CLAIMS

1. A method for controlling a temperature of a substrate support for a substrate processing system, comprising:

setting a temperature of the substrate support in one of Z zones in response to a temperature sensor embedded in the one of the Z zones, where Z is an integer greater than one;

setting the temperature of the substrate support in Z-1 zones of the Z zones using Z-1 power ratios, respectively;

measuring Z resistances of Z resistive heaters embedded in the Z zones at a first temperature and a second temperature;

setting the temperature of the substrate support to a third temperature in response to the temperature sensor and the Z-1 power ratios;

determining Z-1 first target resistances for the Z-1 zones, respectively, at the third temperature;

measuring the Z resistances of the Z resistive heaters at the third temperature, respectively; and

comparing Z-1 resistances of Z-1 resistive heaters for the Z-1 zones and the Z-1 first target resistances at the third temperature, respectively, and selectively adjusting the Z-1 power ratios in response thereto.

2. The method of claim 1, further comprising:

setting the temperature of the substrate support to a fourth temperature in response to the temperature sensor and the Z-1 power ratios;

determining Z-1 second target resistances for the Z-1 zones, respectively, at the fourth temperature;

measuring the Z resistances of the Z resistive heaters at the fourth temperature, respectively; and

comparing Z-1 resistances of Z-1 resistive heaters for the Z-1 zones and the Z-1 second target resistances at the fourth temperature, respectively, and selectively adjusting the Z-1 power ratios in response thereto.

3. The method of claim 1, wherein the selectively adjusting the Z-1 power ratios iterates until the Z-1 resistances of the Z-1 resistive heaters are within a predetermined range of the Z-1 first target resistances at the third temperature.

4. The method of claim 2, wherein the selectively adjusting the Z-1 power ratios iterates until the Z-1 resistances of the Z-1 resistive heaters are within a predetermined range of the Z-1 second target resistances at the fourth temperature.

5. The method of claim 1, wherein:

the Z-1 first target resistances for each of the Z-1 zones are determined in response to a sum of a resistance of a corresponding zone at the first temperature and a product of a difference and a ratio,

the difference comprises a resistance of the corresponding zone at the second temperature minus a resistance of the corresponding zone at the first temperature, and

the ratio comprises a numerator including a difference between a resistance at the one of the Z zones at the third temperature minus a resistance of the one of the Z zones at the first temperature and a denominator including a difference between a resistance at the one of the Z zones at the second temperature minus a resistance of the one of the Z zones at the first temperature.

6. The method of claim 1, wherein the first temperature and the second temperature are lower than an operating temperature of the substrate support during substrate processing.

7. The method of claim 1, wherein measuring the Z resistances of the Z resistive heaters includes:

monitoring Z voltages supplied to the Z resistive heaters, respectively; and

calculating the Z resistances of the Z zones based on the Z voltages supplied to the Z resistive heaters, respectively.

8. The method of claim 1, wherein measuring the Z resistances of the Z zones includes:

monitoring Z currents supplied to the Z resistive heaters, respectively; and

calculating the Z resistances based on the Z currents supplied to the Z resistive heaters, respectively.

9. The method of claim 1, wherein measuring the Z resistances of the Z zones during operation includes:

monitoring Z currents and Z voltages supplied to Z resistive heaters, respectively; and

calculating the Z resistances based on the Z currents and the Z voltages supplied to the Z resistive heaters, respectively.

10. A temperature control system controlling a temperature of a substrate support for a substrate processing system, comprising:

a substrate support including Z zones including Z resistive heaters, respectively, where Z is an integer greater than one;

a temperature sensor embedded in the one of the Z zones; and

a controller configured to:

set the temperature of the substrate support in Z-1 zones of the Z zones using Z-1 power ratios, respectively;

measure Z resistances of Z resistive heaters embedded in the Z zones at a first temperature and a second temperature;

set the temperature of the substrate support to a third temperature in response to the temperature sensor and the Z-1 power ratios;

determine Z-1 first target resistances for the Z-1 zones, respectively, at the third temperature;

measure the Z resistances of the Z resistive heaters at the third temperature, respectively; and

compare Z-1 resistances of Z-1 resistive heaters for the Z-1 zones and the Z-1 first target resistances at the third temperature, respectively, and selectively adjust the Z-1 power ratios in response thereto.

11. The temperature control system of claim 10, wherein the controller is further configured to:

set the temperature of the substrate support to a fourth temperature in response to the temperature sensor and the Z-1 power ratios;

determine Z-1 second target resistances for the Z-1 zones, respectively, at the fourth temperature;

measure the Z resistances of the Z resistive heaters at the fourth temperature, respectively; and

compare Z-1 resistances of Z-1 resistive heaters for the Z-1 zones and the Z-1 second target resistances at the fourth temperature, respectively, and selectively adjust the Z-1 power ratios in response thereto.

12. The temperature control system of claim 10, wherein the controller is configured to selectively adjust the Z-1 power ratios until the Z-1 resistances of the Z-1 resistive heaters are within a predetermined range of the Z-1 first target resistances at the third temperature.

13. The temperature control system of claim 11, wherein the controller is configured to selectively adjust the Z-1 power ratios iterates until the Z-1 resistances of the Z-1 resistive heaters are within a predetermined range of the Z-1 second target resistances at the fourth temperature.

14. The temperature control system of claim 10, wherein the controller is configured to:

determine the Z-1 first target resistances for each of the Z-1 zones in response to a sum of a resistance of a corresponding zone at the first temperature and a product of a difference and a ratio,

wherein the difference comprises a resistance of the corresponding zone at the second temperature minus a resistance of the corresponding zone at the first temperature, and

wherein the ratio comprises a numerator including a difference between a resistance at the one of the Z zones at the third temperature minus a resistance of the one of the Z zones at the first temperature and a denominator including a difference between a resistance at the one of the Z zones at the second temperature minus a resistance of the one of the Z zones at the first temperature.

15. The temperature control system of claim 10, wherein the first temperature and the second temperature are lower than an operating temperature of the substrate support during substrate processing.

16. The temperature control system of claim 10, wherein the controller is configured to measure the Z resistances of the Z resistive heaters by:

monitoring Z voltages supplied to the Z resistive heaters, respectively; and

calculating the Z resistances of the Z zones based on the Z voltages supplied to the Z resistive heaters, respectively.

17. The temperature control system of claim 10, wherein the controller is configured to measure the Z resistances of the Z resistive heaters by:

monitoring Z currents supplied to the Z resistive heaters, respectively; and

calculating the Z resistances based on the Z currents supplied to the Z resistive heaters, respectively.

18. The temperature control system of claim 10, wherein the controller is configured to measure the Z resistances of the Z resistive heaters by:

monitoring Z currents and Z voltages supplied to Z resistive heaters, respectively; and

calculating the Z resistances based on the Z currents and the Z voltages supplied to the Z resistive heaters, respectively.

19. The temperature control system of claim 10, wherein the controller is configured to control a temperature of a gas distribution device to a temperature greater than ambient temperature and less than a heated temperature of the substrate support during calibration.

20. A temperature control system controlling a temperature of a substrate support for a substrate processing system, comprising:

a substrate support including Z zones including Z resistive heaters, respectively, where Z is an integer greater than one;

a temperature sensor embedded in the one of the Z zones; and

a controller configured to:

set the temperature of the substrate support in Z-1 zones of the Z zones using Z-1 power ratios, respectively;

measure Z resistances of Z resistive heaters embedded in the Z zones at a first temperature and a second temperature;

set the temperature of the substrate support to a third temperature in response to the temperature sensor and the Z-1 power ratios;

determine Z-1 first target resistances for the Z-1 zones, respectively, at the third temperature;

measure the Z resistances of the Z resistive heaters at the third temperature, respectively; and

compare Z-1 resistances of Z-1 resistive heaters for the Z-1 zones and the Z-1 first target resistances at the third temperature, respectively, and selectively adjust the Z-1 power ratios in response thereto,

wherein the Z-1 zones do not include temperature sensors.