

The position of the movable tap 213 is adjusted so as to substantially equal the resonance characteristic of the resonance coil 212 to that of the high frequency power supply 273.

Further, a power-feeding part is configured by a movable tap 215 between the grounded both ends of the resonance coil 212 in order to fine-tune the impedance of the resonance coil 212 at the time of initial installation of the device or at the time of changing the process condition.

[0044] A shielding plate 224 is installed to shield an electric field outside the resonance coil 212.

[0045] A plasma generator according to the present embodiments mainly includes the resonance coil 212, the RF sensor 272, and the matching device 274. The high frequency power supply 273 may be included as the plasma generation part.

[0046] Here, the plasma generation principle and the properties of the generated plasma of the apparatus according to the present embodiments will be described with reference to FIG. 2.

The plasma generator in the present embodiments is configured to generate plasma by an ICP (Inductively Coupled Plasma) method as follows. A plasma generation circuit composed of the resonance coil 212 is configured as an RLC parallel resonance circuit. In the above plasma generation circuit, when plasma is generated, the actual resonance frequency fluctuates slightly depending on a fluctuation in a capacitive coupling between a voltage part of the resonance coil 212 and the plasma, a fluctuation in an inductive coupling between the plasma-generating space 201a and the plasma, and an excitation state of the plasma, and the like.

[0047] Therefore, in order to compensate a deviation of resonance in the resonance coil 212 on the power supply side when the plasma is generated, the present embodiments provide a function of detecting, by the RF sensor 272, the reflected wave power from the resonance coil 212 when the plasma is generated, and correcting, by the matching device 274, the output of the high frequency power supply 273 based on the reflected wave power that has been detected.

[0048] Specifically, the matching device 274 increases or decreases the impedance or output frequency of the high frequency power supply 273 so as to minimize the reflected wave power based on the reflected wave power from the resonance coil 212 when the plasma detected by the RF sensor 272 is generated.

[0049] As shown in FIG. 2, since the resonance coil 212 in the present embodiments is supplied

WHAT IS CLAIMED IS:

1. A method of manufacturing a semiconductor device, comprising:
accommodating a substrate in a process chamber;
supplying a first gas containing oxygen into the process chamber;
generating plasma in the process chamber by exciting the first gas;
supplying a second gas containing hydrogen into the process chamber and adjusting a hydrogen concentration distribution in the process chamber according to a density distribution of the plasma in the process chamber; and
processing the substrate with oxidizing species generated by the plasma.
2. The method of Claim 1, wherein in generating the plasma, the plasma is generated so that the density distribution of the plasma in the process chamber is non-uniform in a plane direction of the substrate.
3. The method of Claim 1, wherein in supplying the first gas, the first gas is supplied to a first region in the process chamber, and
wherein in adjusting the hydrogen concentration distribution in the process chamber, the second gas is supplied to a second region which is a region above a processing surface of the substrate and is a region different from the first region in a plane direction of the substrate.
4. The method of Claim 1, wherein in supplying the first gas, the first gas is supplied to a plasma generation region where the plasma is generated,
wherein in adjusting the hydrogen concentration distribution in the process chamber, the second gas is supplied to a plasma non-generation region where the plasma is not generated.
5. The method of Claim 4, wherein a hydrogen concentration distribution in the plasma non-generation region is adjusted according to a distance from the plasma generation region.

6. The method of Claim 1, wherein the hydrogen concentration distribution in the process chamber is controlled by adjusting a supply flow rate of the second gas.
7. The method of Claim 1, wherein the hydrogen concentration distribution in the process chamber is controlled by adjusting a hydrogen content rate of the second gas.
8. The method of Claim 1, wherein a space in the process chamber includes an outer peripheral region along an inner wall of the process chamber and a central region surrounded by the outer peripheral region, and the plasma is generated so that a density of the plasma in the outer peripheral region is higher than a density of the plasma in the central region.
9. The method of Claim 8, wherein ring-shaped plasma along the inner wall of the process chamber is generated in the outer peripheral region.
10. The method of Claim 1, wherein in adjusting the hydrogen concentration distribution in the process chamber, the hydrogen concentration distribution in the process chamber is adjusted so that a density distribution of the oxidizing species supplied to the substrate is uniform in a plane direction on a surface of the substrate.
11. The method of Claim 1, wherein the first gas is a mixture of oxygen gas and hydrogen gas.
12. The method of Claim 1, wherein the second gas is a mixture of oxygen gas and hydrogen gas.
13. The method of Claim 1, wherein a hydrogen content rate of the first gas is different from a hydrogen content rate of the second gas.

14. A substrate processing apparatus comprising:
a process chamber in which a substrate is accommodated;
a first gas supply system configured to supply a first gas containing oxygen into the process chamber;
a second gas supply system configured to supply a second gas, which contains hydrogen and has a hydrogen content rate different from a hydrogen content rate of the first gas, into the process chamber; and
a plasma generator configured to excite a gas in the process chamber,
wherein the first gas supply system is configured to supply the first gas to a first region in the process chamber where plasma is generated at a first plasma density, and
wherein the second gas supply system is configured to supply the second gas to a second region in the process chamber where the plasma is generated at a second plasma density lower than the first plasma density.

15. The substrate processing apparatus of Claim 14, wherein the second region is a region above a processing surface of the substrate and is a region different from the first region in a plane direction of the substrate.

16. The substrate processing apparatus of Claim 14, wherein the second region is a region where the plasma is not generated.

17. A program that causes, by a computer, a substrate processing apparatus to perform a process comprising:
accommodating a substrate in a process chamber of the substrate processing apparatus;
supplying a first gas containing oxygen into the process chamber;
generating plasma in the process chamber by exciting the first gas;
supplying a second gas containing hydrogen into the process chamber and adjusting a

hydrogen concentration distribution in the process chamber according to a density distribution of the plasma in the process chamber; and

processing the substrate with oxidizing species generated by the plasma.