

radio-frequency power to generate plasma in the chamber. The power supply controller provides, from the radio-frequency power supply, the source radio-frequency power having a predetermined source frequency $f[i,n]$ in an n -th phase period of a plurality of phase periods in an i -th waveform cycle in a series of waveform cycles of the electrical bias. The power supply

5 controller determines a source frequency $f[i+1,n]$ of the source radio-frequency power for the n -th phase period in a waveform cycle subsequent to the i -th waveform cycle in the series based on a degree of reflection of the source radio-frequency power in the n -th phase period in the i -th waveform cycle. The power supply controller sets, in determination of the source frequency, the source frequency $f[i+1,n]$ to a frequency obtained by adding a predetermined shift value

10 $\Delta f[n]$ to the source frequency $f[i,n]$ when the degree of reflection of the source radio-frequency power in the n -th phase period in the i -th waveform cycle is a value satisfying a frequency change condition. The power supply controller sets, in determination of the source frequency, the source frequency $f[i+1,n]$ to the source frequency $f[i,n]$ when the degree of reflection does not satisfy the frequency change condition. The power supply controller maintains, in

15 determination of the shift value $\Delta f[n]$, a sign of the shift value $\Delta f[n]$ to be unchanged when the degree of reflection of the source radio-frequency power in the n -th phase period is not on an upward trend in waveform cycles up to the i -th waveform cycle in the series. The power supply controller changes, in determination of the shift value $\Delta f[n]$, the sign of the shift value $\Delta f[n]$ when the degree of reflection in the n -th phase period is on an upward trend in the

20 waveform cycles up to the i -th waveform cycle in the series. The power supply controller changes, in determination of the shift value $\Delta f[n]$, the sign of the shift value $\Delta f[n]$ when a change in the source frequency is determined to be greater than a predetermined value based on comparison of the predetermined value with an absolute value of a difference between the source frequency $f[i,n]$ and a source frequency $f[i,n-u]$ of the source radio-frequency power in

25 an $(n-u)$ -th phase period and comparison of the predetermined value with an absolute value of a difference between the source frequency $f[i,n]$ and a source frequency $f[i,n+u]$ of the source radio-frequency power in an $(n+u)$ -th phase period in the i -th waveform cycle and when both the source frequency $f[i,n-u]$ and the source frequency $f[i,n+u]$ are higher than or lower than the source frequency $f[i,n]$.

[0005a] According to a second aspect of the present invention, there is provided a power supply system, comprising:

a bias power supply configured to provide an electrical bias to a substrate support in a chamber in a plasma processing device;

5 a radio-frequency power supply configured to provide source radio-frequency power to generate plasma in the chamber; and

a power supply controller configured to

provide, from the radio-frequency power supply, the source radio-frequency power having a predetermined source frequency $f[i,n]$ in an n -th phase period of a plurality of phase
10 periods in an i -th waveform cycle in a series of waveform cycles of the electrical bias,

determine a source frequency $f[i+1,n]$ of the source radio-frequency power for the n -th phase period in a waveform cycle subsequent to the i -th waveform cycle in the series based on a degree of reflection of the source radio-frequency power in the n -th phase period in the i -th waveform cycle,

15 set, in determination of the source frequency, the source frequency $f[i+1,n]$ to a frequency obtained by adding a predetermined shift value $\Delta f[n]$ to the source frequency $f[i,n]$ when the degree of reflection of the source radio-frequency power in the n -th phase period in the i -th waveform cycle is a value satisfying a frequency change condition and set, in determination of the source frequency, the source frequency $f[i+1,n]$ to the source frequency
20 $f[i,n]$ when the degree of reflection does not satisfy the frequency change condition,

maintain, in determination of the shift value $\Delta f[n]$, a sign of the shift value $\Delta f[n]$ to be unchanged when the degree of reflection of the source radio-frequency power in the n -th phase period is not on an upward trend in waveform cycles up to the i -th waveform cycle in the series and change, in determination of the shift value $\Delta f[n]$, the sign of the shift value $\Delta f[n]$ when the
25 degree of reflection in the n -th phase period is on an upward trend in the waveform cycles up to the i -th waveform cycle in the series, and

change, in determination of the shift value $\Delta f[n]$, the sign of the shift value $\Delta f[n]$ when a change in the source frequency is determined to be greater than a predetermined value based on comparison of the predetermined value with an absolute value of a difference between the

source frequency $f[i,n]$ and a source frequency $f[i,n-u]$ of the source radio-frequency power in an $(n-u)$ -th phase period and comparison of the predetermined value with an absolute value of a difference between the source frequency $f[i,n]$ and a source frequency $f[i,n+u]$ of the source radio-frequency power in an $(n+u)$ -th phase period in the i -th waveform cycle and when both
 5 the source frequency $f[i,n-u]$ and the source frequency $f[i,n+u]$ are higher than or lower than the source frequency $f[i,n]$.

[0005b] According to a third aspect of the present invention, there is provided a control method, comprising:

(a) providing an electrical bias from a bias power supply to a substrate support in a chamber
 10 in a plasma processing device; and

(b) providing source radio-frequency power from a radio-frequency power supply to generate plasma in the chamber, (b) including

(b-1) providing, from the radio-frequency power supply, the source radio-frequency power having a predetermined source frequency $f[i,n]$ in an n -th phase period of a plurality of
 15 phase periods in an i -th waveform cycle in a series of waveform cycles of the electrical bias, and

(b-2) determining a source frequency $f[i+1,n]$ of the source radio-frequency power for the n -th phase period in a waveform cycle subsequent to the i -th waveform cycle in the series based on a degree of reflection of the source radio-frequency power in the n -th phase period in
 20 the i -th waveform cycle,

wherein in (b-2), the source frequency $f[i+1,n]$ is set to a frequency obtained by adding a predetermined shift value $\Delta f[n]$ to the source frequency $f[i,n]$ when the degree of reflection of the source radio-frequency power in the n -th phase period in the i -th waveform cycle is a value satisfying a frequency change condition, and the source frequency $f[i+1,n]$ is set to the source
 25 frequency $f[i,n]$ when the degree of reflection does not satisfy the frequency change condition, and

in determination of the shift value $\Delta f[n]$,

a sign of the shift value $\Delta f[n]$ is maintained to be unchanged when the degree of reflection of the source radio-frequency power in the n -th phase period is not on an upward

trend in waveform cycles up to the i -th waveform cycle in the series, and the sign of the shift value $\Delta f[n]$ is changed when the degree of reflection in the n -th phase period is on an upward trend in the waveform cycles up to the i -th waveform cycle in the series, and

the sign of the shift value $\Delta f[n]$ is changed when a change in the source frequency is
5 determined to be greater than a predetermined value based on comparison of the predetermined value with an absolute value of a difference between the source frequency $f[i,n]$ and a source frequency $f[i,n-u]$ of the source radio-frequency power in an $(n-u)$ -th phase period and comparison of the predetermined value with an absolute value of a difference between the source frequency $f[i,n]$ and a source frequency $f[i,n+u]$ of the source radio-frequency power in
10 an $(n+u)$ -th phase period in the i -th waveform cycle and when both the source frequency $f[i,n-u]$ and the source frequency $f[i,n+u]$ are higher than or lower than the source frequency $f[i,n]$.