I Claim:

1. A method of fault detection for a multi-zone heating plate in a substrate support assembly used to support a semiconductor substrate in a semiconductor processing apparatus, the heating plate comprising a plurality of planar heater zones, a plurality of power supply lines and a plurality of power return lines, wherein each planar heater zone is connected to one of the power supply lines and one of the power return lines, and no two planar heater zones share the same pair of power supply line and power return line; the method comprising:

(a) obtaining a measured total heating power of one or more planar heater zones;

(b) comparing the measured total heating power to a pre-established total heating power of the one or more planer heater zones;

(c) if the measured total heating power deviates from the pre-established total heating power by a pre-determined margin, triggering an alarm signal.

2. The method of Claim 1, wherein the pre-determined margin is ±20%, ±10%, ±5%, or ±1% of the pre-established total heating power.

3. The method of Claim 1, wherein the measured total heating power is obtained by measuring a voltage V across each of the one or more planar heater zones, measuring a current I flowing through each of the one or more planar heater zones, multiplying V by I, and adding $V \cdot I$ of each of the one or more planar heater zones.

4. The method of Claim 3, wherein the voltage V is measured using a voltmeter connected between one of the power supply lines and one of the power return lines, and the current I is measured using an ammeter connected between one of the power return lines and ground.

5. The method of Claim 1, wherein:

while one or more power supply lines are connected to a power source, and at least one power return line is connected to an electrical ground, the measured total

heating power of the planar heater zones connected to the one or more power supply lines and the at least one power return line is obtained by measuring a voltage V on the one or more power supply lines, and measuring a total current I carried by the at least one power return line, and multiplying V by I; and

the pre-established total heating power is calculated by summing a pre-established heating power of each of the planar heater zones connected to the one or more power supply lines and the at least one power return line.

6. The method of Claim 1, wherein:

while one or more power return lines are connected to an electrical ground, and at least one power supply line is connected to a power source, the measured total heating power of the planar heater zones connected to the one or more power return lines and the at least one power supply line is obtained by measuring a voltage V on the at least one power supply line, measuring a current I on the at least one power supply line, and multiplying V by I; and

the pre-established total heating power is calculated by summing a pre-established heating power of each of the planar heater zones connected to the one or more power return lines and the at least one power supply line.

7. The method of Claim 5, wherein the voltage V on the one or more power supply lines is corrected by subtracting voltage drop that is not on a planar heater zone.

8. The method of Claim 6, wherein the voltage V on the at least one power supply line is corrected by subtracting voltage drop that is not on a planar heater zone.

9. A method of fault detection for a multi-zone heating plate in a substrate support assembly used to support a semiconductor substrate in a semiconductor processing apparatus, the heating plate comprising a plurality of planar heater zones, a plurality of power supply lines and a plurality of power return lines, wherein each planar heater zone is connected to one of the power supply lines and one of the

power return lines, and no two planar heater zones share the same pair of power supply line and power return line; the method comprising:

(a) while all power return lines are connected to the electrical ground through the ammeter and only the *i*-th power supply line is connected to the power source, obtaining a measured total heating power of all the planar heater zones connected to the *i*-th power supply line, by measuring a voltage *V* on the *i*-th power supply line, measuring a total current *I* on all the power return lines, and multiplying *V* by *I*;

(b) comparing the total heating power to a pre-established total heating power calculated by summing a pre-established heating power of each of the planar heater zones connected to the *i*-th power supply line;

(c) if the measured total heating power deviates from the pre-established total heating power by a pre-determined margin, triggering an alarm signal;

(d) while all power supply lines are connected to the power source and only the *j*-th power return line is connected to the electrical ground, obtaining a total heating power of all the planar heater zones connected to the *j*-th power return line, measuring a voltage *V* on all the power supply lines, measuring a current *I* on the *j*-th power return line, and multiplying *V* by *I*;

(e) comparing the measured total heating power to a pre-established total heating power calculated by summing a pre-established heating power of each of the planar heater zones connected to the *j*-th power return line;

(f) if the measured total heating power deviates from the pre-established total heating power by a pre-determined margin, triggering an alarm signal.

10. The method Claim 9, further comprising identifying that the planar heater zone connected to both the *i*-th power supply line and the *j*-th power return line is in a fault condition, if an alarm signal is triggered when only the *i*-th power supply line is connected to the power source and all the power return lines are connected to the electrical ground, and when only the *j*-th power return line is connected to the electrical ground and all the power supply lines are connected to the power source, the planar heater zone connected to both the *i*-th power supply line and the *j*-th power return line is in a fault condition.

11. The method of Claim 9, wherein the voltage V on all the power supply lines and the voltage V on the i-th power supply line are corrected by subtracting voltage drop that is not on a planar heater zone.

Claims:

1. A method of fault detection for a multi-zone heating plate in a substrate support assembly having a cooling plate below the heating plate during processing of a semiconductor substrate in a chamber of a semiconductor processing apparatus, the heating plate comprising a plurality of planar heater zones, a plurality of power supply lines and a plurality of power return lines, wherein each of the power supply lines is connected to a plurality of the planar heater zones and each of the power return lines is connected to a plurality of the planar heater zones, and no two planar heater zones share the same pair of power supply line and power return line; the method comprising:

(a) loading the semiconductor substrate onto the substrate support;

(b) supplying process gas to the chamber;

(c) energizing the process gas into a plasma;

(d) supplying power to one or more of the power supply lines to achieve a support temperature profile while circulating coolant in the cooling plate; wherein the support temperature profile is created by controlling a first multiplexor connected to the power supply lines and a second multiplexor connected to the power return lines to independently control each planar heater zone with the supplied power;

(e) obtaining a measured total heating power of all of the planar heater zones;

(f) comparing the measured total heating power to a pre-established total heating power of the planer heater zones;

(g) if the measured total heating power deviates from the pre-established total heating power by a pre-determined margin, triggering an alarm signal.

2. The method of claim 1, wherein the pre-determined margin is ±20%, ±10%, ±5%, or ±1% of the pre-established total heating power.

3. The method of claim 1, wherein the measured total heating power is obtained by measuring a voltage V across each of the planar heater zones, measuring a current I flowing through each of the planar heater zones, multiplying V by I, and adding V·I of

each of the planar heater zones.

4. The method of claim 3, wherein the voltage V is measured using a voltmeter connected between one of the power supply lines and one of the power return lines, and the current I is measured using an ammeter connected between one of the power return lines and ground.

5. The method of claim 1, wherein:

while one or more power supply lines are connected to a power source, and at least one power return line is connected to an electrical ground, the measured total heating power of the planar heater zones connected to the one or more power supply lines and the at least one power return line is obtained by measuring a voltage V on the one or more power supply lines, and measuring a total current I carried by the at least one power return line, and multiplying V by I; and

the pre-established total heating power is calculated by summing a pre-established heating power of each of the planar heater zones connected to the one or more power supply lines and the at least one power return line.

6. The method of claim 1, wherein:

while one or more power return lines are connected to an electrical ground, and at least one power supply line is connected to a power source, the measured total heating power of the planar heater zones connected to the one or more power return lines and the at least one power supply line is obtained by measuring a voltage V on the at least one power supply line, measuring a current I on the at least one power supply line, and multiplying V by I; and

the pre-established total heating power is calculated by summing a pre-established heating power of each of the planar heater zones connected to the one or more power return lines and the at least one power supply line.

7. The method of claim 5, wherein the voltage V on the one or more power supply lines

is corrected by subtracting voltage drop that is not on a planar heater zone.

8. The method of claim 6, wherein the voltage V on the at least one power supply line is corrected by subtracting voltage drop that is not on a planar heater zone.

9. The method of claim 1, wherein the semiconductor substrate is etched with the plasma.

10. A method of fault detection for a multi-zone heating plate in a substrate support assembly having a cooling plate below the heating plate during processing of a semiconductor substrate in a chamber of a semiconductor processing apparatus, the heating plate comprising a plurality of planar heater zones, a plurality of power supply lines and a plurality of power return lines, wherein each of the power supply lines is connected to a plurality of the planar heater zones and each of the power return lines is connected to a plurality of the planar heater zones, and no two planar heater zones share the same pair of power supply line and power return line; the method comprising:

(a) loading the semiconductor substrate onto the substrate support;

(b) supplying process gas to the chamber;

(c) energizing the process gas into a plasma;

(d) supplying power to one or more of the power supply lines to achieve a support temperature profile while circulating coolant in the cooling plate;

(e) while all power return lines are connected to the electrical ground through the ammeter and only the i-th power supply line is connected to the power source, obtaining a measured total heating power of all the planar heater zones connected to the i-th power supply line, by measuring a voltage Von the i-th power supply line, measuring a total current I on all the power return lines, and multiplying V by I;

(f) comparing the total heating power to a pre-established total heating power calculated by summing a pre-established heating power of each of the planar heater zones connected to the i-th power supply line;

(g) if the measured total heating power deviates from the pre-established total heating power by a pre-determined margin, triggering an alarm signal;

(h) while all power supply lines are connected to the power source and only the j-th power return line is connected to the electrical ground, obtaining a total heating power of all the planar heater zones connected to the j-th power return line, measuring a voltage V on all the power supply lines, measuring a current I on the j-th power return line, and multiplying V by I;

(i) comparing the measured total heating power to a pre-established total heating power calculated by summing a pre-established heating power of each of the planar heater zones connected to the j-th power return line;

(j) if the measured total heating power deviates from the pre-established total heating power by a pre-determined margin, triggering an alarm signal.

11. The method claim 10, further comprising identifying that the planar heater zone connected to both the i-th power supply line and the j-th power return line is in a fault condition, if an alarm signal is triggered when only the i-th power supply line is connected to the power source and all the power return lines are connected to the electrical ground, and when only the j-th power return line is connected to the electrical ground and all the power supply lines are connected to the power source, the planar heater zone connected to both the i-th power supply line and the j-th power return line is in a fault condition.

12. The method of claim 10, wherein the voltage V on all the power supply lines and the voltage V on the i-th power supply line are corrected by subtracting voltage drop that is not on a planar heater zone.

13. The method of claim 10, wherein the semiconductor substrate is etched with the plasma.