasma extends toward the center of the substrate to cover the remaining passivation layer;

stripping the remaining passivation layer using the stripping plasma; and

~~stopping the stripping plasma.~~

~~18~~ 17. A method for cleaning a bevel edge of a substrate, comprising:

placing a substrate in a bevel processing chamber, the substrate having an existing passivation layer formed thereon;

providing a patterning plasma formed in an outer peripheral region of the bevel processing chamber;

patterning the passivation layer using the patterning plasma, by removing the passivation layer on an outer edge portion of the bevel region of the substrate, while maintaining the passivation layer on an inner portion of the bevel region;

stopping the patterning plasma;

cleaning the bevel edge of the substrate using the patterned passivation layer as a protective mask; and

removing the remaining passivation layer.

~~19~~ 18. The method according to claim ~~13~~ 8, wherein said providing the patterning plasma includes:

flowing a patterning gas to the outer peripheral region;

generating the patterning plasma from the patterning gas; and

confining the patterning plasma to the outer peripheral region.

~~15~~10. The method according to claim ~~14~~ 9, wherein said bevel processing chamber comprises:

a substrate support receiving the substrate, the substrate support having a diameter smaller than a diameter of the substrate;

a gas distribution plate opposing the substrate support;

a bottom edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a backside of the substrate;

a top edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a frontside of the substrate;

a bottom edge electrode surrounding the substrate support and electrically isolated therefrom; and

a top edge electrode opposing the bottom edge electrode, the top edge electrode surrounding the gas distribution plate and electrically isolated therefrom,

wherein said confining the pattering plasma includes at least one of:

controlling a distance between the gas distribution plate and a surface of the substrate facing the distribution plate; and

controlling the outer diameter of the top and bottom edge confinement ~~ceramic~~ rings,

and wherein the patterning plasma is generate between the bottom edge electrode and the top edge electrode by providing an RF power.

~~16~~11. The method according to claim ~~14 or 15~~ 9, wherein said cleaning the bevel edge includes:

flowing a cleaning gas to the peripheral region in the bevel processing chamber;

generating a bevel edge cleaning plasma from the cleaning gas;

cleaning the outer edge portion of the substrate using the bevel edge cleaning plasma; and

stopping the bevel edge cleaning plasma.

~~17~~12. The method according to claim ~~16~~ 11, wherein said bevel processing chamber comprises:

a substrate support receiving the substrate, the substrate support having a diameter smaller than a diameter of the substrate;

a bottom edge electrode surrounding the substrate support and electrically isolated therefrom;

a gas distribution plate opposing the substrate support; and

a top edge electrode opposing the bottom edge electrode, the top electrode surrounding the gas distribution plate and electrically isolated therefrom,

wherein the cleaning gasgas is provided through a gap between the gas distribution plate and a surface of the substrate facing the distribution plate,

and wherein the cleaning plasma is generate between the bottom edge electrode and the top edge electrode by providing an RF power.

~~18. An apparatus for processing a bevel edge of a substrate, comprising:~~

~~a bevel processing chamber, comprising:~~

~~a chamber wall forming a bevel processing chamber enclosure;~~

~~a substrate support for supporting a substrate within the bevel processing chamber enclosure, wherein the substrate support has a diameter smaller than a diameter of the substrate;~~

~~a gas inlet for providing gas into the bevel processing chamber enclosure;~~

~~a gas distribution plate coupled to the gas inlet, the gas distribution plate opposing the substrate support;~~

~~at least one electrode for providing power to the bevel processing chamber enclosure for sustaining a plasma, including:~~

~~a bottom edge electrode surrounding the substrate support and electrically isolated therefrom; and~~

~~a top edge electrode opposing the bottom edge electrode, the top electrode surrounding the gas distribution plate and electrically isolated therefrom;~~

~~a pressure regulator for regulating the pressure in the bevel processing chamber enclosure; and~~

~~a gas outlet for exhausting gas from the bevel processing chamber enclosure;~~

~~a gas source in fluid connection with the gas inlet, comprising at least a passivation gas source;~~

a controller controllably connected to the gas source and the at least one electrode, comprising:

at least one processor; and

computer readable media comprising:

computer readable code for generating a passivation plasma from a passivation gas;

computer readable code for confining the passivation plasma to
a peripheral region of the bevel processing chamber;

computer readable code for forming, using the passivation plasma, a passivation layer on the substrate around a bevel region of the waver; and

computer readable code for stopping the passivation plasma.

19. The apparatus according to claim 18, wherein the gas source further comprises a patterning gas source and a cleaning gas source,

and wherein the computer readable media further comprises:

computer readable code for generating a patterning plasma from a patterning gas;

computer readable code for forming the patterning plasma in an outer peripheral region of the processing chamber, by increasing plasma confinement such that the patterning plasma is formed in the outer peripheral region farther from a center of the substrate;

computer readable code for patterning the passivation layer using the patterning plasma, by removing the passivation layer from an outer edge portion of the bevel region, while maintaining the passivation layer on an inner portion of the bevel region;

computer readable code for stopping the patterning plasma; and

computer readable code for cleaning the bevel edge of the substrate using the patterned passivation layer as a protective mask.

20. The apparatus according to claim 19, wherein the gas source further comprises
a stripping gas source,

and wherein the computer readable media further comprises:

~~computer readable code for generating a stripping plasma from a stripping gas, by reducing the plasma confinement such that the stripping plasma extends toward the center of the substrate to cover the remaining passivation layer;~~

~~computer readable code for stripping the remaining passivation layer using the stripping plasma; and~~

~~computer readable code for stopping the stripping plasma.~~

~~21. The method according to claim 1 or 2, wherein said providing the passivation plasma comprises:~~

~~flowing a passivation gas to the peripheral region;~~

~~generating the passivation plasma from the passivation gas; and~~

~~confining the passivation plasma to the peripheral region.~~

~~22. The method according to claim 21, wherein said bevel processing chamber comprises:~~

~~a substrate support receiving the substrate, the substrate support having~~

~~a diameter smaller than a diameter of the substrate;~~

~~a gas distribution plate opposing the substrate support;~~

~~a bottom edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a backside of the substrate;~~

~~a top edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a frontside of the substrate;~~

~~a bottom edge electrode surrounding the substrate support and electrically isolated therefrom; and~~

~~a top edge electrode opposing the bottom edge electrode, the top edge electrode surrounding the gas distribution plate and electrically isolated therefrom,~~

~~wherein said confining the passivation plasma includes at least one of:~~

~~controlling a distance between the gas distribution plate and a surface of the substrate facing the distribution plate; and~~

~~controlling the outer diameter of the top and bottom edge confinement ceramic rings,~~

~~and wherein the passivation plasma is generated between the bottom edge electrode and the top edge electrode by providing an RF power.~~

23. The method according to any one of claims 1-2 and 21-22, further comprising: processing the substrate with a subsequent process, the bevel edge region of
the substrate being protected by the passivation layer during the subsequent process; and

removing the passivation layer.

24. The method according to any one of claims 1-2 and 22-23, further comprising: providing a patterning plasma formed in an outer peripheral region of the processing chamber, by increasing plasma confinement such that the patterning plasma is formed in the outer peripheral region farther from a center of the substrate;

patterning the passivation layer using the patterning plasma, by removing the passivation layer on an outer edge portion of the bevel region, while maintaining the passivation layer on an inner portion of the bevel region;

stopping the patterning plasma;

cleaning the bevel edge of the substrate using the patterned passivation layer as a protective mask; and

removing the remaining passivation layer.

25. The method according to claim 24, wherein said providing the patterning plasma includes:

flowing a patterning gas to the outer peripheral region;

generating the pattering plasma from the patterning gas; and

confining the patterning plasma to the outer peripheral region.

26. The method according to claim 24 or 25, wherein said bevel processing chamber comprises:

a substrate support receiving the substrate, the substrate support having
a diameter smaller than a diameter of the substrate;

a gas distribution plate opposing the substrate support;

a bottom edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a backside of the substrate;

a top edge confinement ring with a varying outer diameter to control the physical confinement of the plasma on a frontside of the substrate;

a bottom edge electrode surrounding the substrate support and electrically isolated therefrom; and

a top edge electrode opposing the bottom edge electrode, the top edge electrode surrounding the gas distribution plate and electrically isolated therefrom,

wherein said increasing the plasma confinement includes at least one of:

reducing a distance between the gas distribution plate and a surface of the substrate facing the distribution plate; and

controlling the outer diameter of the top and bottom edge confinement ceramic rings,

and wherein the patterning plasma is generated between the bottom edge electrode and the top edge electrode by providing an RF power.

27. The method according to any one of claims 24-26, wherein said patterning exposes an underlying layer below the passivation layer in the outer edge portion, said cleaning the bevel edge including:

removing the exposed underlying layer made of an oxide film from the outer edge portion.

28. The method according to any one of claims 24-27, wherein said cleaning the bevel edge includes:

providing a bevel edge cleaning plasma in the bevel processing chamber;

cleaning the outer edge portion of the substrate using the bevel edge cleaning plasma; and

stopping the bevel edge cleaning plasma.

29. The method according to claim 28, wherein said providing the bevel edge cleaning plasma includes:

flowing a cleaning gas to the peripheral region; and

generating the bevel edge cleaning plasma from the cleaning gas by providing an RF power.

30. The method according to any one of claims 24-29, wherein said removing the remaining passivation layer includes:

providing a stripping plasma by reducing the plasma confinement in the bevel processing chamber such that the stripping plasma extends toward the center of the substrate to cover the remaining passivation layer;

~~stripping the remaining passivation layer using the stripping plasma; and~~

~~stopping the stripping plasma.~~