

Claims

1. A plasma processing system comprising:
a plasma chamber including:
 - a substrate support; and
 - an upper electrode opposite the substrate support, the upper electrode having a plurality of concentric temperature control zones;
 - an edge ring proximate to an outer perimeter of a supported substrate;
 - a temperature control mechanism including a pair of electrical connections for coupling electrical power to a heater, the heater is configured to receive the electrical power from the pair of electrical connections during operation, wherein the pair of electrical connections couple to the heater by way of a cam lock secured to the substrate support, the heater of the temperature control mechanism being disposed below and in thermal contact with edge ring for heating the edge ring to a selected edge ring temperature during processing; and
 - a controller coupled to the plasma chamber for setting the selected edge ring temperature.
2. The plasma processing system of claim 1, wherein at least one of the plurality of concentric temperature control zones extends outside a radius of the edge ring.
3. The plasma processing system of claim 1, wherein each one of the plurality of concentric temperature control zones includes a temperature control mechanism.
4. The plasma processing system of claim 3, wherein the temperature control mechanism is capable of heating or cooling a respective one of the plurality of concentric temperature control zones to a corresponding selected temperature control zone temperature.
5. The plasma processing system of claim 1, wherein the substrate support is capable of heating or cooling a supported substrate to a selected substrate temperature.

6. The plasma processing system of claim 1, wherein the plasma chamber further includes a plasma confinement structure, the plasma confinement structure extends outside a radius of the substrate support.
7. The plasma processing system of claim 1, further comprising an RF source coupled to inner upper electrode.
8. The plasma processing system of claim 7, wherein the RF source coupled to the inner upper electrode is capable of heating the inner upper electrode.
9. A plasma processing system comprising:
a plasma chamber including:
a substrate support includes an edge ring proximate to an outer perimeter of a supported substrate wherein the edge ring includes a temperature control mechanism capable of heating the edge ring to a selected edge ring temperature, wherein the temperature control mechanism includes a pair of electrical connections for coupling electrical power to a heater, the heater is configured to receive the electrical power from the pair of electrical connections during operation, wherein the pair of electrical connections couple to a bottom surface of the heater when a cam lock is secured to the substrate support, a top surface of the heater is disposed below the edge ring, the heater is configured to thermally transfer heat for heating the edge ring to the selected edge ring temperature during processing;
an upper electrode opposite the substrate support, the upper electrode having a plurality of concentric temperature control zones wherein at least one of the plurality of concentric temperature control zones extends outside a radius of the edge ring;
a plasma confinement structure, the plasma confinement structure extends outside a radius of the substrate support; and
a controller coupled to the plasma chamber.
10. A plasma processing system, comprising:
a plasma chamber, including:

a substrate support includes an edge ring proximate to an outer perimeter of a supported substrate, wherein the edge ring includes a temperature control mechanism for heating the edge ring to a selected temperature, wherein the temperature control mechanism includes a pair of electrical connections for coupling electrical power to a heater, the heater is configured to receive the electrical power from the pair of electrical connections during operation, wherein the pair of electrical connections couple to a bottom surface of the heater when a cam lock is secured to the substrate support, a top surface of the heater is disposed below the edge ring, the heater is configured as a ring that thermally transfers heat for heating the edge ring to the selected temperature during processing; and

an upper electrode opposite the substrate support, the upper electrode having an inner temperature control zone and an outer temperature control zone, wherein the outer temperature control zone outside a radius of the edge ring, the upper electrode further including an insulator that thermally and electrically insulates the inner temperature control zone from the outer temperature control zone;

a protrusion extending below the outer temperature control zone of the upper electrode, the protrusion disposed at least partially over the edge ring;

a plasma confinement structure, the plasma confinement structure disposed between the substrate support and the protrusion of the upper electrode; and

a controller coupled to the plasma chamber.

Claims

1. A plasma processing system comprising:
a plasma chamber including:
a substrate support; and
an upper electrode opposite the substrate support, the upper electrode having a plurality of concentric temperature control zones; and
a controller coupled to the plasma chamber.
2. The plasma processing system of claim 1, wherein the substrate support includes an edge ring proximate to an outer perimeter of a supported substrate.
3. Plasma processing system of claim 2, wherein the edge ring includes a temperature control mechanism capable of heating or cooling the edge ring to a selected edge ring temperature.
4. The plasma processing system of claim 3, wherein at least one of the plurality of concentric temperature control zones extends outside a radius of the edge ring.
5. The plasma processing system of claim 1, wherein each one of the plurality of concentric temperature control zones includes a temperature control mechanism.
6. The plasma processing system of claim 5, wherein the temperature control mechanism is capable of heating or cooling a respective one of the plurality of concentric temperature control zones to a corresponding selected temperature control zone temperature.
7. The plasma processing system of claim 1, wherein the substrate support is capable of heating or cooling a supported substrate to a selected substrate temperature.
8. The plasma processing system of claim 1, wherein the plasma chamber further includes a plasma confinement structure, the plasma confinement structure extends outside a radius of the substrate support.

9. The plasma processing system of claim 1, further comprising an RF source coupled to the inner upper electrode.
10. The plasma processing system of claim 9, wherein the RF source coupled to the inner upper electrode is capable of heating the inner upper electrode.
11. A plasma processing system comprising:
a plasma chamber including:
a substrate support includes an edge ring proximate to an outer perimeter of a supported substrate wherein the edge ring includes a temperature control mechanism capable of heating or cooling the edge ring to a selected edge ring temperature; and
an upper electrode opposite the substrate support, the upper electrode having a plurality of concentric temperature control zones wherein at least one of the plurality of concentric temperature control zones extends outside a radius of the edge ring;
a plasma confinement structure, the plasma confinement structure extends outside a radius of the substrate support; and
a controller coupled to the plasma chamber.
12. A method of selecting an edge etch rate using a dual temperature zone upper electrode comprising:
creating a plasma in a plasma chamber;
reducing an edge etch rate including increasing an inner upper electrode temperature to a temperature greater than an outer upper electrode temperature; and
increasing an edge etch rate including decreasing an inner upper electrode temperature to a temperature less than an outer upper electrode temperature.
13. The method of claim 12, wherein the outer upper electrode temperature is in a plasma confinement structure, the plasma confinement structure extends outside a radius of a substrate support in the plasma chamber.
14. The method of claim 12, wherein the inner upper electrode temperature is opposite a substrate support in the plasma chamber.

15. The method of claim 12, wherein reducing the edge etch rate further including increasing a substrate temperature to a temperature greater than an outer upper electrode temperature.
16. The method of claim 12, wherein increasing an edge etch rate further including decreasing an inner upper electrode temperature to a temperature less than an edge ring temperature, the edge ring proximate to an outer perimeter of a substrate support in the plasma chamber.
17. The method of claim 12, wherein increasing the inner upper electrode temperature includes applying an RF signal to the inner upper electrode.
18. The method of claim 17, wherein applying the RF signal to the inner upper electrode includes cooling the inner upper electrode.
19. The method of claim 17, wherein heating the inner upper electrode includes maintaining the inner upper electrode at a set point temperature including:
applying the RF signal to the inner upper electrode during a first period and simultaneously cooling the inner upper electrode during the first period; and
stopping applying the RF signal to the inner upper electrode during a second period and simultaneously heating the inner upper electrode during the second period.
20. The method of claim 17, wherein heating the inner upper electrode includes maintaining the inner upper electrode at a set point temperature including:
applying the RF signal to the inner upper electrode during a first period and simultaneously heating the outer upper electrode during the first period; and
stopping applying the RF signal to the inner upper electrode during a second period and simultaneously cooling the outer upper electrode during the second period.