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(54) SEMICONDUCTOR DEVICE, INSPECTION APPARATUS OF SEMICONDUCTOR DEVICE, AND METHOD FOR INSPECTING SEMICONDUCTOR DEVICE

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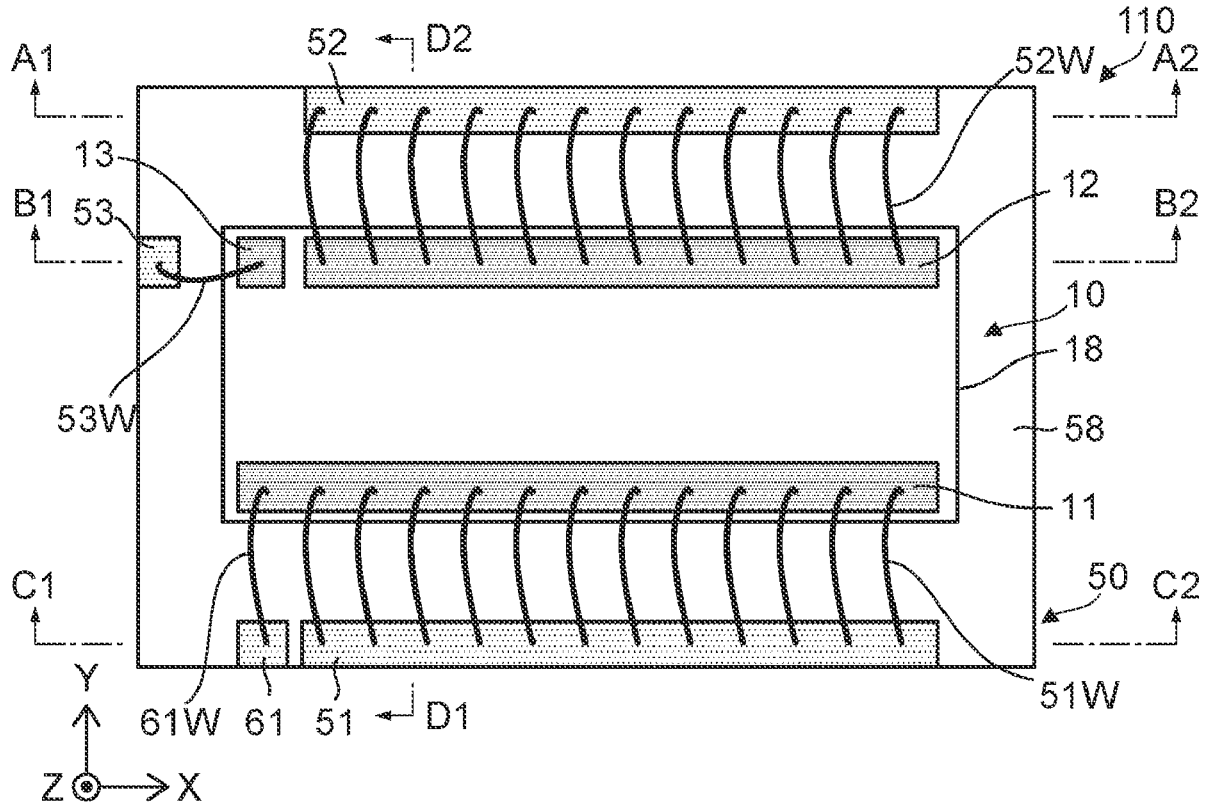
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H01L 29/20	(2006.01)
H01L 29/40	(2006.01)
H01L 29/04	(2006.01)

(52) **U.S. Cl.**

CPC ***H01L 21/02458*** (2013.01); ***H01L 29/04*** (2013.01); ***H01L 29/40*** (2013.01); ***H01L 29/2003*** (2013.01)

(57) **ABSTRACT**

According to one embodiment, a semiconductor device includes a first transistor, and a first mounting member. The first transistor includes a nitride semiconductor layer and includes a first element electrode, a second element electrode, and a third element electrode. The first mounting member includes a first frame electrode, a plurality of first frame connection members electrically connecting the first element electrode and the first frame electrode, a first pad electrode, and a first pad connection member electrically connecting the first element electrode and the first pad electrode.



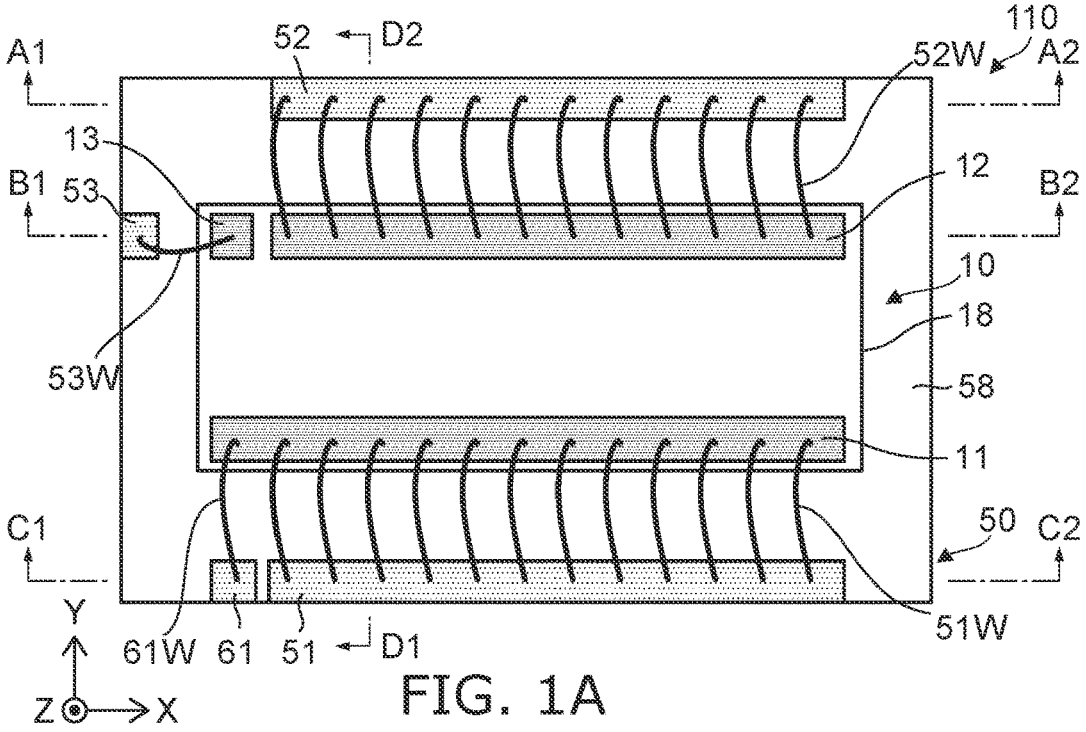


FIG. 1A

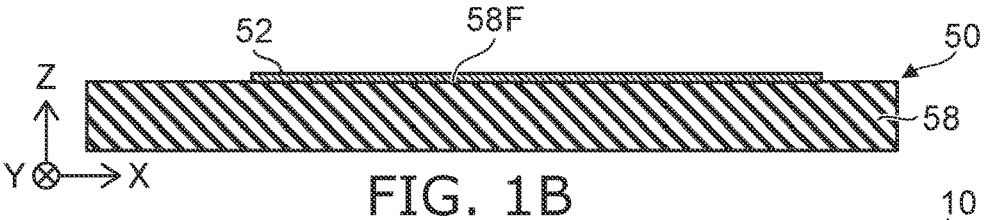


FIG. 1B

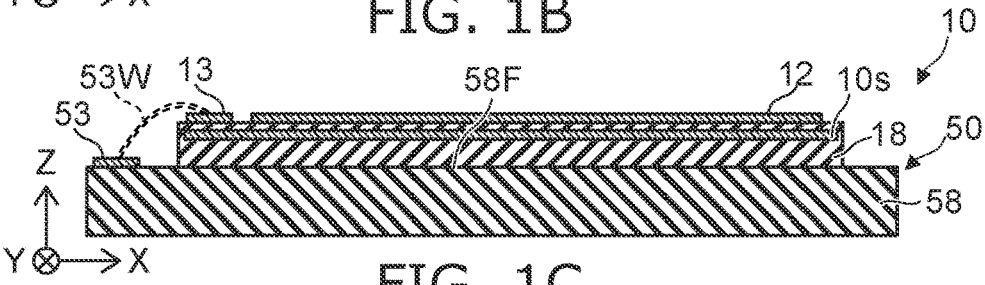


FIG. 1C

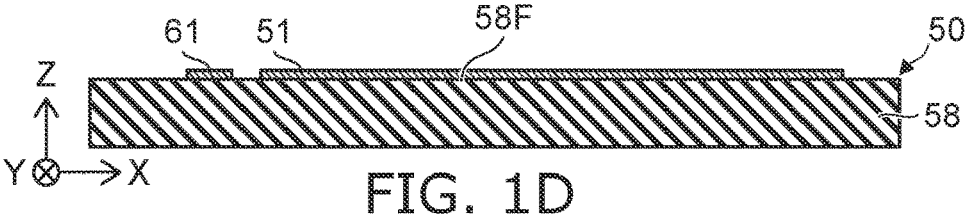


FIG. 1D

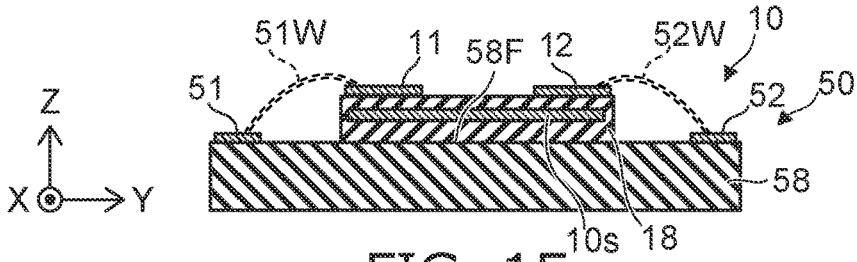


FIG. 1E

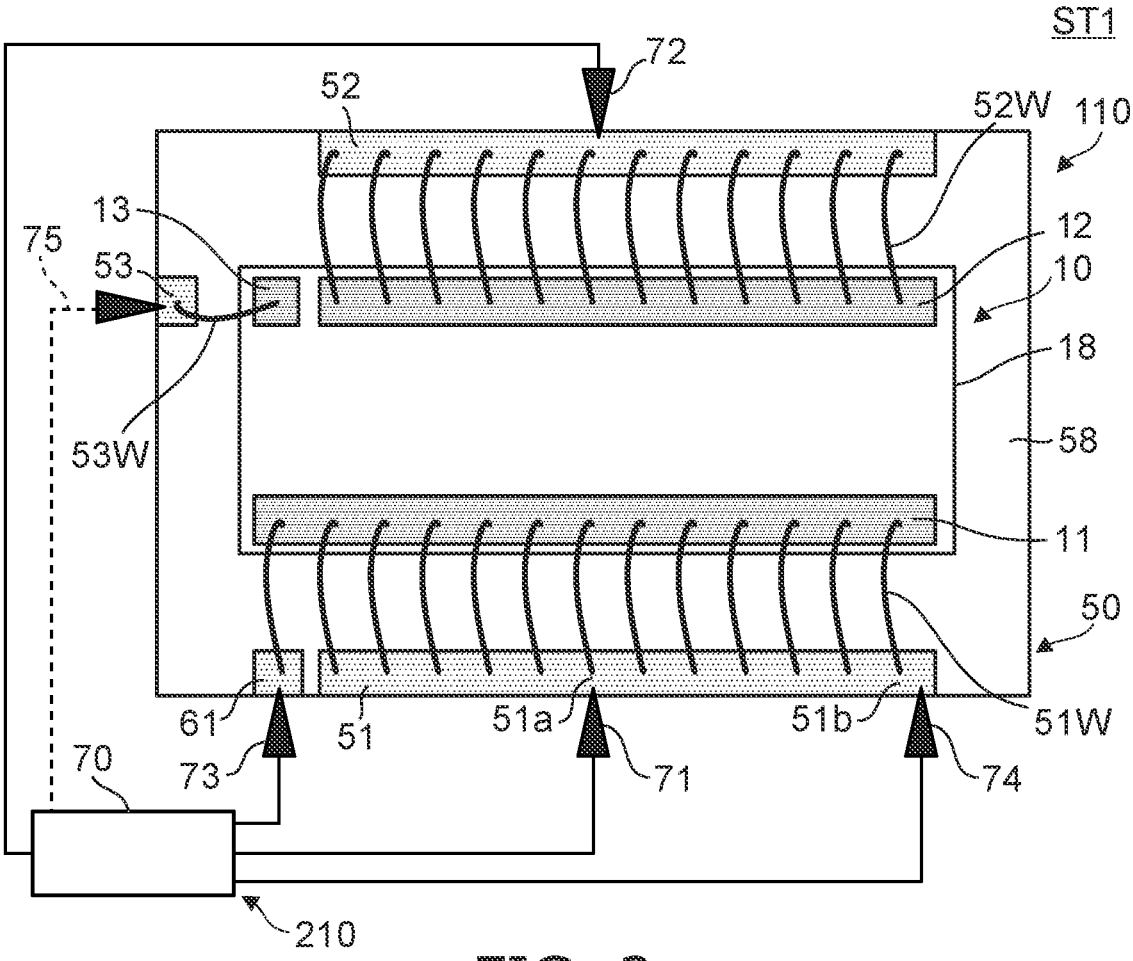

ST1
72
52
52W
110
13
75
53
12
10
18
53W
58
11
50
61
51
51a
51b
51W
70
73
71
74
210

FIG. 2

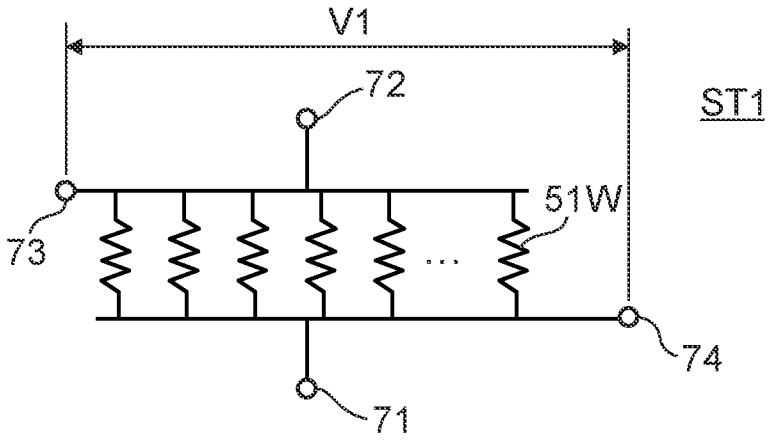

V1
72
ST1
51W
73
74
71

FIG. 3

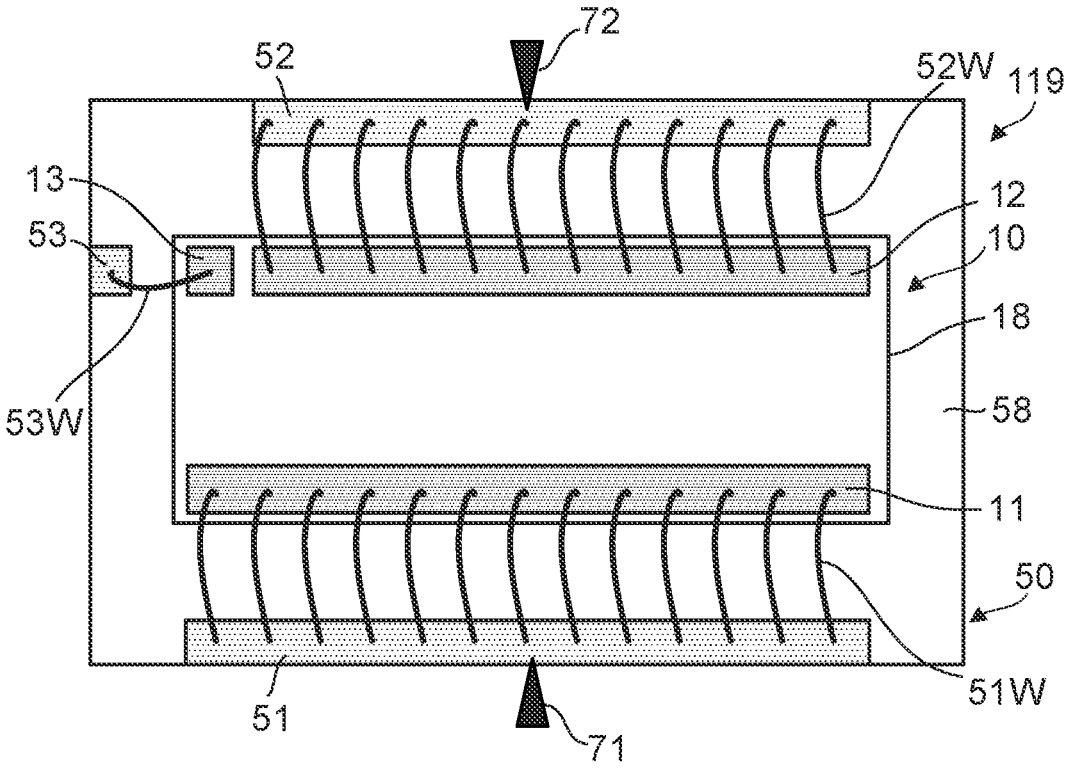

72
52
52W
119
13
12
53
10
18
53W
58
11
50
51W
51
71

FIG. 4

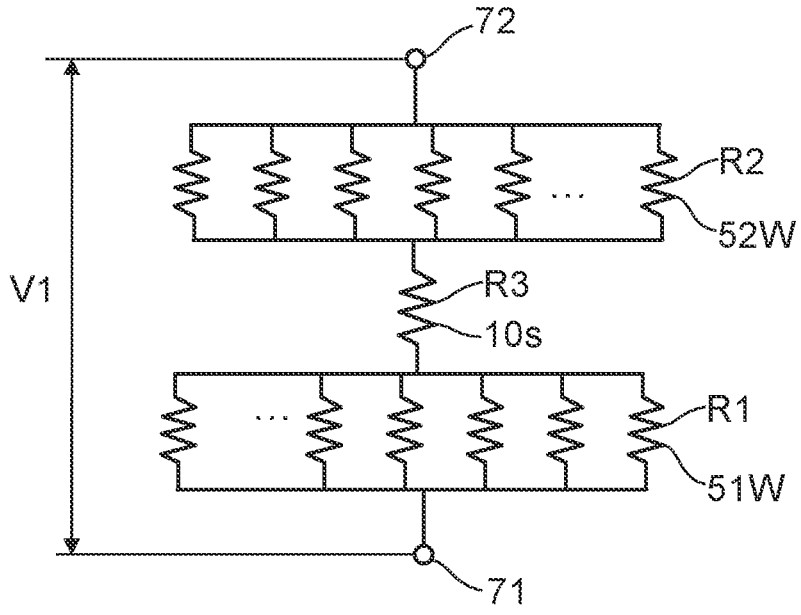

72
R2
52W
V1
R3
10s
R1
51W
71

FIG. 5

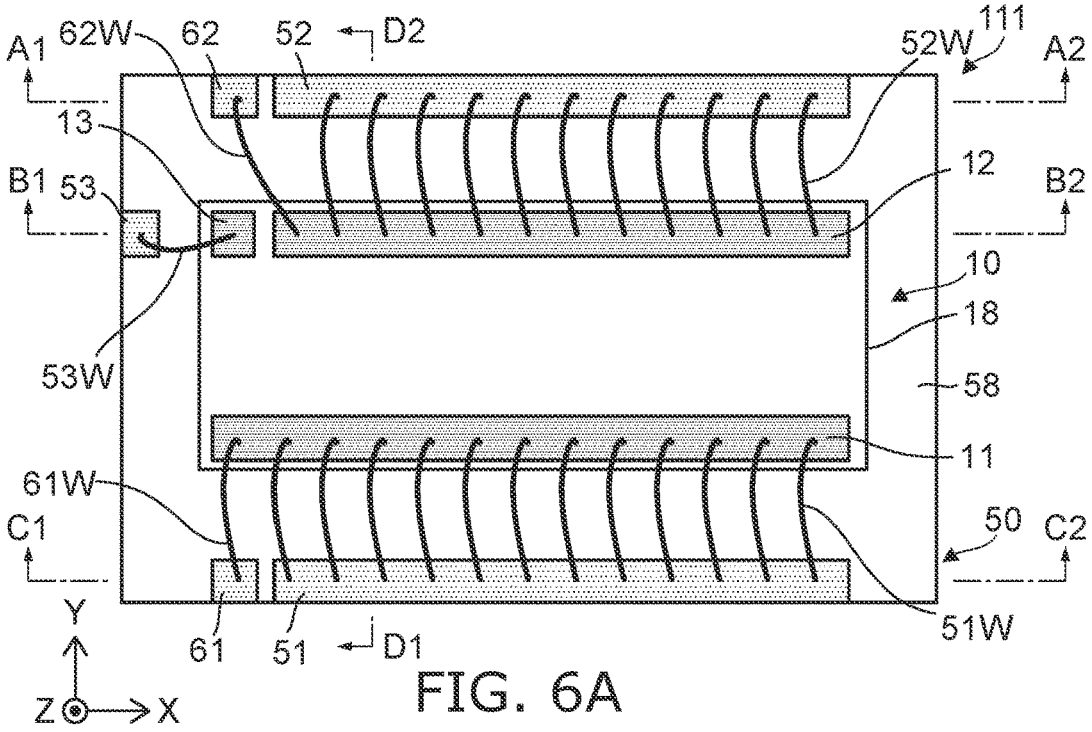


FIG. 6A

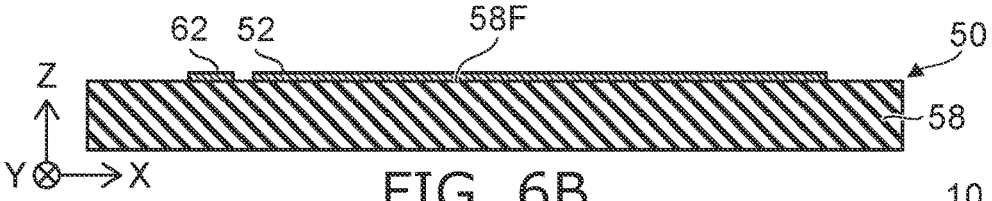


FIG. 6B

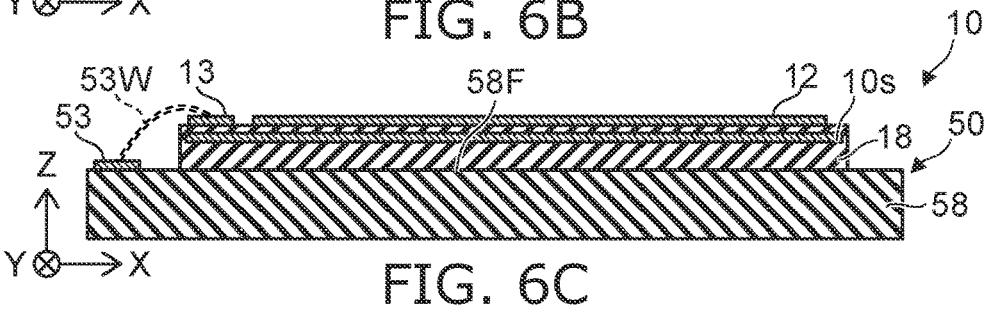


FIG. 6C

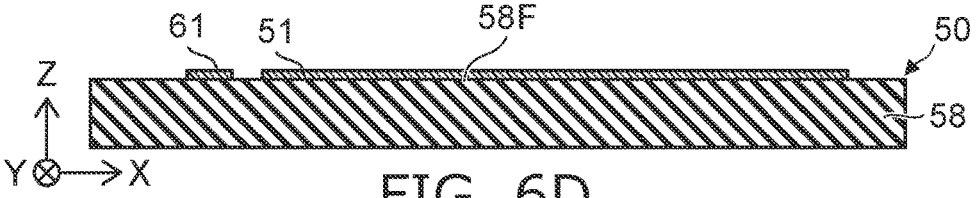


FIG. 6D

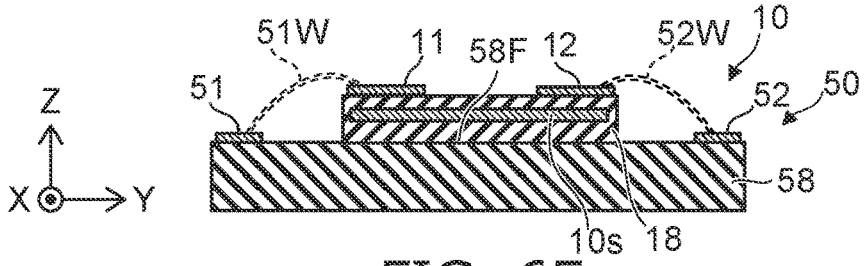


FIG. 6E

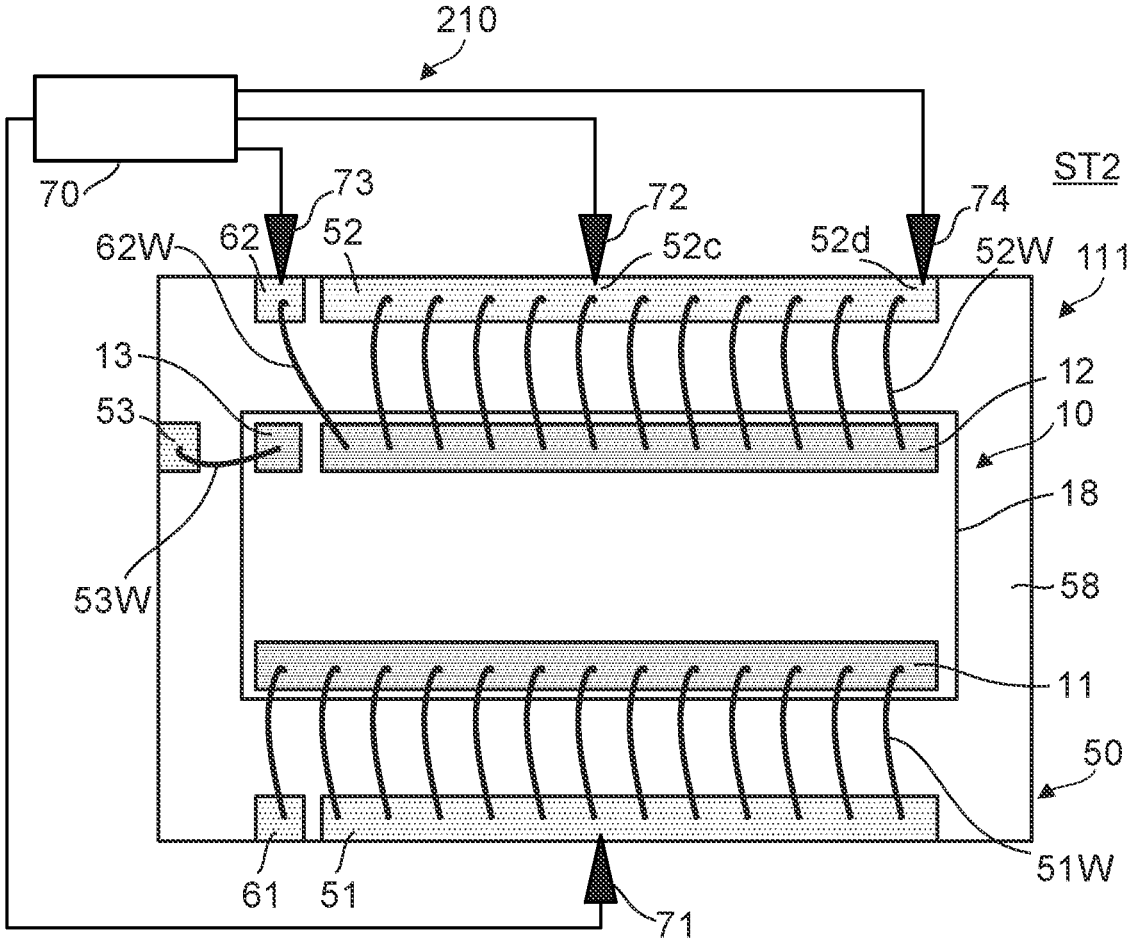

210
70
73
72
74
ST2
62W
62
52
52c
52d
52W
111
13
12
53
10
18
53W
58
11
50
51W
61
51
71

FIG. 7

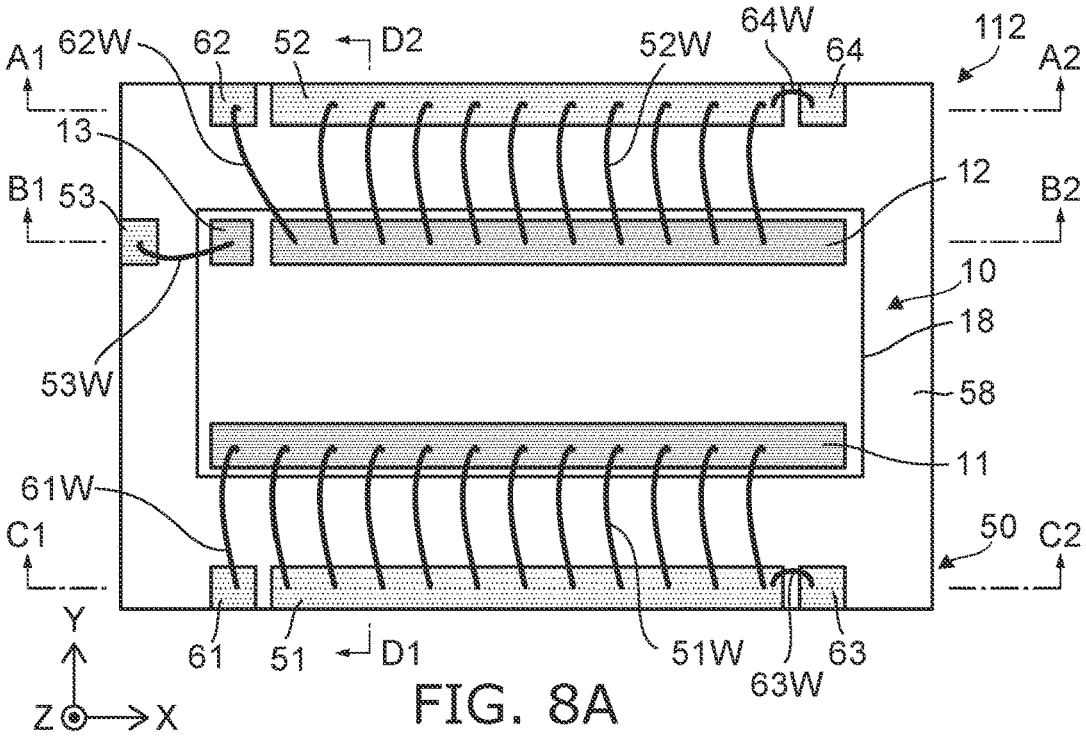


FIG. 8A

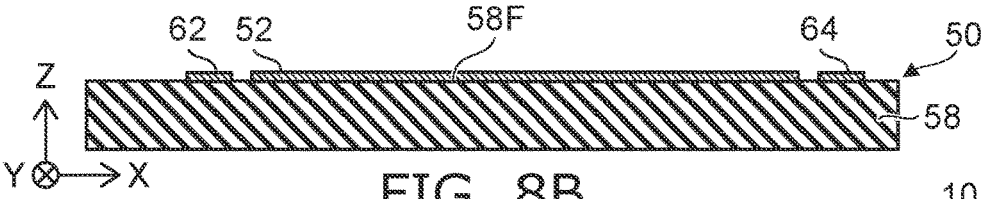


FIG. 8B

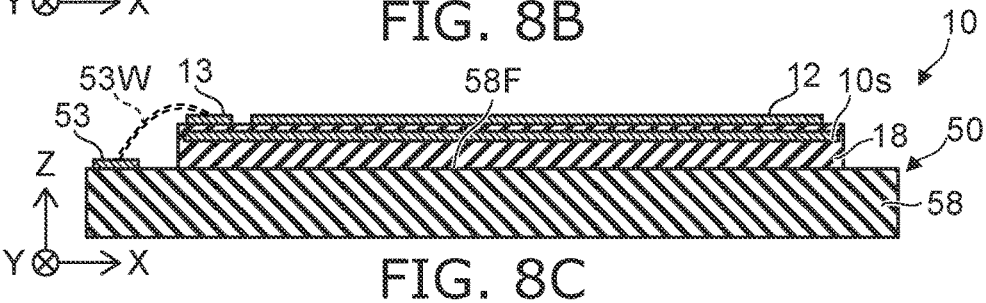


FIG. 8C

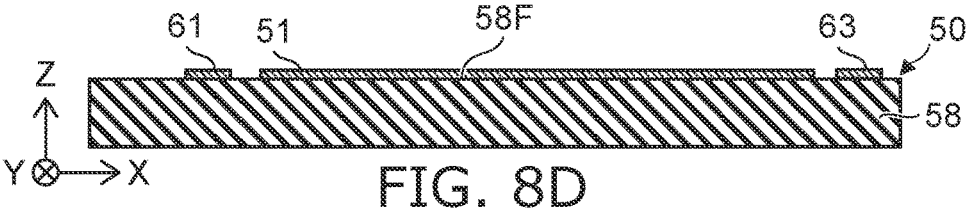


FIG. 8D

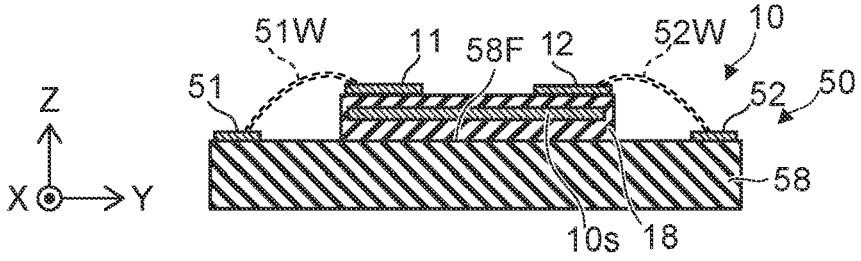


FIG. 8E

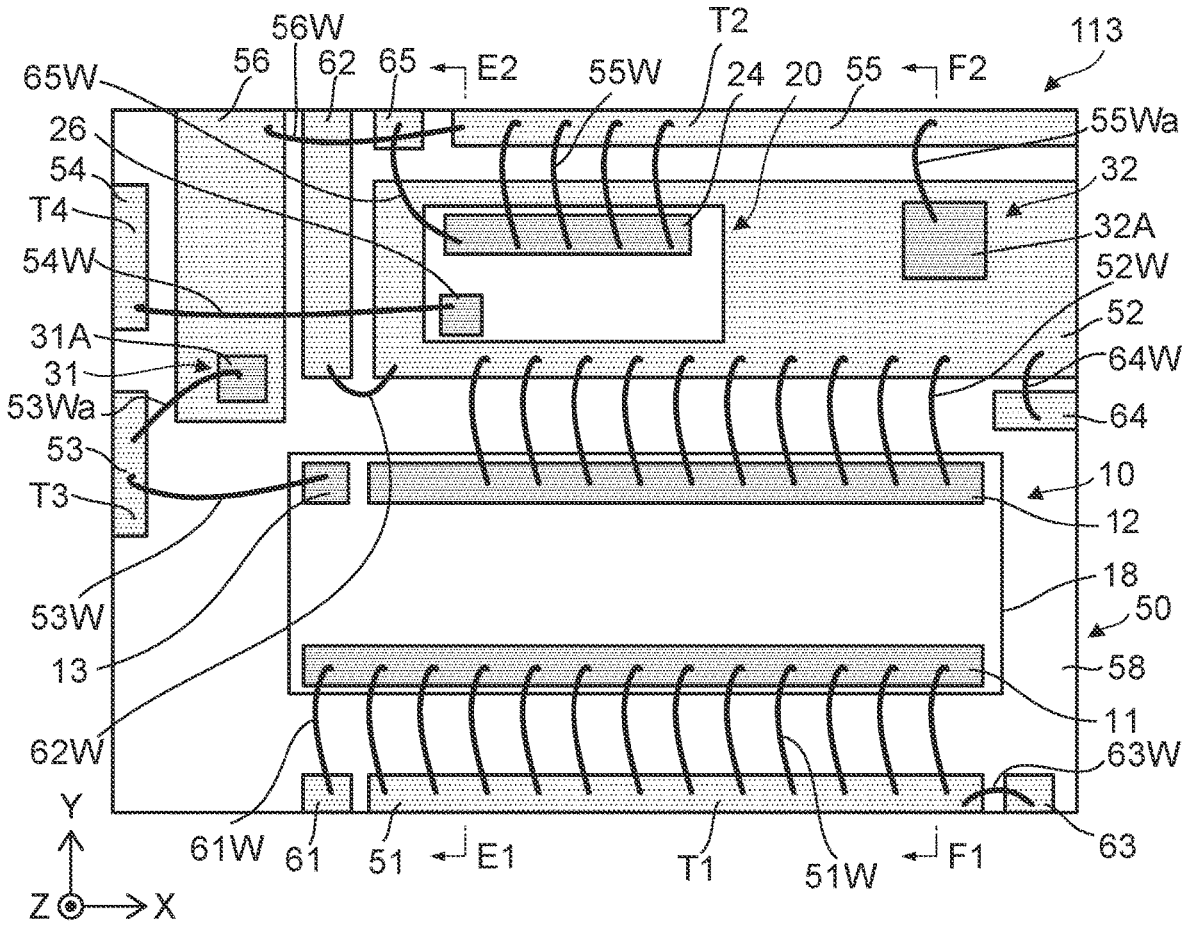

56W
T2
113
65W
56
62
65
E2
55W
24
20
55
F2
55Wa
26
54
32
T4
32A
54W
52W
52
31A
64W
31
53Wa
64
53
10
T3
12
18
53W
50
13
58
11
62W
63W
Y
61W
61
51
E1
T1
51W
F1
63
Z
X

FIG. 9

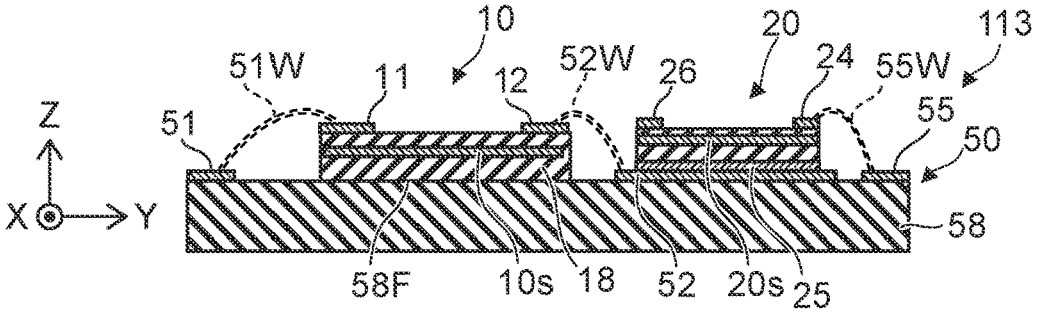


FIG. 10A

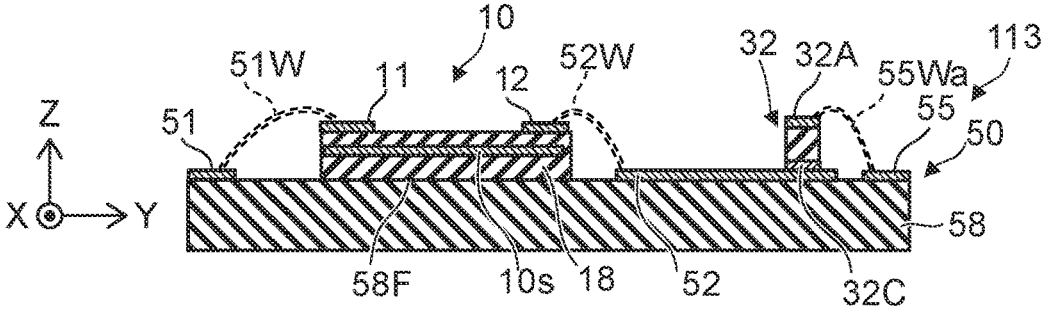


FIG. 10B

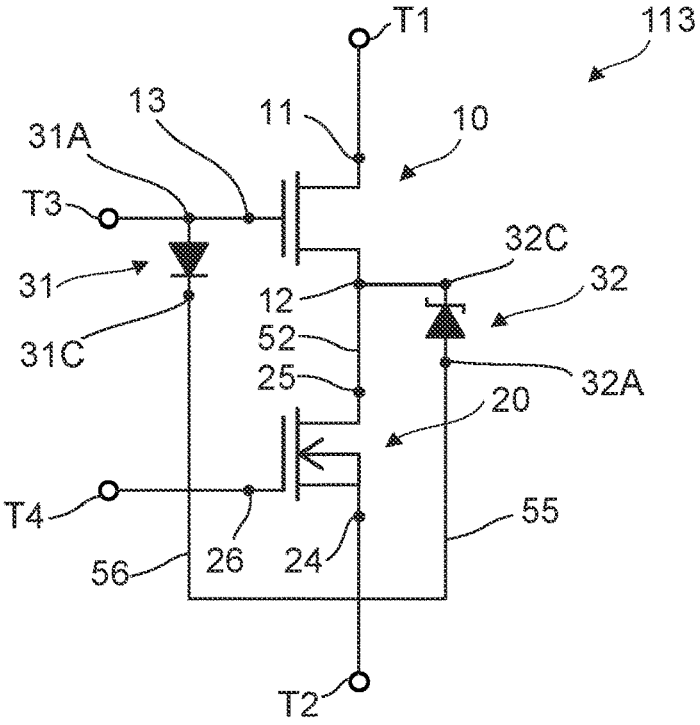


FIG. 11

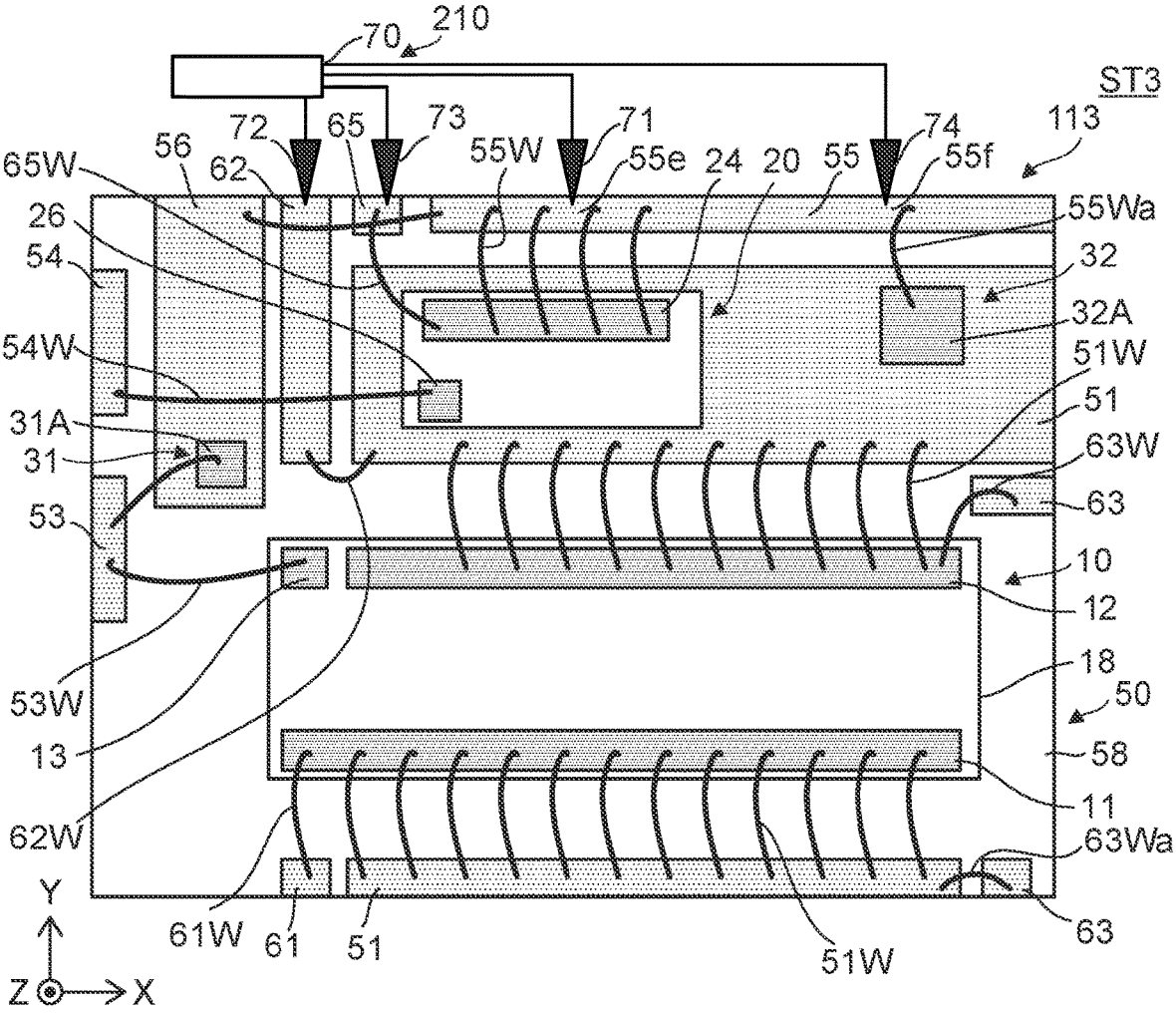

70
210
ST3
72
65
73
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74
113
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62
55W
55e
24
20
55
55f
65W
55Wa
26
54
32
32A
54W
51W
51
31A
31
63W
63
53
10
12
18
50
53W
13
58
11
62W
63Wa
Y
61W
61
51
51W
63
Z
X

FIG. 12

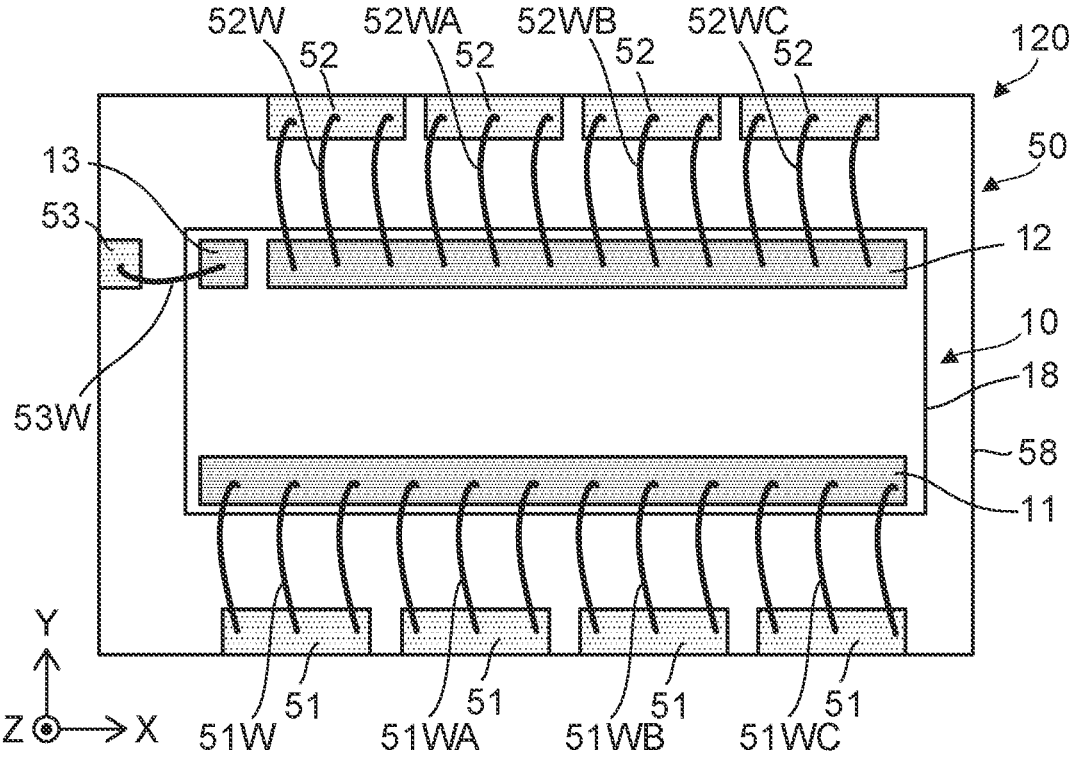

52W
52WA
52WB
52WC
52
52
52
52
120
50
13
53
12
10
18
53W
58
11
Y
Z
X
51W
51
51WA
51
51WB
51
51WC
51

FIG. 13

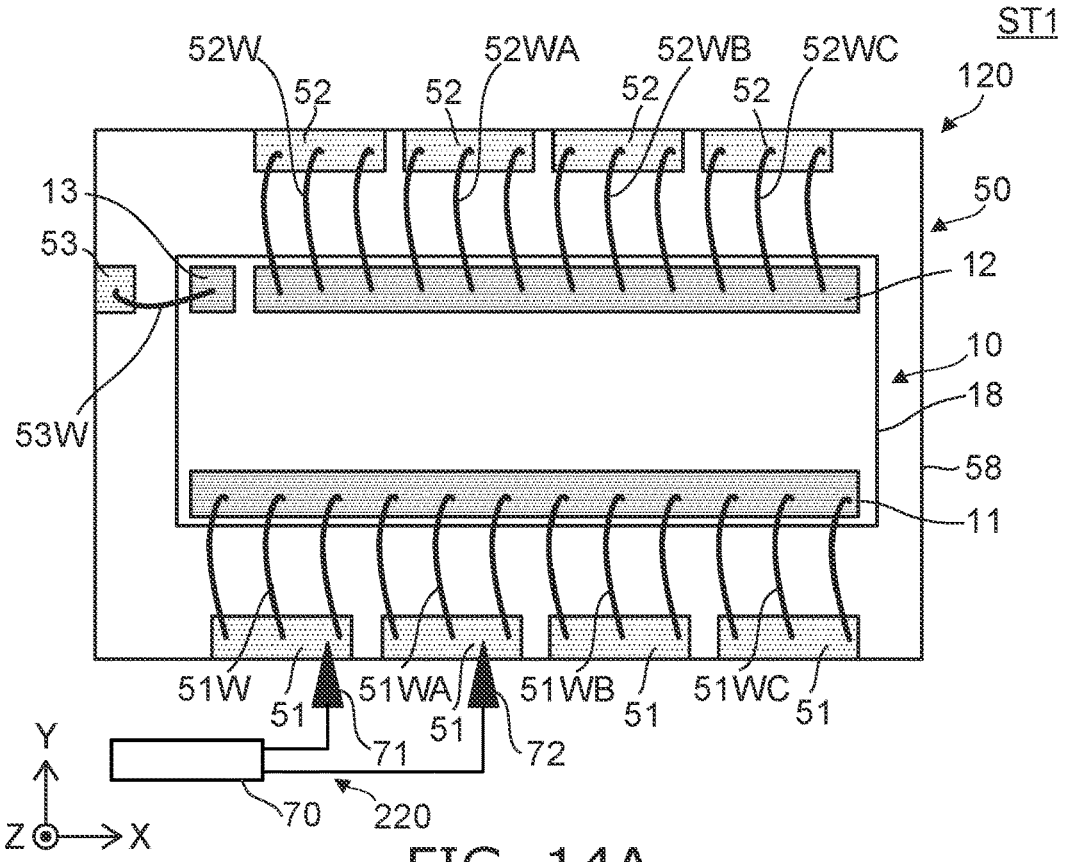


FIG. 14A

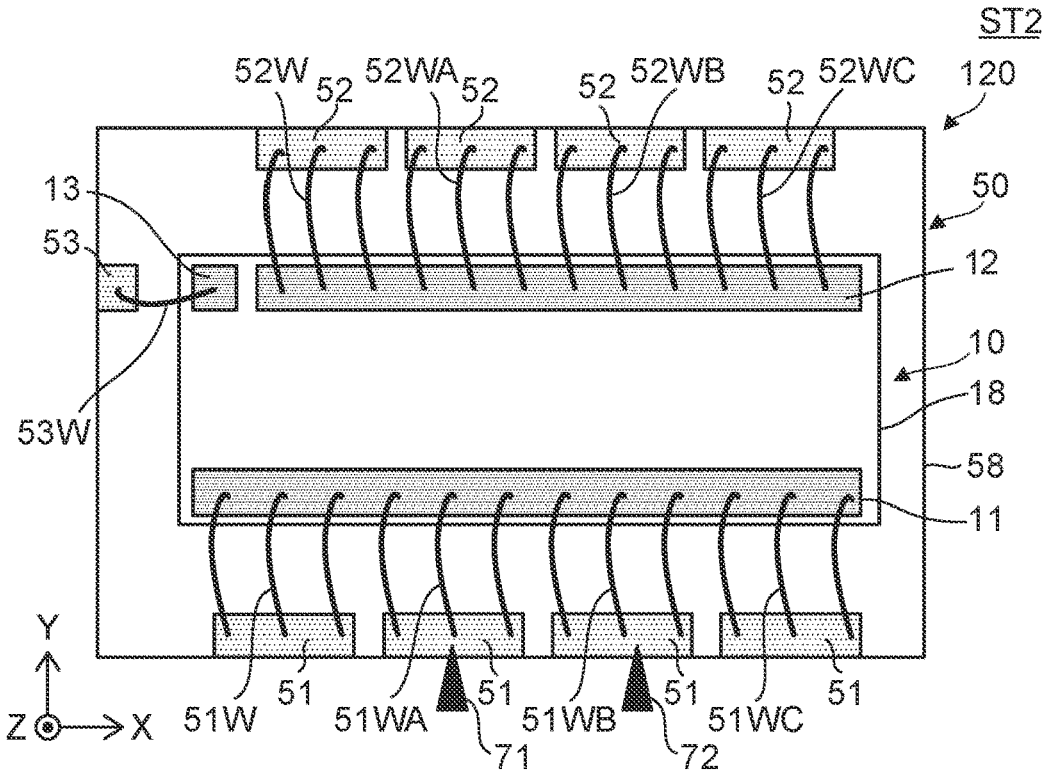


FIG. 14B

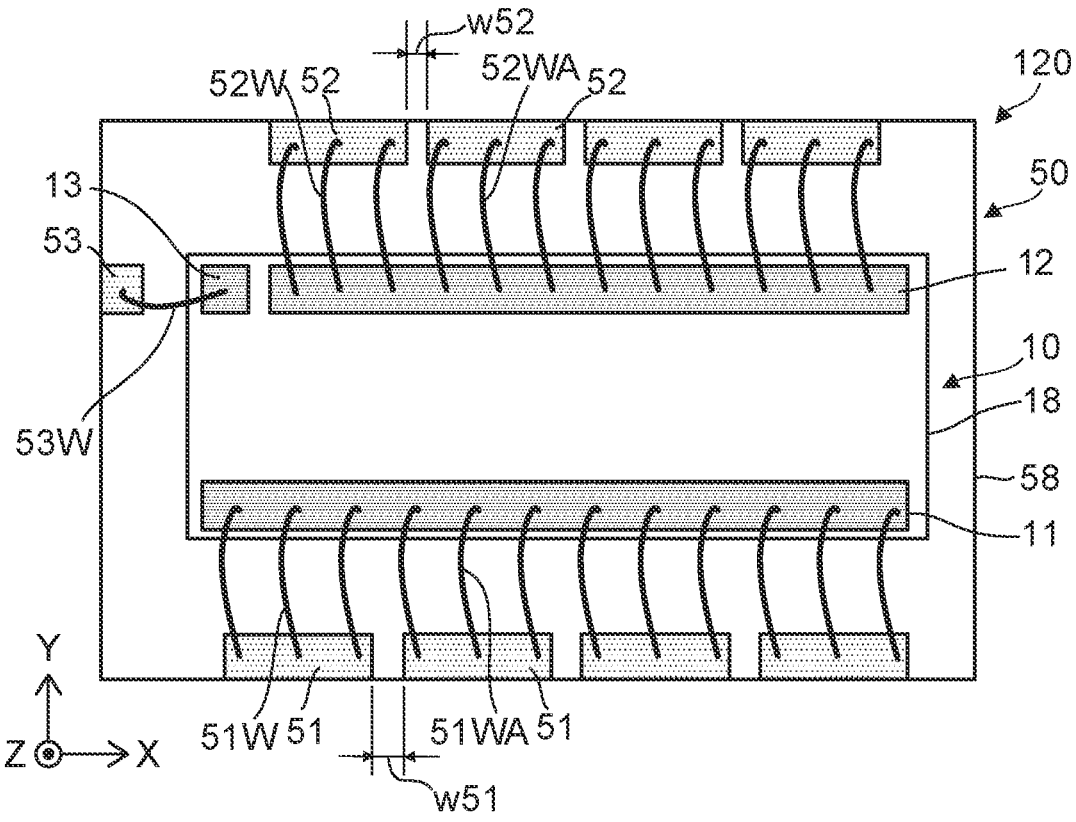

w52
52W
52
52WA
52
120
13
50
53
12
10
18
53W
58
11
Y
Z
X
51W
51
51WA
51
w51

FIG. 15

SEMICONDUCTOR DEVICE, INSPECTION APPARATUS OF SEMICONDUCTOR DEVICE, AND METHOD FOR INSPECTING SEMICONDUCTOR DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2020-072779, filed on Apr. 15, 2020; the entire contents of which are incorporated herein by reference.

FIELD

[0002] Embodiments of the invention generally relate to a semiconductor device, an inspection apparatus of a semiconductor device, and a method for inspecting a semiconductor device.

BACKGROUND

[0003] It is desirable to improve the quality of a semiconductor device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIGS. **1**A to **1**E are schematic views illustrating a semiconductor device according to a first embodiment;

[0005] FIG. **2** is a schematic plan view illustrating an inspection state of the semiconductor device according to the first embodiment;

[0006] FIG. **3** is an equivalent circuit illustrating the inspection state of the semiconductor device according to the first embodiment;

[0007] FIG. **4** is a schematic plan view illustrating a semiconductor device and an inspection state according to a reference example;

[0008] FIG. **5** is an equivalent circuit illustrating the inspection state of the semiconductor device according to the reference example;

[0009] FIGS. **6**A to **6**E are schematic views illustrating a semiconductor device according to the first embodiment;

[0010] FIG. **7** is a schematic plan view illustrating an inspection state of the semiconductor device according to the first embodiment;

[0011] FIGS. **8**A to **8**E are schematic plan views illustrating a semiconductor device according to the first embodiment;

[0012] FIG. **9** is a schematic plan view illustrating a semiconductor device according to the first embodiment;

[0013] FIGS. **10**A and **10**B are schematic cross-sectional views illustrating the semiconductor device according to the first embodiment;

[0014] FIG. **11** is an equivalent circuit diagram illustrating the semiconductor device according to the first embodiment;

[0015] FIG. **12** is a schematic plan view illustrating an inspection state of the semiconductor device according to the first embodiment;

[0016] FIG. **13** is a schematic plan view illustrating an inspection state of a semiconductor device according to a second embodiment;

[0017] FIGS. **14**A and **14**B are schematic plan views illustrating inspection states of the semiconductor device according to the second embodiment; and

[0018] FIG. **15** is a schematic plan view illustrating an inspection state of the semiconductor device according to the second embodiment.

DETAILED DESCRIPTION

[0019] According to one embodiment, a semiconductor device includes a first transistor, and a first mounting member. The first transistor includes a nitride semiconductor layer and includes a first element electrode, a second element electrode, and a third element electrode. The first mounting member includes a first frame electrode, a plurality of first frame connection members electrically connecting the first element electrode and the first frame electrode, a first pad electrode, and a first pad connection member electrically connecting the first element electrode and the first pad electrode.

[0020] According to one embodiment, a semiconductor device includes a first transistor, and a first mounting member. The first transistor includes a nitride semiconductor layer and includes a first element electrode, a second element electrode, and a third element electrode. The first mounting member includes a plurality of first frame electrodes, a plurality of first frame connection members electrically connecting the first element electrode and one of the plurality of first frame electrodes, and an other plurality of first frame connection members electrically connecting the first element electrode and an other one of the plurality of first frame electrodes.

[0021] According to one embodiment, an inspection apparatus of a semiconductor device includes a first probe, a second probe, a third probe, a fourth probe, and a controller electrically connected to the first, second, third, and fourth probes. The controller is configured to inspect the semiconductor device. The semiconductor device includes a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode, and a first mounting member. The first mounting member includes a first frame electrode, a plurality of first frame connection members electrically connecting the first element electrode and the first frame electrode, a second frame electrode, a second frame connection member electrically connecting the second element electrode and the second frame electrode, a first pad electrode, and a first pad connection member electrically connecting the first element electrode and the first pad electrode. In a first inspection state, the first probe is electrically connected to a first portion of the first frame electrode. The second probe is electrically connected to the second frame electrode. The third probe is electrically connected to the first pad electrode. The fourth probe is electrically connected to a second portion of the first frame electrode. The controller is configured to inspect at least a portion of the plurality of first frame connection members by detecting a potential difference between the third probe and the fourth probe when a current is supplied between the first probe and the second probe in the first inspection state.

[0022] According to one embodiment, an inspection apparatus of a semiconductor device includes a first probe, a second probe, and a controller electrically connected to the first and second probes and configured to inspect the semiconductor device. The semiconductor device includes a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode, and a first mounting

member. The first mounting member includes a plurality of first frame electrodes, a plurality of first frame connection members electrically connecting the first element electrode and one of the plurality of first frame electrodes, and an other plurality of first frame connection members electrically connecting the first element electrode and an other one of the plurality of first frame electrodes. In a first inspection state, the first probe is electrically connected to the one of the plurality of first frame electrodes, and the second probe is electrically connected to the other one of the plurality of first frame electrodes. The controller is configured to inspect at least a portion of the plurality of first frame connection members by detecting a current flowing between the first probe and the second probe in the first inspection state.

[0023] According to one embodiment, a method for inspecting a semiconductor device is disclosed. The semiconductor device includes a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode, and a first mounting member. The first mounting member includes a first frame electrode, a plurality of first frame connection members electrically connecting the first element electrode and the first frame electrode, a second frame electrode, a second frame connection member electrically connecting the second element electrode and the second frame electrode, a first pad electrode, and a first pad connection member electrically connecting the first element electrode and the first pad electrode. The method can include inspecting at least a portion of the plurality of first frame connection members by detecting a current flowing between a first probe and a second probe in a first inspection state. The first inspection state includes the first probe being electrically connected to a first portion of the first frame electrode, the second probe being electrically connected to the second frame electrode, a third probe being electrically connected to the first pad electrode, and a fourth probe being electrically connected to a second portion of the first frame electrode.

[0024] According to one embodiment, a method for inspecting a semiconductor device is disclosed. The semiconductor device includes a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode, and a first mounting member. The first mounting member includes a plurality of first frame electrodes, a plurality of first frame connection members electrically connecting the first element electrode and one of the plurality of first frame electrodes, and an other plurality of first frame connection members electrically connecting the first element electrode and an other one of the plurality of first frame electrodes. The method can include inspecting at least a portion of the plurality of first frame connection members by detecting a current flowing between the first probe and the second probe in a first inspection state. The first inspection state includes the first probe being electrically connected to the one of the plurality of first frame electrodes, and the second probe being electrically connected to the other one of the plurality of first frame electrodes.

[0025] Various embodiments are described below with reference to the accompanying drawings.

[0026] 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.

[0027] In the specification and drawings, components similar to those described previously in an antecedent drawing are marked with like reference numerals, and a detailed description is omitted as appropriate.

First Embodiment

[0028] FIGS. **1**A to **1**E are schematic views illustrating a semiconductor device according to a first embodiment. FIG. **1**A is a plan view. FIG. **1**B is a line A**1**-A**2** cross-sectional view of FIG. **1**A. FIG. **1**C is a line B**1**-B**2** cross-sectional view of FIG. **1**A. FIG. **1**D is a line C**1**-C**2** cross-sectional view of FIG. **1**A. FIG. **1**E is a line D**1**-D**2** cross-sectional view of FIG. **1**A.

[0029] As shown in FIG. **1**A, the semiconductor device **110** according to the embodiment includes a first transistor **10** and a first mounting member **50**.

[0030] The first transistor **10** includes a first element electrode **11**, a second element electrode **12**, and a third element electrode **13**. As shown in FIGS. **1**C and **1**E, the first transistor **10** includes a nitride semiconductor layer **10***s*. The nitride semiconductor layer **10***s* includes a nitride semiconductor. For example, the nitride semiconductor layer **10***s* includes GaN.

[0031] As shown in FIG. **1**A, the first mounting member **50** includes a first frame electrode **51**, multiple first frame connection members **51**W, a first pad electrode **61**, and a first pad connection member **61**W. The multiple first frame connection members **51**W electrically connect the first element electrode **11** and the first frame electrode **51**. The first pad connection member **61**W electrically connects the first element electrode **11** and the first pad electrode **61**. The multiple first frame connection members **51**W and the first pad connection member **61**W are, for example, wires.

[0032] In the example as shown in FIGS. **1**B to **1**E, the first mounting member **50** includes a mounting substrate **58**. The mounting substrate **58** includes a first substrate surface **58**F. The first substrate surface **58**F faces the first transistor **10**. The first frame electrode **51**, the first pad electrode **61**, and the first transistor **10** are located on the first substrate surface **58**F. The first substrate surface **58**F faces the first frame electrode **51** and the first pad electrode **61**. The first substrate surface **58**F is, for example, the upper surface.

[0033] The direction from the mounting substrate **58** toward the first frame electrode **51** shown in FIG. **1**D is taken as a first direction. The first direction 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. The first substrate surface **58**F is along the X-Y plane.

[0034] As shown in FIG. **1**E, the position of the nitride semiconductor layer **10***s* in the first direction (the Z-axis direction) is between the position of the first substrate surface **58**F in the first direction and the position of the first element electrode **11** in the first direction. As shown in FIGS. **1**C and **1**E, the position of the nitride semiconductor layer **10**s in the first direction (the Z-axis direction) is between the position of the first substrate surface **58**F in the first direction and the position of the second element electrode **12** in the first direction. As shown in FIG. **1**C, the position of the nitride semiconductor layer **10**s in the first direction (the Z-axis direction) is between the position of the first substrate

surface **58**F in the first direction and the position of the third element electrode **13** in the first direction.

[0035] For example, the first transistor **10** includes an element member **18**. The nitride semiconductor layer **10***s* is on at least a portion of the element member **18**. For example, the first element electrode **11**, the second element electrode **12**, and the third element electrode **13** are located on the element member **18**.

[0036] In the example as shown in FIG. **1**A, the first mounting member **50** includes a second frame electrode **52** and a second frame connection member **52**W. Multiple second frame connection members **52**W are provided in the example. The multiple second frame connection members **52**W electrically connect the second element electrode **12** and the second frame electrode **52**.

[0037] In the example as shown in FIG. **1**A, the first mounting member **50** includes a third frame electrode **53** and a third frame connection member **53**W. The third frame connection member **53**W electrically connects the third element electrode **13** and the third frame electrode **53**.

[0038] The first element electrode **11** is, for example, a drain electrode of the first transistor **10**. The second element electrode **12** is, for example, a source electrode of the first transistor **10**. The third element electrode **13** is, for example, a gate electrode of the first transistor **10**.

[0039] In the example as shown in FIG. **1**A, the direction from the third element electrode **13** toward the second element electrode **12** is along the X-axis direction. The direction from the first element electrode **11** toward the second element electrode **12** is along the Y-axis direction.

[0040] By providing the first pad electrode **61** in the semiconductor device **110** as described below, the state of the multiple first frame connection members **51**W can be inspected with high accuracy. A semiconductor device can be provided thereby in which the quality can be improved.

[0041] FIG. **2** is a schematic plan view illustrating an inspection state of the semiconductor device according to the first embodiment.

[0042] As shown in FIG. **2**, an inspection apparatus **210** of the semiconductor device includes a first probe **71**, a second probe **72**, a third probe **73**, a fourth probe **74**, and a controller **70**. The controller **70** is electrically connected to the first, second, third, and fourth probes **71**, **72**, **73**, and **74**. The controller **70** is configured to inspect the semiconductor device **110**.

[0043] As shown in FIG. **2**, the controller **70** inspects the semiconductor device **110** in a first inspection state ST**1**. In the first inspection state ST**1**, the first probe **71** is electrically connected to a first portion **51***a* of the first frame electrode **51**, the second probe **72** is electrically connected to the second frame electrode **52**, the third probe **73** is electrically connected to the first pad electrode **61**, and the fourth probe **74** is electrically connected to a second portion **51***b* of the first frame electrode **51**. For example, these electrical connections may be performed by contact between the probe and the electrode. As described below, another pad that is electrically connected to one electrode may be provided, and one probe may be electrically connected to the one electrode by electrically connecting the one probe to the other pad. For example, the first portion **51***a* of the first frame electrode **51** is between the first pad electrode **61** and the second portion **51***b* of the first frame electrode **51**.

[0044] The controller **70** is configured to inspect at least a portion of the multiple first frame connection members **51**W in such a first inspection state ST**1** by detecting a potential difference between the third probe **73** and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**. FIG. **3** is an equivalent circuit illustrating the inspection state of the semiconductor device according to the first embodiment.

[0045] As shown in FIG. **3**, a current is supplied between the first probe **71** and the second probe **72** in the first inspection state ST**1**. The resistance of one of the multiple first frame connection members **51**W is taken as a resistance R**1**. The number of the multiple first frame connection members **51**W is taken as a number N**1**. In such a case, a resistance Rx that is measured by a potential difference V**1** generated between the third probe **73** and the fourth probe **74** is R**1**/N**1**. A defect of the multiple first frame connection members **51**W can be detected when the measured resistance Rx is outside a determined value range.

[0046] In such a measurement, the measured resistance Rx is dependent on the multiple first frame connection members **51**W regardless of other resistances (e.g., the resistance inside the first transistor **10**, etc.). Accordingly, the state of the multiple first frame connection members **51**W to be detected can be detected with high accuracy.

[0047] FIG. **4** is a schematic plan view illustrating a semiconductor device and an inspection state according to a reference example.

[0048] As shown in FIG. **4**, the first pad electrode **61** and the first pad connection member **61**W are not provided in the semiconductor device **119** of the reference example. In the inspection of the semiconductor device **119**, the first probe **71** is electrically connected to the first frame electrode **51**, and the second probe **72** is electrically connected to the second frame electrode **52**. For example, a current is supplied between the first probe **71** and the second probe **72**, and a potential difference between the first probe **71** and the second probe **72** is detected. The inspection is performed based on the detected potential difference.

[0049] FIG. **5** is an equivalent circuit illustrating the inspection state of the semiconductor device according to the reference example.

[0050] In the semiconductor device **119**, the resistance of one of the multiple first frame connection members **51**W is taken as the resistance R**1**, and the number of the multiple first frame connection members **51**W is taken as the number N**1**. The resistance of one of the multiple second frame connection members **52**W is taken as a resistance R**2**, and the number of the multiple second frame connection members **52**W is taken as a number N**2**. The resistance inside the first transistor **10** is taken as a resistance R**3**. For example, the resistance R**3** is based on the resistance of the nitride semiconductor layer **10***s*, etc. In such a reference example, the resistance Rx that is measured using the potential difference generated between the first probe **71** and the second probe **72** is R**1**/N**1**+R**2**/N**2**+R**3**. In the reference example, the resistance Rx is dependent not only on the resistance of the multiple first frame connection members **51**W to be detected but also on other resistances (e.g., the resistance R**2**, the resistance R**3**, etc.). Accordingly, in the reference example, it is difficult to detect, with high accuracy, the state of the multiple first frame connection members **51**W to be detected.

[0051] Conversely, in the embodiment, the measured resistance Rx is dependent on the multiple first frame connection members **51**W regardless of other resistances

(e.g., the resistance R**2**, the resistance R**3**, etc.). In the embodiment, the state of the multiple first frame connection members **51**W to be detected can be detected with high accuracy.

[0052] For example, the resistance R**1** of one of the multiple first frame connection members **51**W is taken to be 32 mΩ. The number N**1** of the multiple first frame connection members **51**W is taken to be **40**. The resistance R**2** of one of the multiple second frame connection members **52**W is taken to be 64 mΩ. The number N**2** of the multiple second frame connection members **52**W is taken to be **40**. The resistance R**3** is taken to be 44 mΩ. In such a case, the occurrence of a connection defect in one first frame connection member **51**W is as follows.

[0053] In the semiconductor device **119** of the reference example, the resistance Rx that is detected when there are no defects is 32 mΩ/40+64 mΩ/40+44 mΩ, i.e., 46.4 mΩ. The resistance Rx that is detected when a connection defect has occurred in one first frame connection member **51**W is 32 mΩ/39+64 mΩ/40+44 mΩ, i.e., 46.4205 mΩ. The difference between these resistances is 0.04% of the resistance Rx detected when there are no defects.

[0054] On the other hand, in the semiconductor device **110** according to the embodiment, the resistance Rx that is detected when there are no defects is 32 mΩ/40, i.e., 0.8 mΩ. The resistance Rx that is detected when a connection defect has occurred in one first frame connection member **51**W is 32 mΩ/39, i.e., 0.821 mΩ. The difference between these resistances is 2.6% of the resistance Rx detected when there are no defects.

[0055] Thus, in the embodiment, one defect greatly affects the resistance Rx. According to the embodiment, the state of the multiple first frame connection members **51**W to be detected can be detected with high accuracy. The quality is more easily improved because the inspection has high accuracy. High productivity is easily obtained. According to the embodiment, a semiconductor device can be provided in which the quality can be improved.

[0056] For example, in a transistor that includes a nitride semiconductor such as GaN, etc., the resistance inside the transistor is exceedingly low. Therefore, it is desirable to reduce the resistance of the connection members such as the wires, etc., of such a transistor. Therefore, for example, the electrical connection is performed using multiple connection members (wires, etc.). When multiple connection members are used, for example, the desired characteristics are not obtained when a connection defect occurs in one of the multiple connection members. For example, when a connection defect occurs in one of the multiple connection members, a nonuniform distribution occurs in the current flowing through the element electrodes, and the reliability of the element degrades. Degradation over time of the element over long-term use is easily caused. For a transistor that includes a nitride semiconductor, it is desirable to detect, with high accuracy, the connection state of the multiple connection members to be detected. In the embodiment, the connection state of the multiple connection members (e.g., the multiple first frame connection members **51**W) can be inspected with high accuracy. A semiconductor device can be provided in which the quality can be improved thereby.

[0057] In the embodiment, the controller **70** may include a fifth probe **75** (referring to FIG. **2**). The fifth probe **75** is electrically connected to the third frame electrode **53**. For example, the electrical connection may be performed by contact between the probe and the electrode. For example, the controller **70** may perform the inspection of the multiple first frame connection members **51**W in a state in which a voltage is applied to the third frame electrode **53**.

[0058] FIGS. **6**A to **6**E are schematic views illustrating a semiconductor device according to the first embodiment. FIG. **6**A is a plan view. FIG. **6**B is a line A**1**-A**2** cross-sectional view of FIG. **6**A. FIG. **6**C is a line B**1**-B**2** cross-sectional view of FIG. **6**A. FIG. **6**D is a line C**1**-C**2** cross-sectional view of FIG. **6**A. FIG. **6**E is a line D**1**-D**2** cross-sectional view of FIG. **6**A.

[0059] As shown in FIG. **6**A, the semiconductor device **111** according to the embodiment also includes the first transistor **10** and the first mounting member **50**. In the semiconductor device **111**, the first mounting member **50** includes a second pad electrode **62** and a second pad connection member **62**W. Otherwise, the configuration of the semiconductor device **111** is similar to that of the semiconductor device **110**.

[0060] The second pad connection member **62**W electrically connects the second element electrode **12** and the second pad electrode **62**. As shown in FIG. **6**B, the second pad electrode **62** is located on the first substrate surface **58**F of the mounting substrate **58**. The second pad connection member **62**W is, for example, a wire.

[0061] FIG. **7** is a schematic plan view illustrating an inspection state of the semiconductor device according to the first embodiment.

[0062] As shown in FIG. **7**, the inspection apparatus **210** of the semiconductor device includes the first probe **71**, the second probe **72**, the third probe **73**, the fourth probe **74**, and the controller **70**.

[0063] As shown in FIG. **7**, the controller **70** inspects the semiconductor device **111** in a second inspection state ST**2**. In the second inspection state ST**2**, the first probe **71** is electrically connected to the first frame electrode **51**, the second probe **72** is electrically connected to a third portion **52***c* of the second frame electrode **52**, the third probe **73** is electrically connected to the second pad electrode **62**, and the fourth probe **74** is electrically connected to a fourth portion **52***d* of the second frame electrode **52**. For example, these electrical connections may be performed by contact between the probe and the electrode. For example, the third portion **52***c* of the second frame electrode **52** is between the second pad electrode **62** and the fourth portion **52***d* of the second frame electrode **52**.

[0064] The controller **70** is configured to inspect at least a portion of the multiple second frame connection members **52**W in such a second inspection state ST**2** by detecting a potential difference between the third probe **73** and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**.

[0065] In the semiconductor device **111**, the state of the multiple second frame connection members **52**W to be detected can be detected with high accuracy. A semiconductor device can be provided in which the quality can be improved.

[0066] In the embodiment, the controller **70** may include the fifth probe **75** (referring to FIG. **2**). The fifth probe **75** is electrically connected to the third frame electrode **53**. The controller **70** may perform the inspection of the multiple second frame connection members **52**W in a state in which a voltage is applied to the third frame electrode **53**.

[0067] FIGS. **8**A to **8**E are schematic plan views illustrating a semiconductor device according to the first embodiment.

[0068] As shown in FIGS. **8**A to **8**E, the semiconductor device **112** according to the embodiment also includes the first transistor **10** and the first mounting member **50**. In the semiconductor device **112**, the first mounting member **50** includes a third pad electrode **63** and a third pad connection member **63**W. In the example, the first mounting member **50** further includes a fourth pad electrode **64** and a fourth pad connection member **64**W. Otherwise, the configuration of the semiconductor device **112** is similar to that of the semiconductor device **111**.

[0069] The third pad connection member **63**W electrically connects the third pad electrode **63** and the first frame electrode **51**. The fourth pad connection member **64**W electrically connects the fourth pad electrode **64** and the second frame electrode **52**. For example, at least a portion of the first frame electrode **51** is between the first pad electrode **61** and the third pad electrode **63**. For example, at least a portion of the second frame electrode **52** is between the second pad electrode **62** and the fourth pad electrode **64**. The third pad connection member **63**W and the fourth pad connection member **64**W are, for example, wires

[0070] In the semiconductor device **112**, for example, in the first inspection state ST**1**, the first probe **71** is electrically connected to the first frame electrode **51**, the second probe **72** is electrically connected to the second frame electrode **52**, the third probe **73** is electrically connected to the first pad electrode **61**, and the fourth probe **74** is electrically connected to the third pad electrode **63**. The controller **70** is configured to inspect at least a portion of the multiple first frame connection members **51**W in such a first inspection state ST**1** by detecting a potential difference between the third probe **73** and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**.

[0071] In the semiconductor device **112**, for example, in the second inspection state ST**2**, the first probe **71** is electrically connected to the first frame electrode **51**, the second probe **72** is electrically connected to the second frame electrode **52**, the third probe **73** is electrically connected to the second pad electrode **62**, and the fourth probe **74** is electrically connected to the fourth pad electrode **64**. The controller **70** is configured to inspect at least a portion of the multiple second frame connection members **52**W in such a second inspection state ST**2** by detecting a potential difference between the third probe **73** and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**.

[0072] In the semiconductor device **112** as well, the state to be detected can be detected with high accuracy. A semiconductor device can be provided in which the quality can be improved.

[0073] FIG. **9** is a schematic plan view illustrating a semiconductor device according to the first embodiment.

[0074] FIGS. **10**A and **10**B are schematic cross-sectional views illustrating the semiconductor device according to the first embodiment.

[0075] FIG. **11** is an equivalent circuit diagram illustrating the semiconductor device according to the first embodiment.

[0076] FIG. **10**A is a line E**1**-E**2** cross-sectional view of FIG. **9**. FIG. **10**B is a line F**1**-F**2** cross-sectional view of FIG. **9**.

[0077] As shown in FIG. **9**, the semiconductor device **113** according to the embodiment includes a second transistor **20** in addition to the first transistor **10** and the first mounting member **50**. In the example, the semiconductor device **113** further includes a first diode **31** and a second diode **32**. The configuration of the first transistor **10** of the semiconductor device **113** may be similar to the configuration of the first transistor **10** of the semiconductor device **110**.

[0078] As shown in FIGS. **9** and **10**A, the second transistor **20** includes a fourth element electrode **24**, a fifth element electrode **25**, and a sixth element electrode **26**. As shown in FIGS. **10**A and **11**, the fifth element electrode **25** is electrically connected to the second frame electrode **52**. Thereby, the fifth element electrode **25** is electrically connected to the second element electrode **12**.

[0079] As shown in FIG. **10**A, the second transistor **20** includes a silicon semiconductor layer **20***s*. The second transistor **20** is, for example, a normally-off low breakdown voltage transistor. On the other hand, the first transistor **10** is a normally-on high breakdown voltage transistor. The first transistor **10** and the second transistor **20** have a cascode connection. Thereby, the semiconductor device **113** can have a normally-off operation.

[0080] In the second transistor **20**, the fourth element electrode **24** is, for example, a source electrode. The fifth element electrode **25** is, for example, a drain electrode. The sixth element electrode **26** is, for example, a gate electrode. As shown in FIG. **9**, the first mounting member **50** includes a fourth frame electrode **54** and a fourth frame connection member **54**W. The fourth frame connection member **54**W electrically connects the fourth frame electrode **54** and the sixth element electrode **26**.

[0081] As shown in FIG. **9**, the first mounting member **50** includes a fifth pad electrode **65** and a fifth pad connection member **65**W. The fifth pad connection member **65**W electrically connects the fifth pad electrode **65** and the fourth element electrode **24**.

[0082] As shown in FIG. **9**, the first mounting member **50** includes a fifth frame electrode **55** and a fifth frame connection member **55**W. In the example, multiple fifth frame connection members **55**W are provided. The multiple fifth frame connection members **55**W electrically connect the fifth frame electrode **55** and the fourth element electrode **24**.

[0083] As shown in FIG. **9**, the first mounting member **50** includes a sixth frame electrode **56** and a sixth frame connection member **56**W. The sixth frame connection member **56**W electrically connects the fifth frame electrode **55** and the sixth frame electrode **56**.

[0084] As shown in FIG. **11**, the first diode **31** includes a first anode **31**A and a first cathode **31**C. As shown in FIGS. **10**B and **11**, the second diode **32** includes a second anode **32**A and a second cathode **32**C. As shown in FIGS. **9** and **11**, the first anode **31**A is electrically connected to the third element electrode **13**. In the example as shown in FIG. **9**, the first anode **31**A and the third frame electrode **53** are electrically connected by a connection member **53**Wa. The first anode **31**A is electrically connected to the third element electrode **13** by the connection member **53**Wa and the third frame connection member **53**W.

[0085] As shown in FIG. **11**, the first cathode **31**C is electrically connected to the second anode **32**A. In the example as shown in

[0086] FIGS. **9** and **10**B, the second anode **32**A and the fifth frame electrode **55** are electrically connected by a

connection member **55**Wa. As shown in FIG. **11**, the second cathode **32**C is electrically connected to the second element electrode **12**. In the example as shown in FIG. **10**B, the second cathode **32**C is electrically connected to the second frame electrode **52**. The second cathode **32**C is electrically connected to the second element electrode **12** via the second frame electrode **52** and the second frame connection member **52**W.

[0087] The first diode **31** is, for example, a p-i-n diode. The second diode **32** is, for example, a zener diode (a voltage regulator diode).

[0088] In the example as shown in FIG. **9**, the fourth pad electrode **64** is electrically connected to the second frame electrode **52** via the fourth pad connection member **64**W, the second element electrode **12**, and the multiple second frame connection members **52**W.

[0089] As shown in FIG. **9**, the first frame electrode **51** is used as a first terminal T**1** (referring to FIG. **11**). As shown in FIG. **9**, the fifth frame electrode **55** is used as a second terminal T**2** (referring to FIG. **11**). As shown in FIG. **9**, the third frame electrode **53** is used as a third terminal T**3** (referring to FIG. **11**). As shown in FIG. **9**, the fourth frame electrode **54** is used as a fourth terminal T**4** (referring to FIG. **11**). For example, the first terminal T**1** functions as a drain terminal of the semiconductor device **113**. For example, the second terminal T**2** functions as a source terminal of the semiconductor device **113**. For example, the fourth terminal T**4** functions as a gate terminal of the semiconductor device **113**.

[0090] In the semiconductor device **113** as well, the multiple first frame connection members **51**W can be inspected with high accuracy by providing at least one of the first pad electrode **61** or the third pad electrode **63**. The multiple second frame connection members **52**W can be inspected with high accuracy by providing at least one of the second pad electrode **62** or the fourth pad electrode **64**.

[0091] In the semiconductor device **113**, for example, the multiple fifth frame connection members **55**W can be inspected with high accuracy by providing the fifth pad electrode **65**.

[0092] FIG. **12** is a schematic plan view illustrating an inspection state of the semiconductor device according to the first embodiment. As shown in FIG. **12**, the inspection apparatus **210** of the semiconductor device includes the first probe **71**, the second probe **72**, the third probe **73**, the fourth probe **74**, and the controller **70**. The controller **70** is electrically connected to the first, second, third, and fourth probes **71**, **72**, **73**, and **74**. The controller **70** is configured to inspect the semiconductor device **113**. In addition to the inspections in the first inspection state ST**1** and the second inspection state ST**2** described above, the controller **70** is configured to inspect the semiconductor device **113** in a third inspection state ST**3**.

[0093] As described above, the first mounting member **50** includes the fifth pad electrode **65**, the fifth pad connection member **65**W, the fifth frame electrode **55**, and the multiple fifth frame connection members **55**W. The fifth pad connection member **65**W electrically connects the fifth pad electrode **65** and the fourth element electrode **24**. The multiple fifth frame connection members **55**W electrically connect the fifth frame electrode **55** and the fourth element electrode **24**.

[0094] In the third inspection state ST**3**, the first probe **71** is electrically connected to a fifth portion **55***e* of the fifth frame electrode **55**, the second probe **72** is electrically connected to the second pad electrode **62**, the third probe **73** is electrically connected to the fifth pad electrode **65**, and the fourth probe **74** is electrically connected to a sixth portion **55***f* of the fifth frame electrode **55**. For example, the fifth portion **55***e* of the fifth frame electrode **55** is between the fifth pad electrode **65** and the sixth portion **55***f* of the fifth frame electrode **55**.

[0095] The controller **70** is configured to inspect at least a portion of the multiple fifth frame connection members **55**W in such a third inspection state ST**3** by detecting a potential difference between the third probe **73** and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**. The state of the multiple fifth frame connection members **55**W to be detected can be detected with high accuracy. The quality is more easily improved because the inspection has high accuracy. High productivity is easily obtained. According to the embodiment, a semiconductor device can be provided in which the quality can be improved.

[0096] In the first embodiment, the number of the multiple first frame connection members **51**W is, for example, not less than 20 and not more than 100. The number of the multiple first frame connection members **51**W may be, for example, not less than 30 and not more than 60. The multiple first frame connection members **51**W includes, for example, at least one selected from the group consisting of Au and Cu. The number of the multiple second frame connection members **52**W is, for example, not less than 20 and not more than 100. The number of the multiple second frame connection members **52**W may be, for example, not less than 30 and not more than 60. The multiple second frame connection members **52**W includes, for example, at least one selected from the group consisting of Au and Cu.

[0097] For example, the number of the multiple fifth frame connection members **55**W is, for example, not less than 5 and not more than 30. The number of the multiple fifth frame connection members **55**W may be, for example, not less than 5 and not more than 15. The multiple fifth frame connection members **55**W includes, for example, at least one selected from the group consisting of Au and Cu.

Second Embodiment

[0098] FIG. **13** is a schematic plan view illustrating an inspection state of a semiconductor device according to a second embodiment. As shown in FIG. **13**, the semiconductor device **120** according to the second embodiment includes the first transistor **10** and the first mounting member **50**. The configuration of the first transistor **10** of the semiconductor device **120** may be similar to the configuration of the first transistor **10** of the semiconductor device **110**. For example, the first transistor **10** includes the nitride semiconductor layer **10**s and includes the first element electrode **11**, the second element electrode **12**, and the third element electrode **13** (referring to FIG. **1**E). An example of the first mounting member **50** of the semiconductor device **120** will now be described.

[0099] As shown in FIG. **13**, the first mounting member **50** includes the multiple first frame electrodes **51**, the multiple first frame connection members **51**W, and other multiple first frame connection members **51**WA. The multiple first frame connection members **51**W electrically connect the first element electrode **11** and one of the multiple first frame electrodes **51**. The other multiple first frame connection

members **51**WA electrically connect the first element electrode **11** and another one of the multiple first frame electrodes **51**.

[0100] The first mounting member **50** may include other multiple first frame connection members **51**WB, other multiple first frame connection members **51**WC, etc. The other multiple first frame connection members **51**WB electrically connect the first element electrode **11** and another one of the multiple first frame electrodes **51**. The other multiple first frame connection members **51**WC electrically connect the first element electrode **11** and another one of the multiple first frame electrodes **51**.

[0101] For example, the one of the multiple first frame electrodes **51** described above is next to the other one of the multiple first frame electrodes **51** described above.

[0102] In the semiconductor device **120**, for example, the state of the multiple first frame connection members **51**W, etc., can be inspected by detecting a current flowing between one of the multiple first frame electrodes **51** and another one of the multiple first frame electrodes **51**.

[0103] FIGS. **14**A and **14**B are schematic plan views illustrating inspection states of the semiconductor device according to the second embodiment.

[0104] As shown in FIG. **14**A, an inspection apparatus **220** includes the first probe **71**, the second probe **72**, and the controller **70**. The controller **70** is electrically connected to the first and second probes **71** and **72**. The controller **70** is configured to inspect the semiconductor device **120**.

[0105] As described above, the semiconductor device **120** includes the first transistor **10** and the first mounting member **50**. The first mounting member **50** includes the multiple first frame electrodes **51**, the multiple first frame connection members **51**W, and the other multiple first frame connection members **51**WA.

[0106] In the first inspection state ST**1** as shown in FIG. **14**A, the first probe **71** is electrically connected to the one of the multiple first frame electrodes **51** described above, and the second probe **72** is electrically connected to the other one of the multiple first frame electrodes **51** described above. The multiple first frame connection members **51**W are connected to the one of the multiple first frame electrodes **51** described above. The other multiple first frame connection members **51**WA are connected to the other one of the multiple first frame electrodes **51** described above. The controller **70** is configured to inspect at least a portion of the multiple first frame connection members **51**W (and the other multiple first frame connection members **51**WA) in the first inspection state ST**1** by detecting a current flowing between the first probe **71** and the second probe **72**.

[0107] In such a semiconductor device **120** and such an inspection apparatus **220**, the state of the multiple first frame connection members (the multiple first frame connection members **51**W, the multiple first frame connection members **51**WA, etc.) of interest can be inspected without being affected by the other connection members, etc. A semiconductor device and an inspection apparatus of a semiconductor device can be provided in which the quality can be improved.

[0108] In the second inspection state ST**2** as shown in FIG. **14**B, the first probe **71** is electrically connected to the one of the multiple first frame electrodes **51** described above, and the second probe **72** is electrically connected to the other one of the multiple first frame electrodes **51** described above. The multiple first frame connection members **51**WA are connected to the one of the multiple first frame electrodes **51** described above. The multiple first frame connection members **51**WB are connected to the other one of the multiple first frame electrodes **51** described above. The controller **70** is configured to inspect at least a portion of the multiple first frame connection members **51**WA (and the other multiple first frame connection members **51**WB) in the first inspection state ST**1** by detecting a current flowing between the first probe **71** and the second probe **72**.

[0109] Such a configuration relating to the multiple first frame electrodes **51** and the multiple first frame connection members **51**W is applicable to the multiple second frame electrodes **52** and the multiple second frame connection members **52**W. For example, the multiple second frame connection members **52**W, multiple second frame connection members **52**WA, multiple second frame connection members **52**WB, multiple second frame connection members **52**WC, etc., may be provided.

[0110] In the semiconductor device **120** such as that described above, one first frame electrode **51** can be considered to be divided into multiple regions (the multiple first frame electrodes **51**). The distance between the multiple first frame electrodes **51** may be short.

[0111] FIG. **15** is a schematic plan view illustrating an inspection state of the semiconductor device according to the second embodiment. As shown in FIG. **15**, one of the multiple first frame electrodes **51** is next to another one of the multiple first frame electrodes **51**. In such a case, it is favorable for a distance w**51** between the one of the multiple first frame electrodes **51** described above and the other one of the multiple first frame electrodes **51** described above to be not less than 10 μm and not more than 80 μm.

[0112] As shown in FIG. **15**, one of the multiple second frame electrodes **52** is next to another one of the multiple second frame electrodes **52**. In such a case, it is favorable for a distance w**52** between the one of the multiple second frame electrodes **52** described above and the other one of the multiple second frame electrodes **52** described above to be not less than 10 μm and not more than 80 μm.

Third Embodiment

[0113] A third embodiment relates to the inspection apparatus **210** of the semiconductor device. As described above, the inspection apparatus **210** includes the first to fourth probes **71** to **74** and the controller **70** (referring to FIG. **2**). The controller **70** is configured to inspect the semiconductor device **110**. In the semiconductor device **110** as shown in FIG. **2**, the first mounting member **50** includes the first frame electrode **51**, the multiple first frame connection members **51**W, the second frame electrode **52**, the second frame connection member **52**W, the first pad electrode **61**, and the first pad connection member **61**W.

[0114] In the first inspection state ST**1** illustrated in FIG. **2**, the first probe **71** is electrically connected to the first portion **51***a* of the first frame electrode **51**, the second probe **72** is electrically connected to the second frame electrode **52**, the third probe **73** is electrically connected to the first pad electrode **61**, and the fourth probe **74** is electrically connected to the second portion **51***b* of the first frame electrode **51**. As shown in FIG. **2**, the controller **70** is configured to inspect at least a portion of the multiple first frame connection members **51**W in such a first inspection state ST**1** by detecting a potential difference between the third probe **73**

and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**.

Fourth Embodiment

[0115] A fourth embodiment relates to the inspection apparatus **220** of the semiconductor device.

[0116] As described above, the inspection apparatus **210** includes the first probe **71**, the second probe **72**, and the controller **70** (referring to FIG. **14**A). The controller **70** is configured to inspect the semiconductor device **120**. In the semiconductor device **120**, the first mounting member **50** includes the multiple first frame electrodes **51**, the multiple first frame connection members **51**W, and the other multiple first frame connection members **51**WA. The multiple first frame connection members **51**W electrically connect the first element electrode **11** and one of the multiple first frame electrodes **51**. The other multiple first frame connection members **51**WA electrically connect the first element electrode **11** and another one of the multiple first frame electrodes **51**.

[0117] In the first inspection state ST**1** illustrated in FIG. **14**A, the first probe **71** is electrically connected to the one of the multiple first frame electrodes **51** described above, and the second probe **72** is electrically connected to the other one of the multiple first frame electrodes **51** described above. As shown in FIG. **14**A, the controller **70** is configured to inspect at least a portion of the multiple first frame connection members **51**W (and the multiple first frame connection members **51**WA) in such a first inspection state ST**1** by detecting a current flowing between the first probe **71** and the second probe **72**.

Fifth Embodiment

[0118] A fifth embodiment relates to a method for inspecting the semiconductor device. For example, the method for inspecting the semiconductor device according to the fifth embodiment is based on the inspection apparatus **210** illustrated in FIG. **2**. For example, the first inspection state ST**1** illustrated in FIG. **2** is employed in the inspection method. In the first inspection state ST**1**, the first probe **71** is electrically connected to the first portion **51***a* of the first frame electrode **51**, the second probe **72** is electrically connected to the second frame electrode **52**, the third probe **73** is electrically connected to the first pad electrode **61**, and the fourth probe **74** is electrically connected to the second portion **51***b* of the first frame electrode **51**. In the first inspection state ST**1**, at least a portion of the multiple first frame connection members **51**W is inspected by detecting a current flowing between the first probe **71** and the second probe **72**. The multiple first frame connection members **51**W can be inspected with high accuracy.

[0119] The inspection method according to the fifth embodiment may include, for example, the inspection described with reference to FIG. **12**. For example, in the third inspection state ST**3** illustrated in FIG. **12**, the first probe **71** is electrically connected to the fifth portion **55***e* of the fifth frame electrode **55**, the second probe **72** is electrically connected to the first pad electrode **61**, the third probe **73** is electrically connected to the fifth pad electrode **65**, and the fourth probe **74** is electrically connected to the sixth portion **55***f* of the fifth frame electrode **55**. At least a portion of the multiple fifth frame connection members **55**W is inspected in the third inspection state ST**3** by detecting a potential difference between the third probe **73** and the fourth probe **74** when a current is supplied between the first probe **71** and the second probe **72**. The multiple fifth frame connection members **55**W can be inspected with high accuracy.

Sixth Embodiment

[0120] A sixth embodiment relates to a method for inspecting a semiconductor device. For example, the method for inspecting the semiconductor device according to the sixth embodiment is based on the inspection apparatus **220** illustrated in FIG. **14**A. As described with reference to FIG. **14**A, at least a portion of the multiple first frame connection members **51**W (and the other multiple first frame connection members **51**WA, etc.) is inspected by detecting a current flowing between the first probe **71** and the second probe **72** in the first inspection state ST**1** in which the first probe **71** is electrically connected to one of the multiple first frame electrodes **51** and the second probe **72** is electrically connected to another one of the multiple first frame electrodes **51**. The multiple first frame connection members **51**W (and the other multiple first frame connection members **51**WA, etc.) can be inspected with high accuracy.

[0121] In the embodiments, the first transistor **10** may be normally-on or normally-off. The first transistor **10** may have a JFET structure or a MOS structure.

[0122] In the embodiments, the element member **18** may include, for example, Si. The element member **18** may include, for example, at least one selected from the group consisting of a Si substrate, a SiC substrate, a sapphire substrate, and a GaN substrate. A conductive layer (e.g., an electrode) may be provided at the back surface (the lower surface) of the element member **18**. For example, the conductive layer may be set to a ground potential, etc.

[0123] In the embodiments, the state of multiple connection members can be inspected with high accuracy. By performing such an inspection, for example, a semiconductor device can be provided in which the output characteristics are stable. For example, a semiconductor device can be provided in which the nonuniformity of the current density of the semiconductor device is small and the characteristics are stable. For example, the degradation of the element over long-term use does not occur easily, and a highly reliable semiconductor device can be provided.

[0124] According to the embodiments, a semiconductor device, an inspection apparatus of a semiconductor device, and a method for inspecting a semiconductor device can be provided in which the quality can be improved.

[0125] In the specification, "nitride semiconductor" includes all compositions of semiconductors of the chemical formula $B_xIn_yAl_zGa_{1-x-y-z}N$ ($0 \le x \le 1$, $0 \le y \le 1$, $0 z \le 1$, and $x+y+z \le 1$) for which the composition ratios x, y, and z are changed within the ranges respectively. "Nitride semiconductor" further includes group V elements other than N (nitrogen) in the chemical formula recited above, various elements added to control various properties such as the conductivity type and the like, and various elements included unintentionally.

[0126] 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

semiconductor devices such as transistors, mounting members, element electrodes, frame electrodes, pad electrodes, connection members, and includes in inspection apparatuses such as probes, controllers, etc., from known art. Such practice is included in the scope of the invention to the extent that similar effects thereto are obtained.

[0127] 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.

[0128] Moreover, all semiconductor devices, inspection apparatuses of semiconductor devices, and methods for inspecting semiconductor devices practicable by an appropriate design modification by one skilled in the art based on the semiconductor devices, the inspection apparatuses of semiconductor devices, and the methods for inspecting semiconductor memory devices described above as embodiments of the invention also are within the scope of the invention to the extent that the purport of the invention is included.

[0129] 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.

[0130] 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.

What is claimed is:

1. A semiconductor device, comprising:
- a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode; and
- a first mounting member,
- the first mounting member including
  - a first frame electrode,
  - a plurality of first frame connection members electrically connecting the first element electrode and the first frame electrode,
  - a first pad electrode, and
  - a first pad connection member electrically connecting the first element electrode and the first pad electrode.

2. The device according to claim **1**, wherein
- the first mounting member further includes a mounting substrate,
- the mounting substrate includes a first substrate surface facing the first transistor, and
- the first frame electrode, the first pad electrode, and the first transistor are located on the first substrate surface.

3. The device according to claim **1**, wherein
- the first mounting member further includes a mounting substrate,
- the mounting substrate includes a first substrate surface facing the first transistor,
- a first direction is from the mounting substrate toward the first frame electrode, and
- a position of the nitride semiconductor layer in the first direction is between a position of the first substrate surface in the first direction and a position of the first element electrode in the first direction, between a position of the first substrate surface in the first direction and a position of the second element electrode in the first direction, and between a position of the first substrate surface in the first direction and a position of the third element electrode in the first direction.

4. The device according to claim **1**, wherein
- the first mounting member further includes:
  - a second frame electrode;
  - a plurality of second frame connection members electrically connecting the second element electrode and the second frame electrode;
  - a second pad electrode; and
  - a second pad connection member electrically connecting the second element electrode and the second pad electrode.

5. The device according to claim **4**, wherein
- the first mounting member further includes:
  - a third pad electrode; and
  - a third pad connection member electrically connecting the third pad electrode and the first frame electrode, and
- at least a portion of the first frame electrode is between the first pad electrode and the third pad electrode.

6. The semiconductor device according to claim **5**, wherein
- the first mounting member further includes:
  - a fourth pad electrode; and
  - a fourth pad connection member electrically connecting the fourth pad electrode and the second frame electrode, and
- at least a portion of the second frame electrode is between the second pad electrode and the fourth pad electrode.

7. The device according to claim **1**, further comprising:
- a second transistor including a fourth element electrode, a fifth element electrode, and a sixth element electrode,
- the fifth element electrode being electrically connected to the first frame electrode,
- the first transistor being normally-on.

8. The semiconductor device according to claim **7**, wherein
- the second transistor includes a silicon semiconductor layer, and
- the second transistor is normally-off.

9. The device according to claim **7**, wherein
- the first mounting member further includes:
  - a fifth pad electrode; and
  - a fifth pad connection member electrically connecting the fifth pad electrode and the fourth element electrode.

10. The device according to claim **7**, further comprising:
- a first diode including a first anode and a first cathode; and
- a second diode including a second anode and a second cathode,
- the first anode being electrically connected to the third element electrode,
- the first cathode being electrically connected to the second anode,

the second cathode being electrically connected to the second element electrode.

11. The device according to claim **1**, wherein

a number of the plurality of first frame connection members is not less than 20 and not more than 100.

12. The device according to claim **1**, wherein

the plurality of first frame connection members includes at least one selected from the group consisting of Au and Cu.

13. A semiconductor device, comprising:

a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode; and

a first mounting member,

the first mounting member including

a plurality of first frame electrodes,

a plurality of first frame connection members electrically connecting the first element electrode and one of the plurality of first frame electrodes, and

an other plurality of first frame connection members electrically connecting the first element electrode and an other one of the plurality of first frame electrodes.

14. The semiconductor device according to claim **13**, wherein

the one of the plurality of first frame electrodes is next to the other one of the plurality of first frame electrodes, and

a distance between the one of the plurality of first frame electrodes and the other one of the plurality of first frame electrodes is not less than 10 μm and not more than 80 μm.

15. An inspection apparatus of a semiconductor device, comprising:

a first probe;

a second probe;

a third probe;

a fourth probe; and

a controller electrically connected to the first, second, third, and fourth probes, the controller being configured to inspect the semiconductor device,

the semiconductor device including

a first transistor including a nitride semiconductor layer and including a first element electrode, a second element electrode, and a third element electrode, and

a first mounting member,

the first mounting member including

a first frame electrode,

a plurality of first frame connection members electrically connecting the first element electrode and the first frame electrode,

a second frame electrode,

a second frame connection member electrically connecting the second element electrode and the second frame electrode,

a first pad electrode, and

a first pad connection member electrically connecting the first element electrode and the first pad electrode,

in a first inspection state, the first probe being electrically connected to a first portion of the first frame electrode, the second probe being electrically connected to the second frame electrode, the third probe being electrically connected to the first pad electrode, the fourth probe being electrically connected to a second portion of the first frame electrode,

the controller being configured to inspect at least a portion of the plurality of first frame connection members by detecting a potential difference between the third probe and the fourth probe when a current is supplied between the first probe and the second probe in the first inspection state.

16. The apparatus of the semiconductor device according to claim **15**, wherein

the semiconductor device further includes a second transistor,

the second transistor includes a fourth element electrode, a fifth element electrode, and a sixth element electrode,

the fifth element electrode is electrically connected to the first frame electrode,

the first transistor is normally-on,

the first mounting member further includes

a fifth pad electrode,

a fifth pad connection member electrically connecting the fifth pad electrode and the fourth element electrode,

a fifth frame electrode, and

a plurality of fifth frame connection members electrically connecting the fifth frame electrode and the fourth element electrode,

in a third inspection state, the first probe is electrically connected to a fifth portion of the fifth frame electrode, the second probe is electrically connected to the first pad electrode, the third probe is electrically connected to the fifth pad electrode, and the fourth probe is electrically connected to a sixth portion of the fifth frame electrode, and

the controller is configured to inspect at least a portion of the plurality of fifth frame connection members by detecting a current flowing between the first probe and the second probe when a current is supplied between the first probe and the second probe in the third inspection state.

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