Claims:

1 An upper reflector assembly for use in a process chamber, comprising:

a reflector mounting ring; and

upper reflector plate coupled to the reflector mounting ring and having an upper surface and lower surface, wherein the lower surface includes a plurality of linear channels extending substantially parallel to each other across the lower surface, and wherein the upper reflector plate includes air cooling slots extending from the upper surface to the lower surface.

2. The upper reflector assembly of claim 1, wherein the air cooling slots includes a plurality of first slots configured direct a stream of air towards a plurality of linear heating lamps and a plurality of second slots configured direct a stream of air towards an upper dome of the process chamber.

3. The upper reflector assembly of claim 2, wherein the plurality of first slots extend at an angle less than 90 degrees with respect to the upper surface of the upper reflector plate 224.

4. The upper reflector assembly of claim 1, wherein the upper surface includes a plurality of coolant channels.

5. The upper reflector assembly of claim 1, wherein the plurality of linear channels have different cross-sectional shapes.

6. The upper reflector assembly of claim 1, wherein the plurality of linear channels have at least one of a U-shaped cross section, a V-shaped cross section, an elliptical cross section, a parabolic cross section, or a rectangular cross section.

7. The upper reflector assembly of claim 1, further comprising an inner housing coupled to the reflector mounting ring and a top plate coupled to the inner housing,

wherein the top plate includes an air inlet configured to facilitate a flow of air through the inner housing and through the air cooling slots.

8. The upper reflector assembly of claim 7, further comprising one or more flow turning vanes disposed between the top plate and the upper reflector plate to direct the flow of air from the air inlet to various zones of the upper reflector plate.

9. An upper lamp module, comprising:

an upper reflector assembly including a reflector mounting ring coupled to an upper reflector plate having an upper surface and lower surface, wherein the lower surface includes a plurality of linear channels extending substantially parallel to each other across the lower surface, and wherein the upper reflector plate includes air cooling slots extending from the upper surface to the lower surface; and

a shroud assembly including an outer housing coupled to a lamp mounting ring and a plurality of linear heating lamps coupled to the lamp mounting ring, wherein the lamp mounting ring is removably coupled to the reflector mounting ring, and wherein the plurality of linear heating lamps extend within the plurality of linear channels to reflect heat off of sidewalls of the plurality of linear channels.

10. The upper lamp module of claim 9, wherein the lamp mounting ring includes alignment pins configured to extend through openings in the reflector mounting ring to align and removably the lamp mounting ring to the reflector mounting ring.

11. The upper lamp module of claim 9, wherein each linear lamp of the plurality of linear heating lamps is coupled to the lamp mounting ring at a first end via a lamp clamping mechanism, wherein the lamp clamping mechanism includes a mounting block having a clamp rotatably coupled to the mounting block, wherein an upper surface of the mounting block is contoured to position each linear lamp.

12. The upper lamp module of claim 11, further comprising a rear block having a slot disposed in the mounting block, wherein the first end of the linear lamp is

disposed in the slot to prevent rotational movement of the linear lamp with respect to the mounting block.

13. The upper lamp module of claim 9, wherein the upper reflector assembly includes a top plate having an air inlet and the shroud assembly includes an exhaust port, and wherein the upper reflector assembly and the shroud assembly are configured to flow air from the air inlet to the exhaust port via the air cooling slots of the upper reflector plate.

14. The upper lamp module of claim 9, wherein the upper reflector plate includes an opening therethrough covered with a transparent window and the upper reflector assembly includes a temperature sensor configured to measure a temperature through the transparent window or includes a laser configured to transmit photon energy through the transparent window.

15. An epitaxial deposition chamber, comprising:

a chamber body coupled to an upper dome and a lower dome to define a processing volume of the epitaxial deposition chamber;

a support pedestal disposed in the processing volume to support a substrate;

an upper reflector plate coupled to the chamber body above the upper dome and having an upper surface and lower surface, wherein the lower surface includes a plurality of linear channels extending substantially parallel to each other across the lower surface, and wherein the upper reflector plate includes air cooling slots extending from the upper surface to the lower surface; and

a shroud assembly including a lamp mounting ring and a plurality of linear heating lamps coupled to the lamp mounting ring, wherein the plurality of linear heating lamps extend within the plurality of linear channels to reflect heat off of sidewalls of the plurality of linear channels towards the upper dome.

16. The epitaxial deposition chamber of claim 15, wherein the plurality of linear heating lamps are disposed about 25.0 to about 150.0 mm away from the upper dome.

~~17. The epitaxial deposition chamber of claim 15, wherein the upper surface of the upper reflector plate includes a plurality of coolant channels and a cooling tube is disposed in the plurality of coolant channels to circulate a coolant therethrough.~~

~~18. The epitaxial deposition chamber of claim 15, wherein the air cooling slots include a plurality of first slots configured to cool the plurality of linear heating lamps and a plurality of second slots configured to cool the upper dome of the epitaxial deposition chamber.~~

~~19. The epitaxial deposition chamber of claim 15, wherein the upper reflector plate includes an opening therethrough covered with a transparent window and a temperature sensor is mounted to an upper portion of the epitaxial deposition chamber to measure a temperature of at least one of the upper dome or a substrate disposed on the support pedestal through the transparent window.~~

~~20. The epitaxial deposition chamber of claim 19, wherein the transparent window is made of quartz or calcium fluoride (CaF2).~~

AMENDED CLAIMS
received by the International Bureau on 23 Mars 2021 (23.03.2021)

Claims

[Claim 1] An upper reflector assembly for use in a process chamber, comprising:
an upper reflector plate comprising:
an upper surface;
a lower surface;
a plurality of linear channels extending substantially parallel to each other across the lower surface; and
a plurality of air cooling slots extending from the upper surface to the lower surface, the plurality of air cooling slots comprising a plurality of first slots and a plurality of second slots, the plurality of first slots having a smaller depth than the plurality of second slots.

[Claim 2] The upper reflector assembly of claim 1, wherein the plurality of second slots extend orthogonal to the upper surface.

[Claim 3] The upper reflector assembly of claim 1, wherein the plurality of first slots extend at an angle less than 90 degrees with respect to the upper surface of the upper reflector plate.

[Claim 4] The upper reflector assembly of claim 1, wherein the upper surface includes a plurality of coolant channels.

[Claim 5] The upper reflector assembly of claim 1, wherein the plurality of linear channels have different cross-sectional shapes.

[Claim 6] The upper reflector assembly of claim 1, wherein the plurality of linear channels have at least one of a U-shaped cross section, a V-shaped cross section, an elliptical cross section, a parabolic cross section, or a rectangular cross section.

[Claim 7] The upper reflector assembly of claim 1, further comprising a reflector mounting ring coupled to the upper reflector plate and an inner housing coupled to the reflector mounting ring and a top plate coupled to the inner housing, wherein the top plate includes an air inlet configured to facilitate a flow of air through the inner housing and through the air cooling slots.

[Claim 8] The upper reflector assembly of claim 7, further comprising one or more flow turning vanes disposed between the top plate and the upper reflector plate to direct the flow of air from the air inlet to various zones of the upper reflector plate.

[Claim 9] An upper lamp module, comprising:
an upper reflector assembly including a reflector mounting ring coupled to an upper reflector plate having an upper surface and lower surface,

~~wherein the lower surface includes a plurality of linear channels extending substantially parallel to each other across the lower surface, and wherein the upper reflector plate includes air cooling slots extending from the upper surface to the lower surface; and~~

~~a shroud assembly including an outer housing coupled to a lamp mounting ring and a plurality of linear heating lamps coupled to the lamp mounting ring, wherein the lamp mounting ring is removably coupled to the reflector mounting ring, and wherein the plurality of linear heating lamps extend within the plurality of linear channels to reflect heat off of sidewalls of the plurality of linear channels.~~

~~[Claim 10]~~ ~~The upper lamp module of claim 9, wherein the lamp mounting ring includes alignment pins configured to extend through openings in the reflector mounting ring to align and removably couple the lamp mounting ring to the reflector mounting ring.~~

~~[Claim 11]~~ ~~The upper lamp module of claim 9, wherein each linear lamp of the plurality of linear heating lamps is coupled to the lamp mounting ring at a first end via a lamp clamping mechanism, wherein the lamp clamping mechanism includes a mounting block having a clamp rotatably coupled to the mounting block, wherein an upper surface of the mounting block is contoured to position each linear lamp.~~

~~[Claim 12]~~ ~~The upper lamp module of claim 11, further comprising a rear block having a slot disposed in the mounting block, wherein the first end of the linear lamp is disposed in the slot to prevent rotational movement of the linear lamp with respect to the mounting block.~~

~~[Claim 13]~~ ~~The upper lamp module of claim 9, wherein the upper reflector assembly includes a top plate having an air inlet and the shroud assembly includes an exhaust port, and wherein the upper reflector assembly and the shroud assembly are configured to flow air from the air inlet to the exhaust port via the air cooling slots of the upper reflector plate.~~

~~[Claim 14]~~ ~~The upper lamp module of claim 9, wherein the upper reflector plate includes an opening therethrough covered with a transparent window and the upper reflector assembly includes a temperature sensor configured to measure a temperature through the transparent window or includes a laser configured to transmit photon energy through the transparent window.~~

~~[Claim 15]~~ ~~An upper reflector plate for use in a process chamber, comprising:~~

~~an upper surface;~~

~~a lower surface;~~

~~a plurality of linear channels extending substantially parallel to each other across the lower surface, wherein each of the plurality of linear channels have one of a U-shaped cross section, a V-shaped cross section, an elliptical cross section, a parabolic cross section, or a rectangular cross section;~~

~~a plurality of air cooling slots extending from the upper surface to the lower surface; and~~

~~a plurality of coolant channels formed in the upper surface.~~

~~[Claim 16] The upper reflector plate of claim 15, wherein the air cooling slots include a plurality of first slots and a plurality of second slots, wherein the plurality of first slots have a smaller depth than the plurality of second slots.~~

~~[Claim 17] The upper reflector plate of claim 16, wherein the plurality of first slots extend at an angle of less than 90 degrees with respect to the upper surface.~~

~~[Claim 18] The upper reflector plate of claim 15, wherein the upper reflector plate includes an opening extending from the upper surface to the lower surface and covered with a transparent window.~~

~~[Claim 19] The upper reflector plate of claim 15, wherein one or more of the plurality of linear channels have different cross sectional shapes.~~

~~[Claim 20] The upper reflector plate of claim 15, further comprising a gold plating disposed thereon.~~

1. An upper reflector assembly for use in a process chamber, comprising:

an upper reflector plate comprising:

an upper surface;

a lower surface;

a plurality of linear channels extending substantially parallel to each other across the lower surface, wherein the plurality of linear channels have different cross-sectional shapes; and

a plurality of air cooling slots extending from the upper surface to the lower surface, the plurality of air cooling slots comprising a plurality of first slots and a plurality of second slots, the plurality of first slots having a smaller depth than the plurality of second slots.

2. The upper reflector assembly of claim 1, wherein the plurality of second slots extend orthogonal to the upper surface.

3. The upper reflector assembly of claim 1, wherein the plurality of first slots extend at an angle less than 90 degrees with respect to the upper surface.

4. The upper reflector assembly of claim 1, wherein the upper surface includes a plurality of coolant channels.

5. The upper reflector assembly of claim 1, wherein the plurality of linear channels have at least one of a U-shaped cross section, a V-shaped cross section, an elliptical cross section, a parabolic cross section, or a rectangular cross section.

6. The upper reflector assembly of claim 1, further comprising a reflector mounting ring coupled to the upper reflector plate and an inner housing coupled to the reflector mounting ring and a top plate coupled to the inner housing, wherein the top plate includes an air inlet configured to facilitate a flow of air through the inner housing and through the air cooling slots.

7. The upper reflector assembly of claim 6, further comprising one or more flow turning vanes disposed between the top plate and the upper reflector plate to direct the flow of air from the air inlet to various zones of the upper reflector plate.

8. An upper lamp module, comprising:

an upper reflector assembly including a reflector mounting ring coupled to an upper reflector plate having an upper surface and lower surface, wherein the lower surface includes a plurality of linear channels extending substantially parallel to each other across the lower surface, and wherein the upper reflector plate includes air cooling slots extending from the upper surface to the lower surface; and

a shroud assembly including an outer housing coupled to a lamp mounting ring and a plurality of linear heating lamps coupled to the lamp mounting ring, wherein the lamp mounting ring is removably coupled to the reflector mounting ring, and wherein the plurality of linear heating lamps extend within the plurality of linear channels to reflect heat off of sidewalls of the plurality of linear channels.

9. The upper lamp module of claim 8, wherein the lamp mounting ring includes alignment pins configured to extend through openings in the reflector mounting ring to align and removably couple the lamp mounting ring to the reflector mounting ring.

10. The upper lamp module of claim 8, wherein each linear lamp of the plurality of linear heating lamps is coupled to the lamp mounting ring at a first end via a lamp clamping mechanism, wherein the lamp clamping mechanism includes a mounting block having a clamp rotatably coupled to the mounting block, wherein an upper surface of the mounting block is contoured to position each linear lamp.

11. The upper lamp module of claim 10, further comprising a rear block having a slot disposed in the mounting block, wherein the first end of the linear lamp is disposed in the slot to prevent rotational movement of the linear lamp with respect to the mounting block.

12. The upper lamp module of claim 8, wherein the upper reflector assembly includes a top plate having an air inlet and the shroud assembly includes an exhaust port, and wherein the upper reflector assembly and the shroud assembly are configured to flow air from the air inlet to the exhaust port via the air cooling slots of the upper reflector plate.

13. The upper lamp module of claim 8, wherein the upper reflector plate includes an opening therethrough covered with a transparent window and the upper reflector assembly includes a temperature sensor configured to measure a temperature through the transparent window or includes a laser configured to transmit photon energy through the transparent window.

14. An upper reflector plate for use in a process chamber, comprising:

an upper surface;

a lower surface;

a plurality of linear channels extending substantially parallel to each other across the lower surface, wherein each of the plurality of linear channels have one of a U-shaped cross section, a V-shaped cross section, an elliptical cross section, a parabolic cross section, or a rectangular cross section, and one or more of the plurality of linear channels have different cross sectional shapes;

a plurality of air cooling slots extending from the upper surface to the lower surface; and

a plurality of coolant channels formed in the upper surface.

15. The upper reflector plate of claim 14, wherein the air cooling slots include a plurality of first slots and a plurality of second slots, wherein the plurality of first slots have a smaller depth than the plurality of second slots.

16. The upper reflector plate of claim 15, wherein the plurality of first slots extend at an angle of less than 90 degrees with respect to the upper surface.

17. The upper reflector plate of claim 14, wherein the upper reflector plate includes an opening extending from the upper surface to the lower surface and covered with a transparent window.

18. The upper reflector plate of claim 14, further comprising a gold plating disposed thereon.

19. An upper reflector assembly for use in a process chamber, comprising:

an upper reflector plate comprising:

an upper surface;

a lower surface;

a plurality of linear channels extending substantially parallel to each other across the lower surface; and

a plurality of air cooling slots extending from the upper surface to the lower surface, the plurality of air cooling slots comprising a plurality of first slots and a plurality of second slots, the plurality of first slots having a smaller depth than the plurality of second slots, wherein the plurality of first slots extend at an angle less than 90 degrees with respect to the upper surface.

20. An upper reflector plate for use in a process chamber, comprising:

an upper surface;

a lower surface;

a plurality of linear channels extending substantially parallel to each other across the lower surface, wherein each of the plurality of linear channels have one of a U-shaped cross section, a V-shaped cross section, an elliptical cross section, a parabolic cross section, or a rectangular cross section;

a plurality of air cooling slots extending from the upper surface to the lower surface, wherein the plurality of air cooling slots include a plurality of first slots extending at an angle of less than 90 degrees with respect to the upper surface; and

a plurality of coolant channels formed in the upper surface.

21. The upper reflector plate of claim 20, wherein the plurality of air cooling slots include a plurality of second slots, wherein the plurality of first slots have a smaller depth than the plurality of second slots.