CLAIMS

1. A wafer chuck having a holding surface for holding a wafer, the wafer chuck comprising:

a heating and cooling unit configured to heat or cool the wafer chuck;

at least one temperature sensor disposed in the wafer chuck; and

a heat flow sensor which is disposed in the wafer chuck, and in which a plurality of thermocouples are connected in series and connecting parts between ones adjacent to each other of the thermocouples are alternately disposed at a first depth position from the holding surface and at a second depth position deeper than the first depth position, wherein

the temperature sensor is used to measure a reference temperature that is a temperature at the second depth position in a corresponding part being a part corresponding to a heat generating part of the wafer on the wafer chuck,

the heat flow sensor has a plurality of temperature measurement points provided for the respective thermocouples, the plurality of temperature measurement points being disposed over an entirety of the wafer chuck when the wafer chuck is seen in plan view, and

the heat flow sensor is used to measure a vertical temperature difference between the first depth position and the second depth position in the corresponding part.

2. The wafer chuck according to claim 1, wherein a plurality of the temperature sensors are disposed in a distributed manner.

3. A temperature control system, comprising:

the wafer chuck according to claim 1; and

a temperature control unit configured to calculate a temperature of the corresponding part or the heat generating part as a control temperature, based on a detection result of the temperature sensor and on a detection result of the heat flow sensor.

4. The temperature control system according to claim 3, wherein the temperature control unit executes:

a process of detecting, based on the detection result of the temperature sensor, the reference temperature;

a process of calculating the vertical temperature difference, based on the detection result of the heat flow sensor; and

a process of calculating, as the control temperature, a temperature of a heat generating part temperature measurement point that is a temperature of the corresponding part, based on the reference temperature and the vertical temperature difference.

5. The temperature control system according to claim 3, wherein the temperature control unit executes:

a process of detecting, based on the detection result of the temperature sensor, the reference temperature;

a process of calculating the vertical temperature difference, based on the detection result of the heat flow sensor; and

a process of calculating, as the control temperature, a device temperature that is a temperature of the heat generating part, based on the reference temperature, on the vertical temperature difference, and on data that includes physical property values and dimensions of the wafer and the wafer chuck.

6. The temperature control system according to claim 4 or 5, wherein

in the wafer chuck, a plurality of the temperature sensors are disposed in a distributed manner, and

the temperature control unit detects, as the reference temperature, a lowest temperature among temperatures respectively detected by the plurality of temperature sensors, or an average or a median of the temperatures detected by the plurality of temperature sensors.

7. A temperature control method of controlling a temperature of the wafer chuck according to claim 1, the method including:

a reference temperature detecting step of detecting, by the at least one temperature sensor, the reference temperature of the wafer chuck;

a heat flow detecting step of detecting, by the heat flow sensor, a heat flow caused by partial heat generation of the wafer held on the holding surface; and

a temperature control step of calculating the vertical temperature difference, based on a detection result of the heat flow detecting step, and calculating a temperature of the corresponding part or the heat generating part as a control temperature, based on the reference temperature detected in the reference temperature detecting step and the vertical temperature difference.

8. The temperature control method according to claim 7, wherein

the temperature control step includes

a process of calculating, as the control temperature, a temperature of a heat generating part temperature measurement point that is a temperature of the corresponding part, based on the reference temperature and the vertical temperature difference.

9. The temperature control method according to claim 7, wherein

the temperature control step includes

a process of calculating, as the control temperature, a device temperature that is a temperature of the heat generating part, based on the reference temperature, on the vertical temperature difference, and on data that includes physical property values and dimensions of the wafer and the wafer chuck.