

WHAT IS CLAIMED IS:

1. A plasma processing method comprising:

5       applying a direct-current voltage from a power source device to  
a lower electrode of a substrate support provided in a chamber of a plasma  
processing apparatus, in a first period during generation of plasma in the  
chamber;

10       connecting the lower electrode to a ground in a second period  
different from the first period during generation of the plasma in the  
chamber, wherein the lower electrode is electrically separated from the  
power source device in the second period; and

15       connecting the power source device to the lower electrode in a  
third period during generation of the plasma in the chamber and after the  
second period, the third period starting before a potential of the lower  
electrode reaches a ground potential, wherein the lower electrode is  
electrically separated from the ground in the third period,

20       wherein a point in time of end of the third period is a point in  
time before the potential of the lower electrode reaches a steady state, and  
the lower electrode is electrically separated from the power source device  
at the point in time of end of the third period.

25       2. The plasma processing method according to claim 1, further  
comprising electrically separating the lower electrode from both the  
power source device and the ground in a period between a point in time  
of end of the second period and a point in time of start of the third period.

3. The plasma processing method according to claim 1 or 2, wherein said connecting the lower electrode to the ground and said connecting the power source device to the lower electrode are alternately repeated, and

5           said connecting the lower electrode to the ground is initiated again before the potential of the lower electrode reaches a steady state after execution of said connecting the power source device to the lower electrode.

10           4. A plasma processing apparatus comprising:

a chamber;

a substrate support including a lower electrode and provided in the chamber;

a power source device;

15           a first switch connected between the power source device and the lower electrode;

a second switch connected between the lower electrode and a ground; and

a controller configured to control application of a voltage from the power source device to the lower electrode,

20           wherein the controller is configured to

execute first control of setting the first switch to a conduction state to connect the power source device to the lower electrode to apply a direct-current voltage from the power source device to the lower electrode, and setting the second switch to a non-conduction state to electrically separate the lower electrode from the ground, in a first period

during generation of plasma in the chamber;

execute second control of setting the second switch to a conduction state to connect the lower electrode to the ground, and setting the first switch to a non-conduction state to electrically separate the lower electrode from the power source device, in a second period different from the first period during generation of the plasma in the chamber; and

execute third control of setting the first switch to a conduction state to connect the power source device to the lower electrode, and setting the second switch to a non-conduction state to electrically separate the lower electrode from the ground, in a third period during generation of the plasma in the chamber and after the second period, the third period starting before a potential of the lower electrode reaches a ground potential,

a point in time of end of the third period is a point in time before the potential of the lower electrode reaches a steady state, and

the controller is configured to set the first switch to a non-conduction state to electrically separate the lower electrode from the power source device, at the point in time of end of the third period.

5. The plasma processing apparatus according to claim 4, wherein the controller is configured to further execute control of setting both the first switch and the second switch to a non-conduction state to electrically separate the lower electrode from both the power source device and the ground, in a period between a point in time of end of the second period and a point in time of start of the third period.

6. The plasma processing apparatus according to claim 4 or 5,  
wherein the controller is configured to

alternately repeat the second control and the third control, and  
initiate execution of the second control again before the potential  
5 of the lower electrode reaches a steady state after execution of the third  
control.

7. A plasma processing method comprising:

applying a first direct-current voltage from a first output of a  
10 power source device to a lower electrode of a substrate support provided  
in a chamber of a plasma processing apparatus, in a first period during  
generation of plasma in the chamber, wherein the power source device  
has the first output and a second output for a second direct-current voltage  
having a level lower than a level of the first direct-current voltage;

15 connecting the lower electrode to a ground in a second period  
different from the first period during generation of the plasma in the  
chamber, wherein the lower electrode is electrically separated from the  
first output and the second output in the second period; and

connecting the second output to the lower electrode in a third  
20 period during the generation of the plasma in the chamber and after the  
second period, the third period starting before a potential of the lower  
electrode reaches a ground potential, wherein the lower electrode is  
electrically separated from the first output and the ground in the third  
period,

25 wherein a point in time of end of the third period is a point in  
time before the potential of the lower electrode reaches a steady state, and

the lower electrode is electrically separated from the first output and the second output at the point in time of end of the third period.

8. The plasma processing method according to claim 7, further comprising electrically separating the lower electrode from the first output, the second output, and the ground in a period between a point in time of end of the second period and a point in time of start of the third period.

9. The plasma processing method according to claim 7 or 8, wherein said connecting the lower electrode to the ground and said connecting the second output to the lower electrode are alternately repeated, and

said connecting the lower electrode to the ground is initiated again before the potential of the lower electrode reaches a steady state after execution of said connecting the second output to the lower electrode.

10. A plasma processing apparatus comprising:  
a chamber;  
a substrate support including a lower electrode and provided in the chamber;  
a power source device having a first output for a first direct-current voltage, and a second output for a second direct-current voltage having a level lower than a level of the first direct-current voltage;  
a first switch connected between the first output and the lower

electrode;

a second switch connected between the second output and the lower electrode;

a third switch connected between the lower electrode and a ground; and

a controller configured to control application of a voltage from the power source device to the lower electrode,

wherein the controller is configured to

execute first control of setting the first switch to a conduction state to connect the first output to the lower electrode to apply a first direct-current voltage from the first output to the lower electrode, and setting the second switch and the third switch to a non-conduction state to electrically separate the lower electrode from the second output and the ground, in a first period during generation of plasma in the chamber;

execute second control of setting the third switch to a conduction state to connect the lower electrode to the ground, and setting the first switch and the second switch to a non-conduction state to electrically separate the lower electrode from the first output and the second output, in a second period different from the first period during generation of the plasma in the chamber; and

execute third control of setting the second switch to a conduction state to connect the second output to the lower electrode, and setting the first switch and the third switch to a non-conduction state to electrically separate the lower electrode from the first output and the ground, in a third period during generation of the plasma in the chamber and after the second period, the third period starting before a potential of the lower

electrode reaches a ground potential,

a point in time of end of the third period is a point in time before the potential of the lower electrode reaches a steady state, and

the controller is configured to set the first switch and the second switch to a non-conduction state to electrically separate the lower electrode from the first output and the second output, at the point in time of end of the third period.

11. The plasma processing apparatus according to claim 10, wherein the controller is configured to further execute control of setting the first switch, the second switch, and the third switch to a non-conduction state to electrically separate the lower electrode from the first output, the second output, and the ground, in a period between a point in time of end of the second period and a point in time of start of the third period.

12. The plasma processing apparatus according to claim 10 or 11, wherein the controller is configured to

alternately repeat the second control and the third control, and initiate execution of the second control again before the potential of the lower electrode reaches a steady state after execution of the third control.