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Magnetism detection device

Abstract

A magnetism detection device according to an embodiment of the disclosure includes a sensor section and a resistive section. The sensor section includes a first magnetism detection element. The first magnetism detection element has a first stacked structure and is configured to detect a magnetic field to be detected. The resistive section includes a first resistive element and is coupled to the sensor section. The first resistive element has the first stacked structure.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This is a Continuation of application Ser. No. 17/227,745 filed Apr. 12, 2021, which in turn is a Continuation of application Ser. No. 16/356,210 filed Mar. 18, 2019, which claims the benefit of Japanese Priority Patent Application No. 2018-051264 filed on Mar. 19, 2018, the entire contents of which are incorporated herein by reference.

BACKGROUND
(1) The disclosure relates to a magnetism detection device provided with a magnetism detection element and a resistive element.
(2) The Applicant of the present application has proposed a magnetic sensor provided with a circuit in which a plurality of magneto-resistive effect elements are coupled in series to a compensation resistor. The plurality of magneto-resistive effect elements constitute a bridge circuit. For example, reference is made to Japanese Unexamined Patent Application Publication No. 2011-33456.
SUMMARY
(3) A magnetism detection device according to one embodiment of the disclosure includes a sensor section and a resistive section. The sensor section includes a first magnetism detection element. The first magnetism detection element has a first stacked structure and is configured to detect a magnetic field to be detected. The resistive section includes a first resistive element and is coupled to the sensor section. The first resistive element has the first stacked structure.
(4) A magnetism detection device according to one embodiment of the disclosure includes a sensor section and a resistive section. The sensor section includes a first magnetism detection element. The first magnetism detection element includes a first magnetic body and is configured to detect a magnetic field to be detected. The first magnetic body has first magnetization pinned in a first direction. The resistive section includes a first resistive element and is coupled to the sensor section. The first resistive element includes a second magnetic body having second magnetization pinned in the first direction.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The accompanying drawings are included to provide a further understanding of the disclosure, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments and, together with the specification, serve to explain the principles of the disclosure.
(2) FIG. **1** is a plan view of an overall configuration example of a magnetism detection device according to one embodiment of the disclosure.
(3) FIG. **2** is a cross-sectional view of a cross-sectional configuration of the magnetism detection device illustrated in FIG. **1**.
(4) FIG. **3** is a circuit diagram of the magnetism detection device illustrated in FIG. **1**.
(5) FIG. **4**A is a perspective view of a first stacked structure of a magnetism detection element illustrated in FIG. **1**.
(6) FIG. **4**B is a perspective view of a second stacked structure of the magnetism detection element illustrated in FIG. **1**.

(7) FIG. **5** is a plan view of an overall configuration of a magnetism detection device according to a first modification example of the disclosure.
(8) FIG. **6** is a plan view of an overall configuration of a magnetism detection device according to a second modification example of the disclosure.

DETAILED DESCRIPTION

(9) Some embodiments of the disclosure are described below in detail with reference to the accompanying drawings.
(10) Incidentally, it has been requested to improve productivity of a magnetism detection device provided with such a compensation resistor.
(11) It is desirable to provide a magnetism detection device having a structure that is able to be manufactured by simpler processes.
(12) It is to be noted that the following description is directed to illustrative examples of the technology and not to be construed as limiting to the technology. Factors including, without limitation, numerical values, shapes, materials, components, positions of the components, and how the components are coupled to each other are illustrative only and not to be construed as limiting to the technology. Further, elements in the following example embodiments which are not recited in a most-generic independent claim of the technology are optional and may be provided on an as-needed basis. The drawings are schematic and are not intended to be drawn to scale. It is to be noted that the like elements are denoted with the same reference numerals, and any redundant description thereof will not be described in detail. It is to be noted that the description is given in the following order.

1. EXAMPLE EMBODIMENT

(13) An example of a magnetism detection device including a bridge circuit that includes four magnetism detection elements and a bridge circuit that includes four resistive elements.

2. MODIFICATION EXAMPLES

(14) Examples such as an example of a magnetism detection device further including dummy parts that are arranged among a plurality of magnetism detection elements in a sensor section.

3. OTHER MODIFICATION EXAMPLES

(15) [1. Example Embodiment]
(16) [Configuration of Magnetism Detection Device **1**]
(17) First, a description is given, with reference to FIGS. **1** to **3**, of a configuration of a magnetism detection device **1** according to one embodiment of the disclosure. FIG. **1** is a plan view of an overall configuration example of the magnetism detection device **1**. FIG. **2** is a cross-sectional view of a cross-sectional configuration example of the magnetism detection device **1** as viewed in an arrow direction along a cutting line II-II illustrated in FIG. **1**. FIG. **3** is a circuit diagram illustrating a schematic configuration of a later-described detection circuit **20** in the magnetism detection device **1**. This magnetism detection device **1** may be used as, for example, an angle detection sensor that is used to detect a rotation angle of a rotor.
(18) The magnetism detection device **1** may include a substrate **10** and a detection circuit **20**. The detection circuit **20** may be provided on a surface **10**S of the substrate **10**. The detection circuit **20** may include a bridge circuit **30** and a bridge circuit **40**. The bridge circuit **30** is a specific but non-limiting example corresponding to a “sensor section” in one embodiment of the disclosure, and the bridge circuit **40** is a specific but non-limiting example corresponding to a “resistive section” in one embodiment of the disclosure.
(19) [Bridge Circuit **30**]
(20) As illustrated in FIG. **3**, the bridge circuit **30** may include four bridged magnetism detection elements **11** to **14**, for example. Each of the magnetism detection elements **11** to **14** may be a magneto-resistive effect (MR) element, for example. Each of the magnetism detection elements **11** to **14** is able to detect a variation in an external magnetic field H to be detected. The “variation in an external magnetic field H” as used herein means that this variation may include a variation in

magnitude of the external magnetic field H, or a variation in an angle or an orientation of the external magnetic field H.
(21) Here, each of the magnetism detection elements **11** and **13** has a first stacked structure S**1** illustrated in FIG. **4**A, while each of the magnetism detection elements **12** and **14** may have a second stacked structure S**2** illustrated in FIG. **4**B. Thus, the magnetism detection elements **11** and **13**, and the magnetism detection elements **12** and **14** may output respective signals depending on the variation in the external magnetic field H. Phases of the respective signals may be different from each other by 180°, for example. The first stacked structure S**1** and the second stacked structure S**2** are described below in detail. It is to be noted that FIGS. **4**A and **4**B are exploded perspective views respectively illustrating schematic configurations of the first stacked structure S**1** and the second stacked structure S**2**.
(22) As illustrated in figures such as FIG. **1**, the four magnetism detection elements **11** to **14** constituting the bridge circuit **30** may be provided on the same substrate **10**. The bridge circuit **30** may be coupled to a differential detector **16** illustrated in FIG. **3**, for example. The differential detector **16** may be provided on the substrate **10**, for example. In an alternative embodiment, the differential detector **16** may be provided outside the magnetism detection device **1**.
(23) As illustrated in FIG. **3**, the bridge circuit **30** may have a configuration in which the magnetism detection element **11** and the magnetism detection element **12** coupled in series and the magnetism detection element **13** and the magnetism detection element **14** coupled in series are coupled in parallel to each other. In a more specific but non-limiting example, in the bridge circuit **30**, one end of the magnetism detection element **11** and one end of the magnetism detection element **12** may be coupled at a node P**1**; one end of the magnetism detection element **13** and one end of the magnetism detection element **14** may be coupled at a node P**2**; the other end of the magnetism detection element **11** and the other end of the magnetism detection element **14** may be coupled at a node P**3**; and the other end of the magnetism detection element **12** and the other end of the magnetism detection element **13** may be coupled at a node P**4**. Here, the node P**3** may be coupled to a power supply terminal Vcc, and the node P**4** may be coupled to a ground terminal GND via the bridge circuit **40**. The node P**1** may be coupled to an output terminal Vout**1**, and the node P**2** may be coupled to an output terminal Vout**2**. Each of the output terminal Vout**1** and the output terminal Vout**2** may be coupled to an input-side terminal of the differential detector **16**, for example. This differential detector **16** may detect a potential difference between the node P**1** and the node P**2** at a time when a voltage is applied between the node P**3** and the node P**4**, and output the detected potential difference to an arithmetic circuit **17** as a differential signal S. The potential difference between the node P**1** and the node P**2** is a difference between voltage drops that are respectively generated in the magnetism detection element **11** and the magnetism detection element **14**.
(24) It is to be noted that, in FIG. **3**, an arrow to which a reference numeral JS**11** is attached schematically denotes an orientation of magnetization JS**11** illustrated in FIG. **4**A of a magnetization pinned layer S**11** illustrated in FIG. **4**A in each of the magnetism detection elements **11** and **13**. Further, in FIG. **3**, an arrow to which a reference numeral JS**21** is attached schematically denotes an orientation of magnetization JS**21** illustrated in FIG. **4**B of a magnetization pinned layer S**21** illustrated in FIG. **4**B in each of the magnetism detection elements **12** and **14**. As illustrated in FIG. **3**, the orientation of the magnetization JS**11** and the orientation of the magnetization JS**21** are opposite to each other. In other words, FIG. **3** illustrates that a resistive value of the magnetism detection element **11** and a resistive value of the magnetism detection element **13** vary, e.g., increase or decrease in the same orientation as each other depending on the variation in the external magnetic field H. Further, FIG. **3** also illustrates that both a resistive value of the magnetism detection element **12** and a resistive value of the magnetism detection element **14** vary, i.e., decrease or increase in an orientation opposite to those of the variations in the respective resistive values of the magnetism detection elements **11** and **13** depending on the variation in the external

magnetic field H.

(25) As illustrated in FIG. **1**, the magnetism detection element **11** may include a plurality of first sensor patterns **11**P; the magnetism detection element **12** may include a plurality of second sensor patterns **12**P; the magnetism detection element **13** may include a plurality of third sensor patterns **13**P; and the magnetism detection element **14** may include a plurality of fourth sensor patterns **14**P. Here, each of the plurality of first sensor patterns **11**P and the plurality of third sensor patterns **13**P may have the first stacked structure S**1** illustrated in FIG. **4**A. Meanwhile, each of the plurality of second sensor patterns **12**P and the plurality of fourth sensor patterns **14**P may have the second stacked structure S**2** illustrated in FIG. **4**B. As illustrated in FIG. **1**, each of the plurality of first to fourth sensor patterns **11**P to **14**P may be arranged on the substrate **10** in matrix, for example. It is to be noted that FIG. **1** exemplifies that each of the plurality of first to fourth sensor patterns **11**P to **14**P is arranged to allow four sensor patterns to be lined in an X-axis direction and to allow three sensor patterns to be lined in a Y-axis direction. However, any other arrangement may be adopted in one embodiment of the disclosure. Further, the number of each of the plurality of first to fourth sensor patterns **11**P to **14**P in the magnetism detection elements **11** to **14** may be the same as each other, or may be different from each other. In the magnetism detection element **11**, the plurality of first sensor patterns **11**P may be coupled in series to each other. As illustrated in FIG. **2**, upper surfaces of two adjacent first sensor patterns **11**P may be coupled, for example, by wiring **15**U, or lower surfaces thereof may be coupled by wiring **15**L. Similarly, in the magnetism detection element **12**, the plurality of second sensor patterns **12**P may be coupled in series to each other. In the magnetism detection element **13**, the plurality of third sensor patterns **13**P may be coupled in series to each other. In the magnetism detection element **14**, the plurality of fourth sensor patterns **14**P may be coupled in series to each other.

(26) It is to be noted that a plurality of first to fourth dummy patterns **31**P to **34**P may further be formed in the magnetism detection device **1**. The plurality of first dummy patterns **31**P may be arranged to enclose at least a part of the plurality of first sensor patterns **11**P in the magnetism detection element **11**. The plurality of second dummy patterns **32**P may be arranged to enclose at least a part of the plurality of second sensor patterns **12**P in the magnetism detection element **12**. The plurality of third dummy patterns **33**P may be arranged to enclose at least a part of the plurality of third sensor patterns **13**P in the magnetism detection element **13**. The plurality of fourth dummy patterns **34**P may be arranged to enclose at least a part of the plurality of fourth sensor patterns **14**P in the magnetism detection element **14**.

(27) As illustrated in FIG. **4**A and FIG. **4**B, each of the first stacked structure S**1** and the second stacked structure S**2** may have a spin valve structure in which a plurality of function films including a magnetic layer is stacked. In a specific but non-limiting example, as illustrated in FIG. **4**A, the first stacked structure S**1** may have a configuration in which the magnetization pinned layer S**11**, an intermediate layer S**12**, and a magnetization free layer S**13** are stacked in order in a Z-axis direction. The magnetization pinned layer S**11** has magnetization JS**11** pinned in a +X direction. The intermediate layer S**12** does not exhibit a specific magnetization direction. The magnetization free layer S**13** has magnetization JS**13** that varies depending on magnetic flux density of the external magnetic field H. Each of the magnetization pinned layer S**11**, the intermediate layer S**12**, and the magnetization free layer S**13** may be a thin film that extends in an XY plane. Accordingly, an orientation of the magnetization JS**13** on the magnetization free layer S**13** may be rotatable in the XY plane. It is to be noted that FIG. **4**A illustrates a load state in which the external magnetic field H is applied in the orientation of the magnetization JS**13**.

(28) As illustrated in FIG. **4**B, the second stacked structure S**2** may have a configuration in which the magnetization pinned layer S**21**, an intermediate layer S**22**, and a magnetization free layer S**23** are stacked in order in the Z-axis direction. The magnetization pinned layer S**21** has magnetization JS**21** pinned in a −X direction. The intermediate layer S**22** does not exhibit a specific magnetization direction. The magnetization free layer S**23** has magnetization J**523** that varies depending on the

magnetic flux density of the external magnetic field H. Each of the magnetization pinned layer S**21**, the intermediate layer S**22**, and the magnetization free layer S**23** may be a thin film that extends in the XY plane. Accordingly, an orientation of the magnetization J**523** on the magnetization free layer S**23** may be rotatable in the XY plane. It is to be noted that FIG. **4**B illustrates a load state in which the external magnetic field H is applied in the orientation of the magnetization J**523**.
(29) Thus, the magnetization pinned layer S**11** in the first stacked structure S**1** may have the magnetization JS**11** pinned in the +X direction, while the magnetization pinned layer S**21** in the second stacked structure S**2** may have the magnetization JS**21** pinned in the −X direction. It is to be noted that the magnetization JS**11** is a specific but non-limiting example corresponding to a "first magnetization" in one embodiment of the disclosure, and the magnetization pinned layer S**11** is a specific but non-limiting example corresponding to a "first ferromagnetic layer" in one embodiment of the disclosure. Further, the magnetization JS**21** is a specific but non-limiting example corresponding to a "second magnetization" in one embodiment of the disclosure, and the magnetization pinned layer S**21** is a specific but non-limiting example corresponding to a "second ferromagnetic layer" in one embodiment of the disclosure.
(30) It is to be noted that each of the magnetization pinned layers S**11** and S**21**, the intermediate layers S**12** and S**22**, and the magnetization free layers S**13** and S**23** in the first stacked structure S**1** and the second stacked structure S**2** may have a single-layer structure or a multi-layer structure configured by a plurality of layers. Further, in the first stacked structure S**1**, the magnetization pinned layer S**11**, the intermediate layer S**12**, and the magnetization free layer S**13** may be stacked in an order reverse to that of the above. Similarly, in the second stacked structure S**2**, the magnetization pinned layer S**21**, the intermediate layer S**22**, and the magnetization free layer S**23** may be stacked in an order reverse to that of the above.
(31) The magnetization pinned layer S**11** and the magnetization pinned layer S**21** may be formed by substantially the same material as each other. Each of the magnetization pinned layer S**11** and the magnetization pinned layer S**21** may include, for example, a ferromagnetic material such as cobalt (Co), a cobalt-iron alloy (CoFe), or a cobalt-iron-boron alloy (CoFeB). It is to be noted that an unillustrated antiferromagnetic layer may be provided on side opposite to the intermediate layer S**12** to be adjacent to the magnetization pinned layer S**11** in the first stacked structure S**1**. Similarly, an unillustrated antiferromagnetic layer may be provided on side opposite to the intermediate layer S**22** to be adjacent to the magnetization pinned layer S**21** in the second stacked structure S**2**. Such an antiferromagnetic layer may be configured by an antiferromagnetic material such as a platinum-manganese alloy (PtMn) or an iridium-manganese alloy (IrMn). In the first stacked structure S**1** and the second stacked structure S**2**, the antiferromagnetic layer is in a state in which a spin magnetic moment in the +X direction and a spin magnetic moment in the −X direction completely cancel each other, and serves to fix the orientation of the magnetization JS**11** on the adjacent magnetization pinned layer S**11** to the +X direction, or to fix the orientation of the magnetization JS**21** on the adjacent magnetization pinned layer S**21** to the −X direction.
(32) The intermediate layer S**12** and the intermediate layer S**22** may be formed by substantially the same material as each other. In a case where the spin valve structure serves as a magnetic tunnel junction (MTJ) film, the intermediate layer S**12** and the intermediate layer S**22** may be a non-magnetic tunnel barrier layer including a magnesium oxide (MgO), for example. Each of the intermediate layers S**12** and S**22** may be thin enough to enable a tunnel current based on quantum mechanics to pass therethrough. The tunnel barrier layer including MgO may be obtained by a process such as a process of oxidizing a thin film including magnesium (Mg) and a reactive sputtering process in which sputtering of magnesium is performed under an oxygen atmosphere, besides a sputtering process that uses a target including MgO, for example. It is also possible to configure each of the intermediate layers S**12** and S**22** with use of an oxide or a nitride of each of aluminum (Al), tantalum (Ta), and hafnium (Hf), besides MgO. It is to be noted that the intermediate layer S**12** and the intermediate layer S**22** may be configured by a platinum group

element such as ruthenium (Ru), or a non-magnetic metal such as gold (Au) and copper (Cu), for example. In such a case, the spin valve structure may serve as a giant magneto resistive effect (GMR) film.
(33) Each of the magnetization free layer S**13** and the magnetization free layer S**23** may be a soft ferromagnetic layer, and may be formed by substantially the same material as each other. Each of the magnetization free layer S**13** and the magnetization free layer S**23** may be configured by, for example, a material such as a cobalt-iron alloy (CoFe), a nickel-iron alloy (NiFe), or a cobalt-iron-boron alloy (CoFeB).
(34) Current I**10** from the power supply terminal Vcc may split into current I**1** and current I**2** at the node P**3**. The current I**1** or the current I**2** may be supplied to each of the magnetism detection elements **11** to **14** constituting the bridge circuit **30**. Signals e**1** and e**2** may respectively be extracted from the nodes P**2** and P**1** of the bridge circuit **30**. The signals e**1** and e**2** may flow into the differential detector **16**. Here, when an angle formed by the magnetization JS**21** and the magnetization J**523** is defined as γ, for example, the signal e**1** denotes an output variation that varies in accordance with A×cos(+γ)+B (each of A and B is a constant), and the signal e**2** denotes an output variation that varies in accordance with A×cos(γ−180°)+B.
(35) [Bridge Circuit **40**]
(36) As illustrated in FIG. **3**, the bridge circuit **40** may include four bridged resistive elements **21** to **24**, for example. Each of the resistive elements **21** to **24** may be a magneto-resistive effect element similarly to the magnetism detection elements **11** to **14**. Accordingly, a resistive value of each of the resistive elements **21** to **24** varies depending on the variation in the external magnetic field H. Here, each of the resistive elements **21** and **23** has the first stacked structure S**1** illustrated in FIG. **4**A, while each of the resistive elements **22** and **24** may have the second stacked structure S**2** illustrated in FIG. **4**B. Thus, a resistive value between a node P**7** and a node P**8** is maintained substantially constant regardless of the variation in the external magnetic field H. Hence, the bridge circuit **40** may serve as a resistor element for output correction. The resistor element may adjust an output voltage depending on the application thereof regardless of fluctuation in the external magnetic field H.
(37) The four resistive elements **21** to **24** constituting the bridge circuit **40** may be provided on substrate **10** the same as the magnetism detection elements **11** to **14**.
(38) As illustrated in FIG. **3**, the bridge circuit **40** may have a configuration in which the resistive element **21** and the resistive element **22** coupled in series and the resistive element **23** and the resistive element **24** coupled in series are coupled in parallel to each other. In a more specific but non-limiting example, in the bridge circuit **40**, one end of the resistive element **21** and one end of the resistive element **22** may be coupled at a node P**6**; one end of the resistive element **23** and one end of the resistive element **24** may be coupled at a node P**5**; the other end of the resistive element **21** and the other end of the resistive element **24** may be coupled at the node P**8**; and the other end of the resistive element **22** and the other end of the resistive element **23** may be coupled at the node P**7**. Here, the node P**7** may be coupled to the node P**4** of the bridge circuit **30** via wiring, and the node P**8** may be coupled to the ground terminal GND.
(39) It is to be noted that, in FIG. **3**, an arrow to which the reference numeral JS**11** is attached schematically denotes the orientation of magnetization JS**11** illustrated in FIG. **4**A of the magnetization pinned layer S**11** illustrated in FIG. **4**A in each of the resistive elements **21** and **23**. Further, in FIG. **3**, an arrow to which the reference numeral JS**21** is attached schematically denotes the orientation of magnetization JS**21** illustrated in FIG. **4**B of the magnetization pinned layer S**21** illustrated in FIG. **4**B in each of the resistive elements **22** and **24**. As illustrated in FIG. **3**, the orientation of the magnetization JS**11** and the orientation of the magnetization JS**21** are opposite to each other. In other words, FIG. **3** illustrates that a resistive value of the resistive element **21** and a resistive value of the resistive element **23** vary, e.g., increase or decrease in the same orientation as each other depending on the variation in the external magnetic field H. Further, FIG. **3** illustrates

that both a resistive value of the resistive element **22** and a resistive value of the resistive element **24** vary, i.e., decrease or increase in an orientation opposite to those of the variations in the respective resistive values of the magnetism detection elements **21** and **23** depending on the variation in the external magnetic field H.

(40) As illustrated in FIG. **1**, the resistive element **21** may include a plurality of first resistance patterns **21**P; the resistive element **22** may include a plurality of second resistance patterns **22**P; the resistive element **23** may include a plurality of third resistance patterns **23**P; and the resistive element **24** may include a plurality of fourth resistance patterns **24**P. Here, each of the plurality of first resistance patterns **21**P and the plurality of third resistance patterns **23**P may have the first stacked structure S**1** illustrated in FIG. **4**A. Meanwhile, each of the plurality of second resistance patterns **22**P and the plurality of fourth resistance patterns **24**P may have the second stacked structure S**2** illustrated in FIG. **4**B.

(41) As illustrated in FIG. **1**, the plurality of first resistance patterns **21**P may be arranged to enclose at least a part of the plurality of first sensor patterns **11**P in the magnetism detection element **11**. The plurality of second resistance patterns **22**P may be arranged to enclose at least a part of the plurality of second sensor patterns **12**P in the magnetism detection element **12**. The plurality of third resistance patterns **23**P may be arranged to enclose at least a part of the plurality of third sensor patterns **13**P in the magnetism detection element **13**. The plurality of fourth resistance patterns **24**P may be arranged to enclose at least a part of the plurality of fourth sensor patterns **14**P in the magnetism detection element **14**. It is to be noted that the plurality of first resistance patterns **21**P in the resistive element **21** may be provided, on the substrate **10**, in a region between the magnetism detection element **11** and the magnetism detection element **14** or a region between the magnetism detection element **11** and the magnetism detection element **12**. The plurality of second resistance patterns **22**P in the resistive element **22** may be provided, on the substrate **10**, in a region between the magnetism detection element **12** and the magnetism detection element **11** or a region between the magnetism detection element **12** and the magnetism detection element **13**. The plurality of third resistance patterns **23**P in the resistive element **23** may be provided, on the substrate **10**, in a region between the magnetism detection element **13** and the magnetism detection element **12** or a region between the magnetism detection element **13** and the magnetism detection element **14**. Moreover, the plurality of fourth resistance patterns **24**P in the resistive element **24** may be provided, on the substrate **10**, in a region between the magnetism detection element **14** and the magnetism detection element **13** or a region between the magnetism detection element **14** and the magnetism detection element **11**.

(42) In the resistive element **21**, the plurality of first resistance patterns **21**P may be coupled in series to each other. As illustrated in FIG. **2**, upper surfaces of two adjacent first resistance patterns **21**P may be coupled, for example, by wiring **25**U, or lower surfaces thereof may be coupled by wiring **25**L. Similarly, in the resistive element **22**, the plurality of second resistance patterns **22**P may be coupled in series to each other. In the resistive element **23**, the plurality of third resistance patterns **23**P may be coupled in series to each other. In the resistive element **24**, the plurality of fourth resistance patterns **24**P may be coupled in series to each other.

(43) It is to be noted that, in one embodiment of the disclosure, one or more of the plurality of first dummy patterns **31**P may be used as the plurality of first resistance patterns **21**P. Similarly, in one embodiment of the disclosure, one or more of the plurality of second dummy patterns **32**P may be used as the plurality of second resistance patterns **22**P; one or more of the plurality of third dummy patterns **33**P may be used as the plurality of third resistance patterns **23**P; and one or more of the plurality of fourth dummy patterns **34**P may be used as the plurality of fourth resistance patterns **24**P.

(44) [Operations and Workings of Magnetism Detection Device **1**]

(45) In the magnetism detection device **1** according to the present embodiment, for example, it is possible to detect magnitude of a rotation angle θ of the external magnetic field H in the XY plane

by the detection circuit **20**.

(46) In this magnetism detection device **1**, when the external magnetic field H is rotated with respect to the detection circuit **20**, a variation in a magnetic-field component, which reaches the detection circuit **20**, in the X-axis direction and a variation in the magnetic-field component in the Y-axis direction may be detected by the magnetism detection elements **11** to **14** in the bridge circuit **30**. At that time, the differential signal S based on the signal e**1** and the signal e**2** from the differential detector **16** may flow into the arithmetic circuit **17** as an output from the bridge circuit **30**. Thereafter, it is possible to determine the rotation angle θ of the external magnetic field H in the arithmetic circuit **17**.

(47) [Effects of Magnetism Detection Device **1**]

(48) This magnetism detection device **1** may have a structure that is able to be manufactured by simpler processes.

(49) In a specific but non-limiting example, for example, each of the magnetism detection element **11**, the resistive element **21**, the magnetism detection element **13**, and the resistive element **23** may have the first stacked structure S**1** in common. In other words, among the first stacked structure S**1** of the magnetism detection element **11**, the first stacked structure S**1** of the resistive element **21**, the first stacked structure S**1** of the magnetism detection element **13**, and the first stacked structure S**1** of the resistive element **23**, stacking order of a plurality of stacked films constituting each of them and a constituent material of each of the plurality of stacked films are the same as each other. Accordingly, it is possible to form the magnetism detection element **11**, the resistive element **21**, the magnetism detection element **13**, and the resistive element **23** in a lump by a series of processes. Meanwhile, each of the magnetism detection element **12**, the resistive element **22**, the magnetism detection element **14**, and the resistive element **24** may have the second stacked structure S**2** in common. In other words, among the second stacked structure S**2** of the magnetism detection element **12**, the second stacked structure S**2** of the resistive element **22**, the second stacked structure S**2** of the magnetism detection element **14**, and the second stacked structure S**2** of the resistive element **24**, stacking order of a plurality of stacked films constituting each of them and a constituent material of each of the plurality of stacked films are the same as each other. Accordingly, it is possible to form the magnetism detection element **12**, the resistive element **22**, the magnetism detection element **14**, and the resistive element **24** in a lump by a series of processes. Hence, it is possible to manufacture the magnetism detection device **1** more conveniently as compared with a case where different constituent materials are used for the magnetism detection element and the resistive element or a case where the magnetism detection element and the resistive element have different stacked structures from each other.

(50) Moreover, the magnetization pinned layer S**11** of each of the first stacked structure S**1** of the magnetism detection element **11**, the first stacked structure S**1** of the resistive element **21**, the first stacked structure S**1** of the magnetism detection element **13**, and the first stacked structure S**1** of the resistive element **23** may have the magnetization JS**11** pinned in the +X direction. Accordingly, it is possible to perform, in a lump by the same process, a pinning process for the magnetization JS**11** of the magnetization pinned layer S**11** in each of the first stacked structure S**1** of the magnetism detection element **11**, the first stacked structure **51** of the resistive element **21**, the first stacked structure S**1** of the magnetism detection element **13**, and the first stacked structure S**1** of the resistive element **23**.

(51) Similarly, the magnetization pinned layer S**21** of each of the second stacked structure S**2** of the magnetism detection element **12**, the second stacked structure S**2** of the resistive element **22**, the second stacked structure S**2** of the magnetism detection element **14**, and the second stacked structure S**2** of the resistive element **24** may have the magnetization JS**21** pinned in the −X direction. Accordingly, it is possible to perform, in a lump by the same process, a pinning process for the magnetization JS**21** of the magnetization pinned layer S**21** in each of the second stacked structure S**2** of the magnetism detection element **12**, the second stacked structure S**2** of the resistive

element **22**, the second stacked structure S**2** of the magnetism detection element **14**, and the second stacked structure S**2** of the resistive element **24**.
(52) Further, in the present embodiment, for example, the first resistance patterns **21**P and the first dummy patterns **31**P are designed to be provided to enclose the plurality of first sensor patterns **11**P. Thus, by forming the plurality of first sensor patterns **11**P, the first resistance patterns **21**P, and the first dummy patterns **31**P in a lump, it is possible to sufficiently reduce dispersion of film quality or a film thickness in the plurality of first sensor patterns **11**P. The similar effects are expectable also for the second to fourth sensor patterns **12**P to **14**P.
(53) Further, in the present embodiment, the resistive elements **21** to **24** are designed to be respectively arranged, on the substrate **10**, in regions of gaps among the four magnetism detection elements **11** to **14** arranged in matrix. Thus, for example, in a case where the first to fourth sensor patterns **11**P to **14**P are formed by utilizing a photolithography method, it is possible to effectively utilize the gap among the four magnetism detection elements **11** to **14**. The gap may be generated by limit o f exposure in the photolithography method. In other words, it is possible to practically use, as the first to fourth resistance patterns **21**P to **24**P, the first stacked structure S**1** or the second stacked structure S**2** with film quality unavailable as the first to fourth sensor patterns **11**P to **14**P for detection of the external magnetic field H. This makes it possible to miniaturize the overall dimension in the magnetism detection device **1**.
(54) [2. Modification Examples]
(55) [2.1 First Modification Example]
(56) [Configuration of Magnetism Detection Device **1**A]
(57) FIG. **5** is a plan view of an overall configuration example of a magnetism detection device **1**A according to a first modification example of the disclosure. The magnetism detection device **1** according to the foregoing embodiment is designed to include the resistive elements **21** to **24** to occupy a part of the gap among the four magnetism detection elements **11** to **14**. In contrast, the magnetism detection device **1**A according to the present modification example is designed to include a plurality of dummy patterns **35**P over multiple rows and multiple columns to fill up a gap among the four magnetism detection elements **11** to **14**. The plurality of dummy patterns **35**P may have the same stacked structure as that in any of the plurality of first to fourth sensor patterns **11**P to **14**P. The magnetism detection device **1**A may have substantially the same configuration as that of the magnetism detection device **1** except for this point. Here, the plurality of dummy patterns **35**P may have the same shape and the same dimension as one another.
(58) [Workings and Effects of Magnetism Detection Device **1**A]
(59) As described above, the magnetism detection device **1**A is designed to include the plurality of dummy patterns **35**P to fill up the gap among the plurality of first to fourth sensor patterns **11**P to **14**P in the XY plane. Accordingly, it is possible to mitigate occurrence of dishing when performing a planarization process for surfaces including an upper surface of each of the plurality of first to fourth sensor patterns **11**P to **14**P. As a result, it is possible to suppress dispersion of thickness of each of the plurality of first to fourth sensor patterns **11**P to **14**P, and this makes it possible to expect improvement of detection accuracy of a magnetic field in the magnetism detection device **1**A.
(60) [2.2 Second Modification Example]
(61) [Configuration of Magnetism Detection Device **1**B]
(62) FIG. **6** is a plan view of an overall configuration example of a magnetism detection device **1**B according to a second modification example of the disclosure. The magnetism detection device **1** according to the foregoing embodiment is designed to allow each of the first to fourth sensor patterns **11**P to **14**P in the magnetism detection elements **11** to **14** to be arranged in matrix. Further, the magnetism detection device **1** according to the foregoing embodiment is also designed to allow the first to fourth resistance patterns **21**P to **24**P in the resistive elements **21** to **24** to be arranged to enclose a part of the corresponding first to fourth sensor patterns **11**P to **14**P. In contrast, the

magnetism detection device **1**B according to the second modification example is designed to allow the first to fourth resistance patterns **21**P to **24**P, the first to fourth sensor patterns **11**P to **14**P, and the first to fourth dummy patterns **31**P to **34**P to be arranged in order in the Y-axis direction. Six of each of the first to fourth resistance patterns **21**P to **24**P may be arranged in the X-axis direction. Six of each of the first to fourth sensor patterns **11**P to **14**P may be arranged in the X-axis direction. Six of each of the first to fourth dummy patterns **31**P to **34**P may be arranged in the X-axis direction. In this manner, in one embodiment of the disclosure, the first to fourth resistance patterns **21**P to **24**P and the first to fourth dummy patterns **31**P to **34**P may be formed to be adjacent to the first to fourth sensor patterns **11**P to **14**P, respectively.

(63) [3. Other Modification Examples]

(64) The disclosure has been described hereinabove referring to one embodiment and some modification examples. However, the disclosure is not limited to these embodiment and modification examples, and may be modified in a variety of ways. For example, in the foregoing embodiment and modification examples, the four magnetism detection elements are used as the sensor section to form a full-bridge circuit. However, in one embodiment of the disclosure, for example, two magnetism detection elements may be used to form a half-bridge circuit. Further, the disclosure is not limited to the case where the four resistive elements are used for a bridge circuit as the resistive section. For example, two resistive elements may be used to form a half-bridge circuit. Further, a shape and a dimension of the plurality of sensor patterns, a shape and a dimension of the plurality of resistance patterns, and a shape and a dimension of the plurality of dummy patterns may be the same as one another, or may be different from one another.

(65) Further, in the foregoing embodiment and modification examples, the sensor section and the resistive section have two types of stacked structures, that is, the first stacked structure and the second stacked structure in common. However, in one embodiment of the disclosure, the sensor section and the resistive section may have three or more types of stacked structures in common.

(66) Further, description has been given, in the foregoing embodiment and modification examples, of the magnetism detection device to be used as the angle detection sensor section for use in detection of a rotation angle of a rotor. However, application of the magnetism detection device according to an embodiment of the disclosure is not limited thereto. The magnetism detection device according to an embodiment of the disclosure is applicable to an electromagnetic compass for detection of geomagnetism, for example. Further, the sensor may include a detecting element, other than the magneto-resistive effect element, such as a Hall element, for example.

(67) Further, description has been given, in the foregoing embodiment and modification examples, for example, of the case where both the magnetism detection element **11** and the resistive element **21** have the first stacked structure S**1** and both the magnetism detection element **12** and the resistive element **22** have the second stacked structure S**2**. However, the magnetism detection device according to an embodiment of the disclosure is not limited thereto. For example, the magnetism detection device according to a first aspect of the disclosure may have the following configuration. A sensor section may include a first magnetism detection element having a first stacked structure and being able to detect a magnetic field to be detected. A resistive section includes a first resistive element having the first stacked structure, and is coupled to the sensor section. The first stacked structure as used herein means that respective constituent materials of a plurality of layers constituting the stacked structure and stacking order of the plurality of layers are specified. In other words, when comparing the first stacked structure of the first magnetism detection element with the first stacked structure of the first resistive element, the respective constituent materials of the plurality of layers constituting each first stacked structure may correspond with one another, and the stacking order of the plurality of layers constituting each first stacked structure may correspond with each other.

(68) The magnetism detection device according to a second aspect of the disclosure may have the following configuration. A sensor section includes a first magnetism detection element including a

first magnetic body that has first magnetization pinned in a first direction and being able to detect a magnetic field to be detected. A resistive section includes a first resistive element including a second magnetic body having second magnetization pinned in the first direction, and is coupled to the sensor section. In other words, all of constituent materials in the first magnetism detection element may correspond with all of constituent materials in the first resistive element; a part of the constituent materials in the first magnetism detection element may be different from a part of the constituent materials in the first resistive element; or all of the constituent materials in the first magnetism detection element may be different from all of the constituent materials in the first resistive element. Further, the magnetism detection device according to the second aspect of the disclosure may have the following configuration. The sensor section may further include a second magnetism detection element being able to detect a magnetic field to be detected and including a third magnetic body having third magnetization pinned in a second direction opposite to the first direction. The resistive section may further include a second resistive element including a fourth magnetic body having fourth magnetization pinned in the second direction. A relationship between the second magnetism detection element and the second resistive element are also similar to a relationship between the first magnetism detection element and the first resistive element as described above.

(69) Moreover, the disclosure encompasses any possible combination of some or all of the various embodiments and the modification examples described herein and incorporated herein.

(70) It is possible to achieve at least the following configurations from the above-described example embodiments of the disclosure.

(71) (1) A magnetism detection device including: a sensor section including a first magnetism detection element having a first stacked structure, the first magnetism detection element being configured to detect a magnetic field to be detected; and a resistive section including a first resistive element having the first stacked structure, the resistive section being coupled to the sensor section.

(72) (2) The magnetism detection device according to (1), in which each of the first stacked structure in the first magnetism detection element and the first stacked structure in the first resistive element includes a first ferromagnetic layer having first magnetization substantially pinned in a first direction.

(73) (3) The magnetism detection device according to (1) or (2), in which the resistive section includes a resistor element that adjusts an output voltage regardless of fluctuation in the magnetic field to be detected.

(74) (4) The magnetism detection device according to any one of (1) to (3), in which the first magnetism detection element and the first resistive element are provided on same substrate.

(75) (5) The magnetism detection device according to (4), in which the first magnetism detection element includes a plurality of first sensor patterns arranged on the substrate, each of the plurality of first sensor patterns having the first stacked structure, and the first resistive element includes a plurality of first resistance patterns arranged on the substrate, each of the plurality of first resistance patterns having the first stacked structure.

(76) (6) The magnetism detection device according to (5), in which the plurality of first resistance patterns are provided to be adjacent to the plurality of first sensor patterns.

(77) (7) The magnetism detection device according to (5) or (6), in which the plurality of first resistance patterns are arranged to enclose at least a part of the plurality of first sensor patterns.

(78) (8) The magnetism detection device according to any one of (5) to (7), further including a plurality of first dummy patterns arranged on the substrate, each of the plurality of first dummy patterns having the first stacked structure, in which at least a part of the plurality of first dummy patterns constitutes the plurality of first resistance patterns.

(79) (9) The magnetism detection device according to (8), in which the plurality of first dummy patterns are provided to be adjacent to the plurality of first sensor patterns.

(80) (10) The magnetism detection device according to (8) or (9), in which the plurality of first dummy patterns are arranged to enclose at least a part of the plurality of first sensor patterns.
(81) (11) The magnetism detection device according to (1), in which the sensor section further includes a second magnetism detection element having a second stacked structure, the second magnetism detection element being configured to detect the magnetic field to be detected, and the resistive section further includes a second resistive element having the second stacked structure.
(82) (12) The magnetism detection device according to (11), in which each of the first stacked structure in the first magnetism detection element and the first stacked structure in the first resistive element includes a first ferromagnetic layer having first magnetization substantially pinned in a first direction, and each of the second stacked structure in the second magnetism detection element and the second stacked structure in the second resistive element includes a second ferromagnetic layer having second magnetization substantially pinned in a second direction opposite to the first direction.
(83) (13) The magnetism detection device according to (11) or (12), in which the resistive section includes a resistor element that adjusts an output voltage regardless of fluctuation in the magnetic field to be detected.
(84) (14) The magnetism detection device according to any one of (11) to (13), in which the first magnetism detection element, the second magnetism detection element, the first resistive element, and the second resistive element are provided on same substrate.
(85) (15) The magnetism detection device according to (14), in which the first magnetism detection element includes a plurality of first sensor patterns arranged on the substrate, each of the plurality of first sensor patterns having the first stacked structure, the first resistive element includes a plurality of first resistance patterns arranged on the substrate, each of the plurality of first resistance patterns having the first stacked structure, the second magnetism detection element includes a plurality of second sensor patterns arranged on the substrate, each of the plurality of second sensor patterns having the second stacked structure, and the second resistive element includes a plurality of second resistance patterns arranged on the substrate, each of the plurality of second resistance patterns having the second stacked structure.
(86) (16) The magnetism detection device according to (15), in which the plurality of first resistance patterns are provided to be adjacent to the plurality of first sensor patterns, and the plurality of second resistance patterns are provided to be adjacent to the plurality of second sensor patterns.
(87) (17) The magnetism detection device according to (15) or (16), in which the plurality of first resistance patterns are arranged to enclose at least a part of the plurality of first sensor patterns, and the plurality of second resistance patterns are arranged to enclose at least a part of the plurality of second sensor patterns.
(88) (18) The magnetism detection device according to any one of (15) to (17), further including: a plurality of first dummy patterns arranged on the substrate, each of the plurality of first dummy patterns having the first stacked structure; and a plurality of second dummy patterns arranged on the substrate, each of the plurality of second dummy patterns having the second stacked structure, in which at least a part of the plurality of first dummy patterns constitutes the plurality of first resistance patterns, and at least a part of the plurality of second dummy patterns constitutes the plurality of second resistance patterns.
(89) (19) The magnetism detection device according to (18), in which the plurality of first dummy patterns are provided to be adjacent to the plurality of first sensor patterns, and the plurality of second dummy patterns are provided to be adjacent to the plurality of second sensor patterns.
(90) (20) The magnetism detection device according to (18) or (19), in which the plurality of first dummy patterns are arranged to enclose at least a part of the plurality of first sensor patterns, and the plurality of second dummy patterns are arranged to enclose at least a part of the plurality of second sensor patterns.

(91) (21) The magnetism detection device according to any one of (11) to (20), in which the first magnetism detection element and the second magnetism detection element in the sensor section are coupled in series or coupled in parallel to each other, the first resistive element and the second resistive element in the resistive section are coupled in series or coupled in parallel to each other, and the sensor section and the resistive section are coupled in series to each other.
(92) (22) The magnetism detection device according to any one of (11) to (21), in which the first resistive element and the second resistive element in the resistive section are provided between the first magnetism detection element in the sensor section and the second magnetism detection element in the sensor section.
(93) (23) The magnetism detection device according to any one of (11) to (22), in which each of the first magnetism detection element, the second magnetism detection element, the first resistive element, and the second resistive element includes a magnetic tunnel junction element.
(94) (24) The magnetism detection device according to (1), in which the sensor section further includes a second magnetism detection element having a second stacked structure and being configured to detect the magnetic field to be detected, a third magnetism detection element having the first stacked structure and being configured to detect the magnetic field to be detected, and a fourth magnetism detection element having the second stacked structure and being configured to detect the magnetic field to be detected, and the resistive section further includes a second resistive element having the second stacked structure, a third resistive element having the first stacked structure, and a fourth resistive element having the second stacked structure.
(95) (25) The magnetism detection device according to (24), in which the first stacked structure includes a plurality of first stacked structures, each of the first stacked structures includes a first ferromagnetic layer having first magnetization substantially pinned in a first direction, and the second stacked structure includes a plurality of second stacked structures, each of the second stacked structures includes a second ferromagnetic layer having second magnetization substantially pinned in a second direction opposite to the first direction.
(96) (26) The magnetism detection device according to (24) or (25), in which the sensor section includes a first bridge circuit in which the first magnetism detection element and the second magnetism detection element coupled in series and the third magnetism detection element and the fourth magnetism detection element coupled in series are coupled in parallel to each other, and the resistive section includes a second bridge circuit in which the first resistive element and the second resistive element coupled in series and the third resistive element and the fourth resistive element coupled in series are coupled in parallel to each other.
(97) (27) A magnetism detection device including: a sensor section including a first magnetism detection element including a first magnetic body having first magnetization pinned in a first direction, the first magnetism detection element being configured to detect a magnetic field to be detected; and a resistive section including a first resistive element, the first resistive element including a second magnetic body having second magnetization pinned in the first direction, the resistive section coupled to the sensor section.
(98) (28) The magnetism detection device according to (27), in which the sensor section further includes a second magnetism detection element including a third magnetic body having third magnetization pinned in a second direction opposite to the first direction, the second magnetism detection element being configured to detect the magnetic field to be detected, and the resistive section further includes a second resistive element, the second resistive element including a fourth magnetic body having fourth magnetization pinned in the second direction.
(99) According to the magnetism detection device of an embodiment of the disclosure, a structure that is able to be manufactured by simpler processes is provided.
(100) Although the disclosure has been described in terms of exemplary embodiment and modification examples, it is not limited thereto. It should be appreciated that variations may be made in the described embodiment and modification examples by a person having ordinary skill in

the art without departing from the scope of the disclosure as defined by the following claims. The limitations in the claims are to be interpreted broadly based on the language employed in the claims and not limited to examples described in this specification or during the prosecution of the application, and the examples are to be construed as non-exclusive. For example, in this disclosure, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. The term “substantially” and its variations are defined as being largely but not necessarily wholly what is specified as understood by a person having ordinary skill in the art. Moreover, no element or component in this disclosure is intended to be dedicated to the public regardless of whether the element or component is explicitly recited in the following claims.

Claims

1. A magnetism detection device comprising: a plurality of first sensor patterns including a first magnetism detection element having a first stacked structure, the first magnetism detection element being configured to detect a magnetic field to be detected; and a plurality of first dummy patterns having the first stacked structure.
2. The magnetism detection device according to claim 1, wherein the first stacked structure in each of the plurality of first sensor patterns includes a first ferromagnetic layer having a first magnetization substantially pinned in a first direction, and the first stacked structure in each of the plurality of first dummy patterns includes a first ferromagnetic layer having a first magnetization substantially pinned in the first direction.
3. The magnetism detection device according to claim 1, wherein the plurality of first sensor patterns and the plurality of first dummy patterns are provided on same substrate.
4. The magnetism detection device according to claim 3, wherein the plurality of first dummy patterns are provided to be adjacent to the plurality of first sensor patterns.
5. The magnetism detection device according to claim 3, wherein the plurality of first dummy patterns are arranged to enclose at least a part of the plurality of first sensor patterns.
6. The magnetism detection device according to claim 1, further comprising: a plurality of second sensor patterns including a second magnetism detection element having a second stacked structure, the second magnetism detection element being configured to detect the magnetic field to be detected; and a plurality of second dummy patterns having the second stacked structure.
7. The magnetism detection device according to claim 6, wherein the plurality of first sensor patterns, the plurality of first dummy patterns, the plurality of second sensor patterns, and the plurality of second dummy patterns are provided on same substrate.
8. The magnetism detection device according to claim 7, wherein the plurality of first dummy patterns are provided to be adjacent to the plurality of first sensor patterns, and the plurality of second dummy patterns are provided to be adjacent to the plurality of second sensor patterns.
9. The magnetism detection device according to claim 7, wherein the plurality of first dummy patterns are arranged to enclose at least a part of the plurality of first sensor patterns, and the plurality of second dummy patterns are arranged to enclose at least a part of the plurality of second sensor patterns.
10. The magnetism detection device according to claim 6, wherein the first magnetism detection element and the second magnetism detection element are coupled in series or coupled in parallel to each other.
11. The magnetism detection device according to claim 6, wherein each of the first magnetism detection element, the second magnetism detection element, the plurality of first dummy patterns, and the plurality of second dummy patterns comprises a magnetic tunnel junction element.
12. The magnetism detection device according to claim 1, further comprising: a plurality of second sensor patterns including a second magnetism detection element having a second stacked structure,

the second magnetism detection element being configured to detect the magnetic field to be detected; a plurality of third sensor patterns including a third magnetism detection element having the first stacked structure, the third magnetism detection element being configured to detect the magnetic field to be detected; a plurality of fourth sensor patterns including a fourth magnetism detection element having the second stacked structure, the fourth magnetism detection element being configured to detect the magnetic field to be detected; a plurality of second dummy patterns having the second stacked structure; a plurality of third dummy patterns having the first stacked structure; and a plurality of fourth dummy patterns having the second stacked structure.

13. The magnetism detection device according to claim 12, wherein the first stacked structure comprises a plurality of first stacked structures, each of the first stacked structures includes a first ferromagnetic layer having first magnetization substantially pinned in a first direction, and the second stacked structure comprises a plurality of second stacked structures, each of the second stacked structures includes a second ferromagnetic layer having second magnetization substantially pinned in a second direction opposite to the first direction.

14. A magnetism detection device comprising: a plurality of first sensor patterns including a first magnetism detection element, the first magnetism detection element including a first magnetic body having first magnetization pinned in a first direction; and a plurality of first dummy patterns including a second magnetic body having second magnetization pinned in the first direction.

15. The magnetism detection device according to claim 14, further comprising: a plurality of second sensor patterns including a second magnetism detection element, the second magnetism detection element including a third magnetic body having third magnetization pinned in a second direction opposite to the first direction; and a plurality of second dummy patterns including a fourth magnetic body having fourth magnetization pinned in the second direction.