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SENSOR

Abstract

According to one embodiment, a sensor includes a first element including a first resistance member and a first conductive member, a second element including a second resistance member, and a third resistance member connected in series with the second resistance member. An absolute value of a third temperature coefficient of a third resistance of the third resistance member is smaller than an absolute value of a first temperature coefficient of a first resistance of the first resistance member. The absolute value of the third temperature coefficient is smaller than an absolute value of a second temperature coefficient of the second resistance member. The third resistance is lower than the second resistance.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2022-035782, filed on Mar. 9, 2022; the entire contents of which are incorporated herein by reference.

FIELD

[0002] Embodiments described herein relate generally to a sensor.

BACKGROUND

[0003] For example, there is a sensor based on a MEMS (Micro Electro Mechanical Systems) element or the like. It is desired to improve the accuracy of the sensor.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. **1** is a schematic view illustrating a sensor according to a first embodiment;

[0005] FIG. **2** is a graph illustrating characteristics of the sensor;

[0006] FIG. **3** is a schematic cross-sectional view illustrating the sensor according to the first embodiment;

[0007] FIGS. **4**A and **4**B are schematic cross-sectional views illustrating the sensor according to the first embodiment;

[0008] FIG. **5** is a schematic plan view illustrating the sensor according to the first embodiment;

[0009] FIGS. **6**A and **6**B are schematic plan views illustrating the sensor according to the first embodiment;

[0010] FIG. **7** is a schematic view illustrating a sensor according to a second embodiment; and

[0011] FIG. **8** is a schematic plan view illustrating the sensor according to the second embodiment.

DETAILED DESCRIPTION

[0012] According to one embodiment, a sensor includes a first element including a first resistance member and a first conductive member, a second element including a second resistance member, and a third resistance member connected in series with the second resistance member. An absolute value of a third temperature coefficient of a third resistance of the third resistance member is smaller than an absolute value of a first temperature coefficient of a first resistance of the first resistance member. The absolute value of the third temperature coefficient is smaller than an absolute value of a second temperature coefficient of the second resistance member. The third resistance is lower than the second resistance.

[0013] According to one embodiment, a sensor includes a first element including a first resistance member and a first conductive member, a second element including a second resistance member, and a third resistance member connected in parallel with the first resistance member. An absolute value of a third temperature coefficient of a third resistance of the third resistance member is smaller than an absolute value of a first temperature coefficient of a first resistance of the first resistance member.

[0014] Various embodiments are described below with reference to the accompanying drawings.

[0015] The drawings are schematic and conceptual; and the relationships between the thickness and width of portions, the proportions of sizes among portions, etc., are not necessarily the same as the actual values. The dimensions and proportions may be illustrated differently among drawings, even for identical portions.

[0016] In the specification and drawings, components similar to those described previously or illustrated in an antecedent drawing are marked with like reference numerals, and a detailed description is omitted as appropriate.

First Embodiment

[0017] FIG. **1** is a schematic view illustrating a sensor according to a first embodiment.

[0018] FIG. **1** is a circuit diagram of a sensor **110** according to the embodiment. A shown in FIG. **1**, the sensor **110** includes a first element **10**A and a second element **10**B.

[0019] The first element **10**A includes a first resistance member **11** and a first conductive member **21**. As described later, the first conductive member **21** functions as a heater. The second element **10**B includes a second resistance member **12**. In this example, the second element **10**B includes a second conductive member **22**. The second conductive member **22** is, for example, a dummy heater.

[0020] The sensor **110** further includes a third resistance member **63**. The third resistance member **63** is connected in series with the second resistance member **12**. The sensor **110** may include a wiring member **64** and a wiring member **65**. The wiring member **64** is electrically connected with the second resistance member **12** and the third resistance member **63**. The wiring member **65** is electrically connected with the first resistance member **11**.

[0021] The first resistance member **11** has a first resistance R**1**. The second resistance member **12** has a second resistance R**2**. The third resistance member **63** has a third resistance R**3**. The wiring member **64** has a wiring resistance R**4**. The wiring member **65** has a wiring resistance R**5**. These resistances are electrical resistances.

[0022] In the embodiment, the absolute value of a third temperature coefficient of the third resistance R**3** of the third resistance member **63** is smaller than the absolute value of a first temperature coefficient of the first resistance R**1** of the first resistance member **11**. The absolute value of the third temperature coefficient is smaller than the absolute value of a second temperature coefficient of the second resistance R**2** of the second resistance member **12**. The third resistance member **63** is a low temperature coefficient resistance.

[0023] The third resistance R**3** of the third resistance member **63** is lower than the second resistance R**2** of the second resistance member **12**. For example, the wiring resistance R**4** of the wiring member **64** is lower than the third resistance R**3**.

[0024] In the embodiment, for example, a current i**1** is supplied to the first conductive member **21**. For example, a power supply **76** applies a voltage to the first conductive member **21**. As a result, the current i**1** flows through the first conductive member **21**. As the temperature of the first conductive member **21** rises, the temperature of the first resistance member **11** rises. At this time, the degree of heat conduction from the first resistance member **11** to the surrounding atmosphere changes depending on the type and concentration of the gas to be detected around the first element **10**A. For example, the thermal conductivity of the surrounding atmosphere changes depending on the type of gas. For example, the thermal conductivity of the surrounding atmosphere changes depending on the concentration of the gas.

[0025] The degree of heating of the first resistance member **11** changes depending on the degree of heat conduction of the first resistance member **11**. That is, the temperature of the first resistance member **11** changes according to the type and concentration of the gas to be detected. As a result, the electrical resistance of the first resistance member **11** changes. By detecting the change in the electrical resistance of the first resistance member **11**, the type and concentration of the gas to be detected existing around the first element **10**A can be detected.

[0026] In this example, a first detection current id**1** is supplied to the first resistance member **11** from a first current source **75***a*. The potential of one end of the first resistance member **11** based on the first detection current id**1** is detected.

[0027] On the other hand, the second element **10**B is not provided with a conductive member. Alternatively, in the second element **10**B, even if the conductive member (second conductive member **22**) is provided, no current is supplied to the second conductive member **22**. As a result, the temperature of the second resistance member **12** is substantially unaffected by the detection target. By observing the difference between the characteristics of the second resistance member **12** and the characteristics of the first resistance member **11**, the change in temperature of the first resistance member **11** can be detected with high accuracy. As a result, the gas to be detected can be detected with high accuracy. The second resistance member **12** is, for example, a reference element.
[0028] For example, in the second element **10**B, a second detection current id**2** is supplied to the second resistance member **12** from a second current source **75***b*. The potential of the second resistance member **12** based on the second detection current id**2** is detected.
[0029] In this example, a differential amplifier **71** is provided. The differential amplifier **71** includes a first input **71***a* and a second input **71***b*. A signal corresponding to the potential of the first resistance member **11** is input to the first input **71***a*. A signal corresponding to the potential of the second resistance member **12** is input to the second input **71***b*.
[0030] By detecting a difference between the potential of the first resistance member **11** and the potential of the second resistance member **12**, the change in the electric resistance of the first resistance member **11** due to the detection target can be extracted with high accuracy.
[0031] The output of the differential amplifier **71** may be input to an AD conversion circuit **72**. The change in the electrical resistance of the first resistance member **11** may be output as a digital value.
[0032] The sensor **110** may include a circuit part **70**. The circuit part **70** includes the differential amplifier **71**. The circuit part **70** may include the AD conversion circuit **72**. The circuit part **70** may include the power supply **76**. The circuit part **70** may include the first current source **75***a* and the second current source **75***b*. The value of the second detection current id**2** may be the same as the value of the first detection current id**1**.
[0033] For example, the configuration (material and shape) of the second resistance member **12** is substantially the same as the configuration (material and shape) of the first resistance member **11**. As a result, when the temperatures of these resistance members are the same, the electrical resistance and the temperature coefficient of these resistance members are substantially the same. As a result, it is expected that the change in the resistance of the first resistance member **11** can be detected with high accuracy by differential amplification even when the environmental temperature around the sensor changes.
[0034] However, as described above, the first resistance member **11** is heated by the first conductive member **21**. Therefore, in the detection operation, the temperature of the first resistance member **11** is higher than the temperature of the second resistance member **12**. Therefore, a difference (offset) occurs between the electrical resistance of the first resistance member **11** and the electrical resistance of the second resistance member **12**. This offset may result in inaccurate detection of changes in the resistance of the first resistance member **11**. When the offset exceeds the operating range of the differential amplifier **71**, it becomes difficult to detect the change in the resistance of the first resistance member **11**.
[0035] On the other hand, a reference example for designing the second resistance member **12** can be considered in consideration of the change in the electric resistance due to the temperature rise of the first resistance member **11** in advance. For example, the shape of the second resistance member **12** is made different from the shape of the first resistance member **11**. As a result, the electrical resistance of the second resistance member **12** whose temperature does not rise substantially can be made substantially the same as the electrical resistance of the first resistance member **11** whose temperature has risen. However, in this reference example, since the shape of the second resistance member **12** is different from the shape of the first resistance member **11**, the temperature

coefficients of the electrical resistance of these resistance members do not match. There is a difference in temperature coefficient. Therefore, for example, when the environmental temperature around the sensor changes, it is difficult to detect the change in the electrical resistance of the first resistance member **11** with high accuracy.

[0036] In the embodiment, the third resistance member **63** is provided. The third resistance member **63** is connected in series with the second resistance member **12**. As a result, the electrical resistance of the series circuit of the second resistance member **12** and the third resistance member **63** increases. The electrical resistance of the series circuit can be made substantially the same as the electrical resistance of the first resistance member **11** when the temperature rises.

[0037] Further, the third resistance member **63** is set to have a small temperature coefficient of electrical resistance. For example, as will be described later, a material of the third resistance member **63** is different from that of the first resistance member **11** and the second resistance member **12**. As a result, a low temperature coefficient can be obtained in the third resistance member **63**.

[0038] Since the temperature coefficient of the third resistance member **63** is small, the temperature change of the electrical resistance of the third resistance member **63** can be substantially ignored. As a result, a difference in temperature coefficient between the series circuit including the second resistance member **12** and the third resistance member **63** and the first resistance member **11** can be made small to a negligible extent. The difference in temperature coefficient can be suppressed.

[0039] In the embodiment, the change in the electric resistance of the first resistance member **11** can be detected with high accuracy even when the environmental temperature around the sensor changes, for example. As a result, the detection target can be detected with high accuracy in a wide temperature range.

[0040] For example, the first resistance member **11** is heated by the first conductive member **21**. A material that can obtain stable characteristics even when heated is applied to the first resistance member **11**. The temperature coefficient is not always small in materials that emphasize stability of properties. In other words, the temperature coefficient of the first resistance member **11** is relatively large.

[0041] As described above, the second resistance member **12** is a reference element. Therefore, it is preferable that the configuration of the second resistance member **12** is set to be substantially the same as the configuration of the first resistance member **11**. Therefore, the temperature characteristic of the second resistance member **12** is also large as in the first resistance member **11**.

[0042] In the embodiment, by providing the third resistance member **63**, the configuration of the second resistance member **12** can be the same as the configuration of the first resistance member **11**. Thereby, for example, the temperature coefficient of the second resistance member **12** can be made substantially the same as the temperature coefficient of the first resistance member **11**. For example, the design of the second resistance member **12** is simplified and the manufacturing efficiency is high.

[0043] As described above, in the embodiment, the absolute value of the third temperature coefficient of the third resistance R**3** of the third resistance member **63** is smaller than the absolute value of the first temperature coefficient of the first resistance R**1** of the first resistance member **11**. The absolute value of the third temperature coefficient is smaller than the absolute value of the second temperature coefficient of the second resistance R**2** of the second resistance member **12**. The third resistance member **63** having a small temperature coefficient is used. Thereby, the electrical resistance of the series circuit including the second element **10**B and the third resistance member **63** can be made substantially the same as the resistance of the first element **10**A when heated. Then, the temperature coefficient of the series circuit can be made substantially the same as the temperature coefficient of the first element **10**A.

[0044] In the embodiment, the third resistance R**3** is lower than the second resistance R**2**. The sum of the third resistance R**3** and the second resistance R**2** is substantially the same as the first resistance R**1** when heated. For example, the third resistance R**3** corresponds to a difference between the first resistance R**1** when heated and the second resistance R**2** which is substantially unheated. The amount of change in the first resistance R**1** due to the temperature change of the first resistance member **11** is smaller than the absolute value of the first resistance R**1** (that is, the absolute value of the second resistance R**2**). Since the third resistance R**3** is lower than the second resistance R**2**, the sum of the third resistance R**3** and the second resistance R**2** can be substantially the same as the first resistance R**1** when heated. In the embodiment, the third resistance R**3** is lower than the first resistance R**1**.

[0045] A wiring resistance exists in the first element **10**A and the second element **10**B. The wiring resistance is lower than the resistance of the resistance member. As a result, the desired operation can be obtained while suppressing the loss.

[0046] For example, in the first element **10**A, there is a wiring resistance (not shown in FIG. **1**) due to the wiring member. This wiring resistance is lower than that of the first resistance R**1** of the first resistance member **11**, and can be ignored.

[0047] For example, in the second element **10**B, there is a wiring resistance R**4** due to the wiring member **64**. The wiring resistance R**4** is lower than the second resistance R**2** of the second resistance member **12**, and lower than the third resistance R**3** of the third resistance member **63**.

[0048] In the embodiment, the absolute value of the third temperature coefficient of the third resistance R**3** of the third resistance member **63** is not more than ⅓ of the absolute value of the first temperature coefficient of the first resistance R**1** of the first resistance member. The absolute value of the third temperature coefficient is not more than ⅓ of the absolute value of the second temperature coefficient of the second resistance R**2** of the second resistance member **12**. This makes it possible to suppress the difference in temperature coefficient.

[0049] In the embodiment, the absolute value of the first temperature coefficient is, for example, not less than 300 ppm/K. The absolute value of the second temperature coefficient is, for example, not less than 300 ppm/K. The absolute value of the third temperature coefficient is, for example, not more than 100 ppm/K. The absolute value of the third temperature coefficient may be, for example, not more than 50 ppm/K. The difference in temperature coefficient can be further suppressed.

[0050] For example, the third resistance member **63** includes, for example, at least one selected from the group consisting of Ni and Cr. A small temperature coefficient is obtained. For example, the third resistance member **63** includes Ni and Cr. At this time, the composition ratio of Cr in the third resistance member **63** is, for example, not less than 30 wt % and not more than 80 wt %. An example of the temperature coefficient of a material including Ni and Cr will be described later.

[0051] The first resistance member **11** and the second resistance member **12** include at least one selected from the group consisting of Ti, TiN, Al, W, Si, Cu, Au, Pd and Pt. For example, in the first resistance member **11**, stable characteristics can be obtained when heated. The material of the second resistance member **12** is, for example, the same as the material of the first resistance member **11**. In the second resistance member **12**, good characteristics as a reference element can be obtained.

[0052] The wiring member **64** includes, for example, at least one selected from the group consisting of aluminum, copper and gold. Low wiring resistance R**4** is stable and easy to obtain.

[0053] The wiring resistance R**4** is, for example, not more than ⅓ times of the third resistance R**3**. The wiring resistance R**4** is, for example, not less than 0.01Ω and less than 100Ω. The wiring resistance R**5** is, for example, not more than ⅓ times of the first resistance R**1**. The wiring resistance R**5** is, for example, not less than 0.01Ω and less than 100Ω. The third resistance R**3** is, for example, not less than 2Ω and not more than 100 kΩ. The first resistance R**1** is, for example, not less than 100Ω and not more than 1 MΩ. The second resistance R**2** is, for example, not less than 100Ω and not more than 1 MΩ.

[0054] FIG. **2** is a graph illustrating characteristics of the sensor.

[0055] FIG. **2** illustrates a temperature coefficient of a material including Ni and Cr. The horizontal axis is a concentration C**1** (Cr) of Cr. The vertical axis is a temperature coefficient TCR of electrical resistivity. As shown in FIG. **2**, a small temperature coefficient TCR can be obtained when the Cr concentration C**1** (Cr) is not less than 30 wt % and not more than 80 wt %. When the third resistance member **63** includes Ni and Cr, the composition ratio of Cr in the third resistance member **63** is preferably, for example, not less than 30 wt % and not more than 80 wt %. When the third resistance member **63** includes Ni and Cr, the composition ratio of Cr in the third resistance member **63** is more preferably not less than 40 wt % and not more than 80 wt %, for example. An even smaller temperature coefficient TCR is obtained.

[0056] In the following, an example of the configuration of the first element **10**A and the second element **10**B will be described.

[0057] FIGS. **3**, **4**A and **4**B are schematic cross-sectional views illustrating the sensor according to the first embodiment.

[0058] FIG. **5** is a schematic plan view illustrating the sensor according to the first embodiment.

[0059] FIG. **3** is a cross-sectional view taken along line A**1**-A**2** of FIG. **5**. FIG. **4**A is a cross-sectional view taken along line B**1**-B**2** of FIG. **5**. FIG. **4**B is a cross-sectional view taken along line C**1**-C**2** of FIG. **5**.

[0060] As shown in FIGS. **3**, **4**A, **4**B and **5**, the sensor **110** according to the embodiment includes a base body **41**, the first element **10**A, the second element **10**B, the third resistance member **63** and the wiring member **64**.

[0061] The base body **41** includes a first base body region **41***a* and a second base body region **41***b*. In this example, the base body **41** includes a substrate **41***s* and an insulating film **41***i*. The substrate **41***s* may be, for example, a semiconductor substrate (for example, a silicon substrate). The substrate **41***s* may include, for example, a semiconductor circuit or the like. The substrate **41***s* may include a connecting member such as a via electrode.

[0062] The first element **10**A is provided in the first base body region **41***a*. A first direction from the first base body region **41***a* to the first element **10**A is taken as a Z-axis direction. One direction perpendicular to the Z-axis direction is taken as an X-axis direction. A direction perpendicular to the Z-axis direction and the X-axis direction is taken as a Y-axis direction.

[0063] A second direction from the first base body region **41***a* to the second base body region **41***b* crosses the first direction. The second direction is, for example, the X-axis direction.

[0064] The first element **10**A includes a first detection element **11**E. The first detection element **11**E includes the first resistance member **11** and the first conductive member **21**. As shown in FIGS. **3** and **5**, the first resistance member **11** includes a first resistance portion **11***a* and a first resistance other portion **11***b*. For example, the first resistance portion **11***a* may be one end of the first resistance member **11**. The first resistance other portion **11***b* may be another end of the first resistance member **11**. As shown in FIGS. **4**A and **5**, the first conductive member **21** includes a first conductive portion **21***a* and a first conductive other portion **21***b*. For example, the first conductive portion **21***a* may be one end of the first conductive member **21**. The first conductive other portion **21***b* may be another end of the first conductive member **21**.

[0065] As shown in FIGS. **3** and **5**, in this example, the first element **10**A further includes a first connection portion **31**C and a first support portion **31**S. The first support portion **31**S is fixed to the base body **41**. A part of the first connection portion **31**C is supported by the first support portion **31**S. Another part of the first connection portion **31**C supports the first detection element **11**E away from the first base body region **41***a*. A first gap g**1** is provided between the first base body region **41***a* and the first detection element **11**E.

[0066] In this example, the first element **10**A further includes a first other connection portion **31***a*C and a first other support portion **31***a*S. The first other support portion **31***a*S is fixed to the base body **41**. A part of the first other connection portion **31***a*C is supported by the first other support portion **31***a*S. Another part of the first other connection portion **31***a*C supports the first detection element

11E away from the first base body region **41**_a_. In this example, there is at least a part of the first detection element **11**E between the first connection portion **31**C and the first other connection portion **31**_a_C.

[0067] The second element **10**B is provided in the second base body region **41**_b_. A direction from the second base body region **41**_b_ to the second element **10**B is along the Z-axis direction.

[0068] The second element **10**B includes a second detection element **12**E. In this example, the second detection element **12**E includes the second resistance member **12** and the second conductive member **22**. As shown in FIGS. **3** and **5**, the second resistance member **12** includes a second resistance portion **12**_a_ and a second resistance other portion **12**_b_. For example, the second resistance portion **12**_a_ may be one end of the second resistance member **12**. The second resistance other portion **12**_b_ may be another end of the second resistance member **12**. As shown in FIGS. **4**B and **5**, the second conductive member **22** includes a second conductive portion **22**_a_ and a second conductive other portion **22**_b_. For example, the second conductive portion **22**_a_ may be one end of the second conductive member **22**. The second conductive other portion **22**_b_ may be another end of the second conductive member **22**.

[0069] As shown in FIGS. **3** and **5**, in this example, the second element **10**B further includes a second connection portion **32**C and a second support portion **32**S. The second support portion **32**S is fixed to the base body **41**. A part of the second connection portion **32**C is supported by the second support portion **32**S. Another part of the second connection portion **32**C supports the second detection element **12**E away from the second base body region **41**_b_. In this example, the second gap g**2** is provided between the second base body region **41**_b_ and the second detection element **12**E.

[0070] In this example, the second element **10**B further includes a second other connection portion **32**_a_C and a second other support portion **32**_a_S. The second other support portion **32**_a_S is fixed to the base body **41**. A part of the second other connection portion **32**_a_C is supported by the second other support portion **32**_a_S. Another part of the second other connection portion **32**_a_C supports the second detection element **12**E away from the second base body region **41**_b_. In this example, there is at least a part of the second detection element **12**E between the second connection portion **32**C and the second other connection portion **32**_a_C.

[0071] By supporting the first detection element **11**E away from the base body **41**, the heat of these detection elements is suppressed from being conducted through the base body **41**. This facilitates stable detection of the detection target with high sensitivity.

[0072] For example, the first resistance portion **11**_a_ is electrically connected with the circuit part **70** via a wiring layer **51**M and a terminal **51**MT. For example, the first resistance other portion **11**_b_ is electrically connected with the circuit part **70** via a wiring layer **51**_a_M and a terminal **51**_a_MT. For example, the first conductive portion **21**_a_ is electrically connected with the circuit part **70** via a wiring layer **53**M and a terminal **53**MT. For example, the first conductive other portion **21**_b_ is electrically connected with the circuit part **70** via the wiring layer **53**_a_M and the terminal **53**_a_MT.

[0073] For example, the second resistance portion **12**_a_ is electrically connected with the third resistance member **63** via a wiring layer **52**M. The third resistance member **63** is electrically connected with the wiring member **64**. The wiring member **64** is electrically connected with the circuit part **70** via a terminal **52**MT. For example, the second resistance other portion **12**_b_ is electrically connected with the circuit part **70** via a wiring layer **52**_a_M and a terminal **52**_a_MT. The second conductive portion **22**_a_ is not electrically connected with the circuit part **70**. The second conductive other portion **22**_b_ is not electrically connected with the circuit part **70**. In the embodiment, the second conductive portion **22**_a_ and the second conductive other portion **22**_b_ may be electrically connected with the circuit part **70**, and no current may be supplied from the circuit part **70**.

[0074] The circuit part **70** outputs a signal **70**_s_ corresponding to the output of the differential amplifier **71** (see FIG. **1**).

[0075] As shown in FIG. **3**, the first element **10**A (and the first detection element **11**E) may include a first insulating member **18**A. The second element **10**B (and the second detection element **12**E) may include a second insulating member **18**B. At least a part of the first insulating member **18**A is provided around the first resistance member **11** and the first conductive member **21**. A part of the first insulating member **18**A is provided between the first resistance member **11** and the first conductive member **21**. At least a part of the second insulating member **18**B is provided around the second resistance member **12** and the second conductive member **22**. A part of the second insulating member **18**B is provided between the second resistance member **12** and the second conductive member **22**. The second insulating member **18**B has substantially the same structure as the first insulating member **18**A. A length, width, thickness and material of the second insulating member **18**B are substantially the same as a length, width, thickness and material of the first insulating member **18**A.

[0076] As shown in FIG. **3**, the first element **10**A may further include a first conductive layer **51**L. The first conductive layer **51**L is electrically connected with the first resistance portion **11***a* of the first resistance member **11**. At least a part of the first conductive layer **51**L may be provided on the first support portion **31**S. In this example, the first conductive layer **51**L is electrically connected with the wiring layer **51**M provided on the base body **41**.

[0077] As shown in FIG. **3**, the second element **10**B may further include a second conductive layer **52**L. The second conductive layer **52**L is electrically connected with the second resistance portion **12***a* of the second resistance member **12**. At least a part of the second conductive layer **52**L may be provided on the second support portion **32**S. In this example, the second conductive layer **52**L is electrically connected with the wiring layer **52**M provided on the base body **41**.

[0078] The first element **10**A may further include a first other conductive layer **51***a*L. The first other conductive layer **51***a*L is electrically connected with the first resistance other portion **11***b* of the first resistance member **11**. At least a part of the first other conductive layer **51***a*L may be provided on the first other support portion **31***a*S. In this example, the first other conductive layer **51***a*L is electrically connected with the wiring layer **51***a*M provided on the base body **41**.

[0079] The second element **10**B may further include a second other conductive layer **52***a*L. The second other conductive layer **52***a*L is electrically connected with the second resistance other portion **12***b* of the second resistance member **12**. At least a part of the second other conductive layer **52***a*L may be provided on the second other support portion **32***a*S. In this example, the second other conductive layer **52***a*L is electrically connected with the wiring layer **52***a*M provided on the base body **41**.

[0080] As shown in FIGS. **4**A and **5**, in this example, the first element **10**A includes a third connection portion **33**C and a third support portion **33**S. The third support portion **33**S is fixed to the base body **41**. A part of the third connection portion **33**C is supported by the third support portion **33**S. Another part of the third connection portion **33**C supports the first detection element **11**E away from the first base body region **41***a*.

[0081] In this example, the first element **10**A includes a third other connection portion **33***a*C and a third other support portion **33***a*S. The third other support portion **33***a*S is fixed to the base body **41**. A part of the third other connection portion **33***a*C is supported by the third other support portion **33***a*S. Another part of the third other connection portion **33***a*C supports the first detection element **11**E away from the first base body region **41***a*.

[0082] As shown in FIG. **4**A, the first element **10**A may further include a third conductive layer **53**L. At least a part of the third conductive layer **53**L is provided on the third support portion **33**S. In this example, the third conductive layer **53**L is electrically connected with the wiring layer **53**M provided on the base body **41**.

[0083] As shown in FIG. **4**A, the first element **10**A may further include a third other conductive layer **53***a*L. At least a part of the third other conductive layer **53***a*L is provided on the third other support portion **33***a*S. In this example, the third other conductive layer **53***a*L is electrically connected with the wiring layer **53***a*M provided on the base body **41**.

[0084] As shown in FIGS. **4**B and **5**, in this example, the second element **10**B includes a fourth connection portion **34**C and a fourth support portion **34**S. The fourth support portion **34**S is fixed to the base body **41**. A part of the fourth connection portion **34**C is supported by the fourth support portion **34**S. Another portion of the fourth connection portion **34**C supports the second detection element **12**E away from the second base body region **41***b*.

[0085] In this example, the second element **10**B includes a fourth other connection portion **34***a*C and a fourth other support portion **34***a*S. The fourth other support portion **34***a*S is fixed to the base body **41**. A part of the fourth other connecting portion **34***a*C is supported by the fourth other support portion **34***a*S. Another part of the fourth other connection portion **34***a*C supports the second detection element **12**E away from the second base body region **41***b*.

[0086] As shown in FIG. **4**B, the second element **10**B may further include a fourth conductive layer **54**L. At least a part of the fourth conductive layer **54**L is provided on the fourth support portion **34**S. In this example, the fourth conductive layer **54**L is electrically connected with the wiring layer **54**M provided on the base body **41**. The fourth conductive layer **54**L is electrically connected with the second conductive portion **22***a*.

[0087] As shown in FIG. **4**B, the second element **10**B may further include a fourth other conductive layer **54***a*L. At least a part of the fourth other conductive layer **54***a*L is provided on the fourth other support portion **34***a*S. In this example, the fourth other conductive layer **54***a*L is electrically connected with the wiring layer **54***a*M provided on the base body **41**. The fourth other conductive layer **54***a*L is electrically connected with the second conductive other portion **22***b*.

[0088] FIGS. **6**A and **6**B are schematic plan views illustrating the sensor according to the first embodiment.

[0089] These figures are plan views of the layer including the first resistance member **11** and the second resistance member **12**.

[0090] As shown in FIG. **6**A, the first detection element **11**E may include a first layer **15***a* and a second layer **15***b*. The first layer **15***a* and the second layer **15***b* have the same material and thickness as the first resistance member **11**. The first resistance member **11** is provided between the first layer **15***a* and the second layer **15***b*. By providing these layers, warp (deformation) of the first detection element **11**E is suppressed.

[0091] As shown in FIG. **6**B, the second detection element **12**E may include a third layer **15***c* and a fourth layer **15***d*. The third layer **15***c* and the fourth layer **15***d* have the same material and thickness as the second resistance member **12**. The second resistance member **12** is provided between the third layer **15***c* and the fourth layer **15***d*. By providing these layers, warp (deformation) of the second detection element **12**E is suppressed.

[0092] As described above, in this example, the first gap g**1** is provided between the first base body region **41***a* and the first resistance member **11**, and the second gap g**2** is provided between the second base body region **41***b* and the second resistance member **12**. In the embodiment, it is not necessary to provide a gap between the second base body region **41***b* and the second resistance member **12**.

[0093] As shown in FIG. **5**, a position of the third resistance member **63** in the second direction (for example, the X-axis direction) is between a position of the first resistance member **11** in the second direction and a position of the second resistance member **12** in the second direction. The second resistance member **12** is provided at a position far from the first resistance member **11**. In the second resistance member **12**, the influence of the temperature rise of the first element **10**A is suppressed. Even if the third resistance member **63** having a small temperature coefficient is provided near the first resistance member **11** (first element **10**A), the influence of the temperature rise on the third resistance member **63** can be substantially ignored.

[0094] As shown in FIG. **3**, the base body **41** may include a third base body region **41***c*. The third base body region **41***c* is between the first base body region **41***a* and the second base body region **41***b*. The third resistance member **63** is provided, for example, in the third base body region **41***c*.

[0095] For example, the planar shape of the second element **10**B in the plane (X-Y plane) crossing the first direction (Z-axis direction) is substantially the same as the planar shape of the first element **10**A in the plane (X-Y plane).

Second Embodiment

[0096] FIG. **7** is a schematic view illustrating a sensor according to a second embodiment.

[0097] FIG. **7** is a circuit diagram of a sensor **120** according to the embodiment. As shown in FIG. **7**, the sensor **120** includes the first element **10**A, the second element **10**B, and the third resistance member **63**.

[0098] The first element **10**A includes the first resistance member **11** and the first conductive member **21**. The second element **10**B includes the second resistance member **12**. The second element **10**B may include the second conductive member **22**. The third resistance member **63** is connected in parallel with the first resistance member **11**. The absolute value of the third temperature coefficient of the third resistance R**3** of the third resistance member **63** is smaller than the absolute value of the first temperature coefficient of the first resistance R**1** of the first resistance member **11**. In the sensor **120**, the configuration of the first element **10**A and the second element **10**B may be the same as the configuration of the sensor **110**.

[0099] In the sensor **120**, a parallel circuit including the first resistance member **11** and the third resistance member **63** is provided. As a result, when the temperature of the first resistance member **11** rises, the electrical resistance of the parallel circuit approaches the electrical resistance of the second resistance member **12**. Since the absolute value of the third temperature coefficient of the third resistance R**3** of the third resistance member **63** is small, the temperature coefficient of the parallel circuit can be made substantially the same as the temperature coefficient of the second element **10**B.

[0100] In this example, the wiring member **64** is connected in series with the third resistance member **63**. The third resistance member **63** and the wiring member **64** connected in series are connected in parallel with the first resistance member **11**. The wiring resistance R**4** of the wiring member **64** is lower than the third resistance R**3**. The wiring resistance R**4** may be practically ignored.

[0101] FIG. **8** is a schematic plan view illustrating the sensor according to the second embodiment.

[0102] As shown in FIG. **8**, in the sensor **120** according to the embodiment, the third resistance member **63** is provided. The third resistance member **63** is electrically connected in parallel with the first resistance portion **11***a* and the first resistance other portion **11***b*. In this example, the wiring member **64** electrically connected with the third resistance member **63** makes an electrical connection. In this example, the wiring member **64** crosses the first element **10**A (for example, the third connection portion **33**C) in the Z-axis direction. The wiring member **64** may be a bonding wire.

[0103] In the first embodiment and the second embodiment, the first resistance R**1** of the first resistance member **11** changes due to the temperature rise of the first resistance member **11** due to the current i**1** flowing through the first conductive member **21**. A third resistance member **63** is provided to compensate for the changed resistance. As a result, the detection target can be detected with high accuracy. The first resistance R**1** changed due to the temperature rise changes according to the state of the gas (detection target) around the first element **10**A.

[0104] In embodiments, detection targets include, for example, at least one selected from the group consisting of hydrogen, helium, carbon dioxide, methane and sulfur hexafluoride (SF.sub.6), methane and propane.

[0105] In the embodiment, the operation of the sensor may be linked with the arithmetic device. For example, data of an appropriate value regarding the resistance value of the third resistance member **63** from the test result of the sensor may be stored in the memory. Using the test results after manufacturing the sensor, the shape of the resistance layer to be the third resistance member **63** may be deformed by trimming or the like. In the third resistance member **63**, the resistance is adjusted. Trimming may be performed using, for example, a laser.

[0106] The embodiment may include the following configurations (e.g., technical proposals).

Configuration 1

[0107] A sensor, comprising: [0108] a first element including a first resistance member and a first conductive member; [0109] a second element including a second resistance member; and [0110] a third resistance member connected in series with the second resistance member, [0111] an absolute value of a third temperature coefficient of a third resistance of the third resistance member being smaller than an absolute value of a first temperature coefficient of a first resistance of the first resistance member, [0112] the absolute value of the third temperature coefficient being smaller than an absolute value of a second temperature coefficient of the second resistance member, and [0113] the third resistance being lower than the second resistance.

Configuration 2

[0114] The sensor according to Configuration 1, wherein [0115] the third resistance is lower than the first resistance.

Configuration 3

[0116] The sensor according to Configuration 1 or 2, further comprising: [0117] a wiring member electrically connected with the second resistance member and the third resistance member, [0118] a wiring resistance of the wiring member being lower than the third resistance.

Configuration 4

[0119] A sensor, comprising: [0120] a first element including a first resistance member and a first conductive member; [0121] a second element including a second resistance member; and [0122] a third resistance member connected in parallel with the first resistance member, [0123] an absolute value of a third temperature coefficient of a third resistance of the third resistance member being smaller than an absolute value of a first temperature coefficient of a first resistance of the first resistance member.

Configuration 5

[0124] The sensor according to Configuration 4, further comprising: [0125] a wiring member connected in series with the third resistance member, [0126] the third resistance member and the wiring member connected in series being connected in parallel with the first resistance member, [0127] a wiring resistance of the wiring member being lower than the third resistance.

Configuration 6

[0128] The sensor according to Configuration 1 or 4, wherein [0129] a first resistance of the first resistance member changes due to temperature rise of the first resistance member due to a current flowing through the first conductive member.

Configuration 7

[0130] The sensor according to Configuration 6, wherein [0131] the first resistance changed due to the temperature rise changes depending on a state of gas around the first element.

Configuration 8

[0132] The sensor according to any one of Configurations 1 to 7, wherein [0133] the second element further includes a second conductive member.

Configuration 9

[0134] The sensor according to any one of Configurations 1 to 8, further comprising: [0135] a base body including a first base body region and a second base body region, [0136] the first element being provided in the first base body region, [0137] a first gap being provided between the first base body region and the first resistance member, [0138] the second element being provided in the second base body region, and [0139] a second direction from the first base body region to the second base body region crossing a first direction from the first base body region to the first resistance member.

Configuration 10

[0140] The sensor according to Configuration 9, wherein [0141] a second gap is provided between

the second base body region and the second resistance member.
Configuration 11
[0142] The sensor according to Configuration 9 or 10, wherein [0143] a planar shape of the second element in a plane crossing the first direction is substantially same as a planar shape of the first element in the plane.
Configuration 12
[0144] The sensor according to any one of Configurations 9 to 11, wherein [0145] a position of the third resistance member in the second direction is between a position of the first resistance member in the second direction and a position of the second resistance member in the second direction.
Configuration 13
[0146] The sensor according to any one of Configurations 1 to 12, wherein [0147] the absolute value of the third temperature coefficient is not more than ⅓ of the absolute value of the first temperature coefficient, and not more than ⅓ of the absolute value of the second temperature coefficient.
Configuration 14
[0148] The sensor according to any one of Configurations 1 to 13, wherein [0149] the absolute value of the first temperature coefficient is not less than 300 ppm/K, [0150] the absolute value of the second temperature coefficient is not less than 300 ppm/K, and [0151] the absolute value of the third temperature coefficient is not more than 100 ppm/K.
Configuration 15
[0152] The sensor according to Configuration 14, wherein [0153] the absolute value of the third temperature coefficient is not more than 50 ppm/K.
Configuration 16
[0154] The sensor according to any one of Configurations 1 to 15, wherein [0155] the third resistance member includes at least one selected from the group consisting of Ni and Cr.
Configuration 17
[0156] The sensor according to any one of Configurations 1 to 16, wherein [0157] the third resistance member includes Ni and Cr, and a composition ratio of Cr in the third resistance member is not less than 30 wt % and not more than 80 wt %.
Configuration 18
[0158] The sensor according to Configuration 16 or 17, wherein [0159] the first resistance member and the second resistance member include at least one selected from the group consisting of Ti, TiN, Al, W, Si, Cu, Au, Pd and Pt.
Configuration 19
[0160] The sensor according to Configuration 3 or 5, wherein [0161] the wiring member includes at least one selected from the group consisting of aluminum, copper and gold.
Configuration 20
[0162] The sensor according to any one of Configurations 1 to 19, further comprising: [0163] a circuit part, [0164] the circuit part including a differential amplifier including a first input and a second input, [0165] a signal corresponding to a potential of the first resistance member being input to the first input, and [0166] a signal corresponding to a potential of the second resistance member being input to the second input.
[0167] According to one embodiment, a sensor can be provided, in which accuracy improvement is possible.
[0168] Hereinabove, exemplary embodiments of the invention are described with reference to specific examples. However, the embodiments of the invention are not limited to these specific examples. For example, one skilled in the art may similarly practice the invention by appropriately selecting specific configurations of components included in sensors such as base bodies, elements, processors, etc., from known art. Such practice is included in the scope of the invention to the extent that similar effects thereto are obtained.

[0169] Further, any two or more components of the specific examples may be combined within the extent of technical feasibility and are included in the scope of the invention to the extent that the purport of the invention is included.
[0170] Moreover, all sensors practicable by an appropriate design modification by one skilled in the art based on the sensors described above as embodiments of the invention also are within the scope of the invention to the extent that the spirit of the invention is included.
[0171] Various other variations and modifications can be conceived by those skilled in the art within the spirit of the invention, and it is understood that such variations and modifications are also encompassed within the scope of the invention.
[0172] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the invention.

Claims

1-3. (canceled)
4. A sensor, comprising: a first element including a first resistance member and a first conductive member; a second element including a second resistance member; and a third resistance member connected in parallel with the first resistance member, an absolute value of a third temperature coefficient of a third resistance of the third resistance member being smaller than an absolute value of a first temperature coefficient of a first resistance of the first resistance member.
5. The sensor according to claim 4, further comprising: a wiring member connected in series with the third resistance member, the third resistance member and the wiring member connected in series being connected in parallel with the first resistance member, a wiring resistance of the wiring member being lower than the third resistance.
6-20. (canceled)
21. The sensor according to claim 4, wherein a first resistance of the first resistance member changes due to temperature rise of the first resistance member due to a current flowing through the first conductive member.
22. The sensor according to claim 21, wherein the first resistance changed due to the temperature rise changes depending on a state of gas around the first element.
23. The sensor according to claim 4, wherein the second element further includes a second conductive member.
24. The sensor according to claim 4, further comprising: a base body including a first base body region and a second base body region, the first element being provided in the first base body region, a first gap being provided between the first base body region and the first resistance member, the second element being provided in the second base body region, and a second direction from the first base body region to the second base body region crossing a first direction from the first base body region to the first resistance member.
25. The sensor according to claim 24, wherein a second gap is provided between the second base body region and the second resistance member.
26. The sensor according to claim 24, wherein a planar shape of the second element in a plane crossing the first direction is substantially same as a planar shape of the first element in the plane.
27. The sensor according to claim 24, wherein a position of the third resistance member in the second direction is between a position of the first resistance member in the second direction and a position of the second resistance member in the second direction.

28. The sensor according to claim 4, wherein the absolute value of the third temperature coefficient is not more than ⅓ of the absolute value of the first temperature coefficient, and not more than ⅓ of the absolute value of the second temperature coefficient.

29. The sensor according to claim 4, wherein the absolute value of the first temperature coefficient is not less than 300 ppm/K, the absolute value of the second temperature coefficient is not less than 300 ppm/K, and the absolute value of the third temperature coefficient is not more than 100 ppm/K.

30. The sensor according to claim 29, wherein the absolute value of the third temperature coefficient is not more than 50 ppm/K.

31. The sensor according to claim 4, wherein the third resistance member includes at least one selected from the group consisting of Ni and Cr.

32. The sensor according to claim 4, wherein the third resistance member includes Ni and Cr, and a composition ratio of Cr in the third resistance member is not less than 30 wt % and not more than 80 wt %.

33. The sensor according to claim 31, wherein the first resistance member and the second resistance member include at least one selected from the group consisting of Ti, TiN, Al, W, Si, Cu, Au, Pd and Pt.

34. The sensor according to claim 5, wherein the wiring member includes at least one selected from the group consisting of aluminum, copper and gold.

35. The sensor according to claim 4, further comprising: a circuit part, the circuit part including a differential amplifier including a first input and a second input, a signal corresponding to a potential of the first resistance member being input to the first input, and a signal corresponding to a potential of the second resistance member being input to the second input.