

Claims

1. A substrate processing apparatus, comprising:
 - an inner chamber formed by an upper portion and a lower portion;
 - 5 a substrate support to support a substrate within the upper portion of the inner chamber;
 - a plasma system to provide the inner chamber with plasma species from the top side of the inner chamber
 - an outer chamber surrounding the upper portion of the inner chamber
 - 10 whereas the lower portion of the inner chamber extends to the outside of the outer chamber and remains uncovered by the outer chamber.
2. The apparatus of claim 1, comprising:
 - 15 a heater in the outer portion to heat the upper portion of the inner chamber.
3. The apparatus of claim 1 or 2, comprising:
 - heat reflectors in the outer chamber.
4. The apparatus of any preceding claim, wherein the plasma system is configured to provide the inner chamber with two different plasma species entering the inner chamber via a top part of the upper portion of the inner chamber.
- 20 5. The apparatus of any preceding claim, comprising:
 - a movable lid system.
- 25 6. The apparatus of claim 5, comprising:
 - a feedthrough of at least one in-feed line in the lid system.
7. The apparatus of claim 5 or 6, wherein the plasma system comprises:
 - 30 a plasma applicator in the movable lid system.
8. The apparatus of any preceding claim, wherein the plasma system comprises a microwave plasma generator and/or a hollow cathode plasma generator.

9. The apparatus of any preceding claim, wherein the inner chamber comprises a reaction chamber bowl.
- 5 10. The apparatus of claim 9, wherein the substrate support resides symmetrically with respect to the reaction chamber bowl.
11. The apparatus of any preceding claim, comprising a flow guide part in between the plasma system and a reaction chamber bowl.
- 10 12. The apparatus of any preceding claim 9-11, the apparatus being configured to press the reaction chamber bowl against the flow guide part, a reaction chamber top part forming the top part of the upper portion of the inner chamber or a reaction chamber counterpart, optionally having a seal therebetween.
- 15 13. The apparatus of any preceding claim 12, wherein the seal is a vacuum seal.
14. The apparatus of any preceding claim 9-13, wherein the reaction chamber bowl is configured to be lowered by a bowl lift actuator for substrate loading.
- 20 15. The apparatus of any preceding claim, comprising a free lateral distance of at least 50 mm from the perimeter of the substrate support to a nearest surface of a surrounding reaction chamber bowl.
- 25 16. The apparatus of any preceding claim, comprising a Peltier cooler attached to a chemical source container, where the Peltier cooler comprises a control arrangement configured to control the cooler with two fixed non-zero voltage levels.
- 30 17. A substrate processing apparatus, comprising:
an inner chamber;
an outer chamber at least partly surrounding the inner chamber;
a substrate support to support a substrate in the inner chamber; and

a plasma system comprising a first plasma generator to generate a first plasma species within the inner chamber and a second plasma generator which is a remote plasma generator to generate a second plasma species on the outside of the inner chamber.

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18. A substrate processing apparatus, comprising:

- an inner chamber;
- an outer chamber at least partly surrounding the inner chamber;
- a substrate support to support a substrate in the inner chamber;
- 10 a movable lid system; and
- a plasma applicator in the lid system.

19. The apparatus of claim 18, wherein the movable lid system is a hinged lid system or a lift lid.

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20. The apparatus of claim 18 or 19, comprising a feedthrough of at least one in-feed line through the lid system.

21. A substrate processing apparatus, comprising:

- 20 an inner chamber;
- an outer chamber at least partly surrounding the inner chamber; and
- a heat reflector part (or plate) in the outer chamber moving together with a reaction chamber bowl to cover a substrate loading opening of the substrate processing apparatus.

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22. A substrate processing apparatus, comprising:

- an inner chamber;
- an outer chamber at least partly surrounding the inner chamber; and
- a through-hole feedthrough for at least one gas in-feed line to pass through
- 30 an outer chamber lid.

23. A substrate processing apparatus, comprising:

- a reaction chamber;

a substrate support;

a pedestal of the substrate support being attached to a reaction chamber bottom via an attachment flange, the attachment flange residing within the reaction chamber.

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24. A substrate processing apparatus, comprising:

a reaction chamber with a lower portion, the lower portion of the reaction chamber comprising a first exhaust opening for a turbomolecular pump, and a second exhaust opening is for another exhaust pump, an exhaust line traveling
10 via the second exhaust opening by-passing the turbomolecular pump.

25. A substrate processing apparatus, comprising:

an inner chamber;

an outer chamber at least partly surrounding the inner chamber, the inner
15 chamber comprising a lower portion, the apparatus comprising an exhaust line from the outer chamber entering the lower portion of the inner chamber and exiting the lower portion towards an exhaust pump via an exhaust opening.

26. The apparatus of claim 25, where the output from the outer chamber and
20 entering the lower portion occurs via a second flow restricting control valve, such as a butterfly valve.

27. The apparatus of claim 25 or 26, where the exiting towards the exhaust pump occurs via a first flow restricting control valve, such as a pendulum valve.
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28. The apparatus of any preceding claim 25-27, where the exhaust pump is a turbomolecular pump.

29. A substrate processing apparatus, comprising:

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a reaction chamber;

a substrate support;

a pedestal of the substrate support attached to a reaction chamber bottom;

and

lifter pins of the substrate support whose movement is actuated from below through a connecting element that extends through the bottom of the reaction chamber.

- 5 30. The apparatus of claim 29, comprising a part around the pedestal to which the lifter pins are attached to vertically move the pins by moving the said part with the connecting element.

31. A substrate processing apparatus, comprising:

- 10 an inner chamber comprising a reaction chamber bowl, and
 an outer chamber at least partly surrounding the inner chamber, the apparatus being configured to move the reaction chamber bowl by actuating the movement of the bowl on the outside of the outer chamber.

- 15 32. The apparatus of claim 31, comprising a sealed feedthrough through the outer chamber for a connecting element to pass through and transfer vertical motion to the reaction chamber bowl.

33. A substrate processing apparatus, comprising:

- 20 a reaction chamber;
 a lid or a lid system comprising a plasma applicator to provide the reaction chamber with plasma species; and
 a cooling arrangement in the lid or lid system.

- 25 34. The apparatus of claim 33, wherein the cooling arrangement comprises a channel attached to or embedded into the lid or lid system for flowing a coolant, such as water.