

chamber main body and the plasma is large, energy of ions irradiated to an inner wall of the chamber main body is increased, so that particles are released from the chamber main body. The particles released from the chamber main body contaminates the substrate placed on the stage. To suppress the generation of these particles, Patent Document 1 discloses a technique using an adjustment mechanism configured to adjust a ground capacity of the chamber. The adjustment mechanism described in Patent Document 1 is configured to adjust an area ratio between a cathode and an anode facing the chamber, that is, an A/C ratio.

[0004] Patent Document 1: Japanese Patent Laid-open Publication No. 2011-228694

SUMMARY

[0005] As one kind of the plasma processing apparatus, there is used a plasma processing apparatus configured to supply a radio frequency power for bias ("radio frequency bias power") to the lower electrode. The radio frequency bias power is supplied to the lower electrode to increase an etching rate of the substrate by increasing the energy of the ions irradiated to the substrate. In this plasma processing apparatus, if the potential of the plasma is increased, the potential difference between the plasma and the chamber main body is increased, and the energy of the ions irradiated to the inner wall of the chamber main body is also increased. In this regard, it is required to suppress a decrease of the etching rate of the substrate and reduce the energy of the ions irradiated to the inner wall of the chamber main body.

[0005a] According to a first aspect of the present application, there is provided a plasma etching method performed in a plasma processing apparatus, the plasma processing apparatus comprising: a chamber; a substrate support disposed in the chamber; at least one electrode disposed in the substrate support; an RF power source for exciting a gas supplied into the

chamber; and at least one DC power source configured to apply DC voltage to the at least one electrode, the plasma etching method comprising: supplying an RF power from the RF power source to the at least one electrode; and applying pulsed negative DC voltage from the at least one DC power source to the at least one electrode in a plurality of cycles, at least one of the plurality of cycles having a duty ratio equal to or less than 40%, wherein the supplying of the RF power and the applying of the pulsed negative DC voltage are synchronized with each other.

[0005b] According to a second aspect of the present application, there is provided a plasma etching method performed in a plasma processing apparatus, the plasma processing apparatus comprising: a chamber; a substrate support disposed in the chamber; at least one electrode disposed in the substrate support; an RF power source for exciting a gas supplied into the chamber; and at least one DC power source configured to apply DC voltage to the at least one electrode, the plasma etching method comprising: supplying an RF power from the RF power source to the at least one electrode; applying pulsed negative DC voltage from the at least one DC power source to the at least one electrode in a plurality of cycles, at least one of the plurality of cycles having a duty ratio equal to or less than 40%; stopping the supplying of the RF power while the pulsed negative DC voltage is applied; and supplying the RF power while the applying of the pulsed negative DC voltage is stopped.

[0005c] According to a third aspect of the present application, there is provided a plasma etching apparatus, comprising: a chamber; a substrate support disposed in the chamber; at least one electrode disposed in the substrate support; an RF power source configured to apply RF power to the at least one electrode and to excite a gas supplied into the chamber; at least one DC power source configured to apply DC voltage to the at least one electrode; a switching unit configured to apply pulsed negative DC voltage from the at least one DC power source to the at

least one electrode in a plurality of cycles, at least one of the plurality of cycles having a duty ratio equal to or less than 40%; and a controller configured to control the RF power source and the switching unit such that applying of the RF power and applying of the pulsed negative DC voltage are synchronized with each other.

[0006] In one exemplary embodiment, there is provided a plasma processing method performed in a plasma processing apparatus. The plasma processing apparatus includes a chamber main body, a stage, a radio frequency power supply and one or more DC power supplies. An internal space of the chamber main body is configured as a chamber. The stage is provided