

DESCRIPTION

TITLE OF THE INVENTION: PROBE

TECHNICAL FIELD

5 [0001] The present disclosure relates to a probe.

BACKGROUND ART

[0002] In inspection of the characteristics of a semiconductor device, there is a method for simultaneously
10 inspecting a plurality of semiconductor devices on a wafer by using a probe card. In this inspection method, a semiconductor device is operated by being supplied with power from a power source probe of a probe card and an output signal of the semiconductor device is extracted by a signal
15 probe, and a tester determines whether or not the output signal is normal.

[0003] When a plurality of semiconductor devices are simultaneously inspected, if one of the semiconductor devices which are inspection objects is damaged, overcurrent flows
20 into the damaged semiconductor device, thereby causing an electrically unstable condition. Due to this electrically unstable condition, predetermined power fails to be supplied to the other normal semiconductor devices. Therefore, even if normal, such semiconductor devices do not output correct
25 signals, and thus are determined to be not normal.

[0004] To prevent such an error, a protective resistor has been provided to a wiring circuit of a power source probe of a probe card for supplying current to a semiconductor device. However, this results in the wiring being further densified, and thus it is proposed that the protective resistor is provided inside the power source probe and not to the wiring (Patent Document 1).

[0005] In a probe proposed in Patent Document 1, in a step of stacking conductive layers for a probe body by a MEMS technique, a resistance layer made of material with a higher resistivity than that of the material of the conductive layer is used in formation of a predetermined conductive layer, whereby a structure that one layer of the conductive layers of the probe body is substituted with the resistance layer is provided.

[0006] Regarding a structure that the protective resistor is provided inside the probe, a probe including a resistance layer which is formed at a probe tip portion of a probe tip so as to interrupt an electric path is proposed (Patent Document 2).

CITATION LIST

PATENT DOCUMENT

[0007] Patent Document 1: Japanese Laid-Open Patent Publication No. 2008-198956

Patent Document 2: Japanese Laid-Open Patent

Publication No. 2009-150801

SUMMARY OF THE INVENTION

5 PROBLEM TO BE SOLVED BY THE INVENTION

[0008] In the probe according to Patent Document 1, a part of the conductive layers to be stacked is substituted with the resistance layer, whereby a structure that the resistance layer is included in resistance conductive layers is
10 provided. However, the protective resistor needs to have a high resistance value, and thus the electric path needs to have a smaller sectional area and to be longer in order to increase the resistance value.

[0009] However, the height of the probe is limited, and
15 thus the thickness of the resistance layer cannot be set larger. At a portion where the probe is fixed, in a case where a part of the conductive layers to be stacked is substituted with the resistance layer, the sectional area of the resistance layer to be stacked is large, so that the
20 resistance value cannot be increased.

[0010] In addition, as described in Patent Document 1 and Patent Document 2, in the case where the resistance layer with a higher electric resistivity is provided near the probe tip, the sectional area of the electric path can be formed
25 smaller but there is a problem that heat generated in the

resistance layer influences the semiconductor device which is an inspection object.

[0011] Further, stacking the conductive layers a part of which is substituted with the resistance layer means stacking
5 the conductive layers including the one made of a different material, and thus bonding force between conductive layers made of different materials at a boundary interface therebetween is reduced, leading to reduction in mechanical strength.

10 [0012] The present disclosure has been made to solve the above problem, and an object of the present disclosure is to provide a probe having therein a function as a protective resistor while maintaining mechanical strength.

15 MEANS TO SOLVE THE PROBLEM

[0013] A probe according to the present disclosure includes: a support structural body supporting a probe body; and an electric path structural body forming an electric path from a probe tip portion to a probe base portion of the probe
20 body, wherein the probe base portion of the probe body is separated into a probe base portion of the support structural body and a probe base portion of the electric path structural body, and a resistor portion having a predetermined resistance value is provided in series to the electric path
25 of the electric path structural body.

EFFECT OF THE INVENTION

[0013] According to the present disclosure, a probe having therein a function as a protective resistor while maintaining
5 mechanical strength can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] [FIG. 1] FIG. 1 is a front view of a probe according to embodiment 1.

10 [FIG. 2] FIG. 2 is a perspective view of the probe according to embodiment 1.

[FIG. 3] FIG. 3 is a partial sectional view of a probe card to which the probe according to embodiment 1 is mounted.

15 [FIG. 4] FIG. 4 is a front view of a probe according to embodiment 2.

[FIG. 5] FIG. 5 is a front view of a modification of the probe according to embodiment 2.

[FIG. 6] FIG. 6 is a front view of a probe
20 according to embodiment 3.

[FIG. 7] FIG. 7 is a sectional view taken along an A-A line in FIG. 6.

[FIG. 8] FIG. 8 is a process chart showing a method for producing the probe according to embodiment 3.

25 [FIG. 9] FIG. 9 is a partial sectional view of a

probe card to which the probe according to embodiment 3 is mounted.

[FIG. 10] FIG. 10 is a front view of a probe according to embodiment 4.

5 [FIG. 11] FIG. 11 is a front view of a probe according to embodiment 5.

DESCRIPTION OF EMBODIMENTS

[0016] A probe card includes a power source probe for
10 supplying power to a semiconductor device which is an inspection object, a signal probe for extracting an output signal of an operation result of the semiconductor device, and a ground probe for grounding an electric circuit of the semiconductor device.

15 The present disclosure is intended for not only a power source probe but also a probe that needs a wiring resistance having a predetermined value. In the following description, a power source probe will be described.

[0017] Embodiment 1

20 A probe according to embodiment 1 will be described with reference to the drawings. Hereinafter, in the drawings, the same reference characters denote the same or corresponding parts.

FIG. 1 is a front view of the probe according to
25 embodiment 1. As shown in FIG. 1, a probe 10 includes a

probe tip portion 11 which is brought into contact with an input terminal of a semiconductor device which is an inspection object, a probe base portion 12 which is fixed to a probe card and is connected to wiring, and a probe middle
5 portion 13 located in the middle portion of the probe 10.

[0018] In FIG. 1, the probe base portion 12 of the probe 10 is separated into a support structural body 14 and an electric path structural body 15 each surrounded by a broken line. The support structural body 14 and the electric path
10 structural body 15 are formed on the same plane. The support structural body 14 mechanically supports the probe tip portion 11. The electric path structural body 15 forms an electric path between the probe tip portion 11 and the probe base portion 12.

15 [0019] That is, the support structural body 14 and the electric path structural body 15 are integrated at the probe tip portion 11 of the probe 10, and are separate at the probe base portion 12 of the probe 10 to form a probe base
12A of the support structural body 14 and a probe base
20 portion 12B of the electric path structural body 15. A resistor portion 16 is provided in series to the electric path of the electric path structural body 15.

[0020] FIG. 2 is a perspective view of the probe 10 shown in FIG. 1. The probe 10 is produced by stacking metal layers
25 by electroforming. In the probe 10, the probe tip portion

11, the probe portion 12 (the probe base portion 12A of the support structural body 14 and the probe base portion 12B of the electric path structural body 15), the support structural body 14, and the electric path structural body 15 each have
5 an outer shape defined by a mask pattern, and are formed by stacking metal.

[0021] That is, the support structural body 14 and the electric path structural body 15 are simultaneously formed of layers of the same metal. Thus, the support structural body
10 14 and the electric path structural body 15 are formed on the same plane. The resistor portion 16 is formed by stacking metal materials with a higher resistivity than that of the metal material of the probe 10.

[0022] FIG. 3 is a partial sectional view showing the
15 structure of a probe card 100 to which the probe 10 shown in FIG. 1 is mounted. A probe shown on the right side in FIG. 3 is a power source probe 10P, and a probe shown on the left side in FIG. 3 is a signal probe 10S.

[0023] As shown in FIG. 3, the resistor portion 16 is
20 provided in series to the electric path in the probe base portion 12B of the electric path structural body 15 of the power source probe 10P, and the probe base portion 12B is fixed by a solder 104 to a power source electrode 102P provided on a space transformer 101 of the probe card 100.

25 [0024] The probe base portion 12A of the support

structural body 14 of the power source probe 10P is fixed by the solder 104 to a floating electrode 102F of the probe card 100. The floating electrode 102F is electrically floating and is connected nowhere. That is, the floating electrode
5 102F is electrically insulated.

[0025] The probe base portion 12 of the signal probe 10S is fixed by the solder 104 to a signal electrode 102S provided on the space transformer 101 of the probe card 100.

Here, the conditions of the support structural body
10 14 and the electric path structural body 15 of the power source probe 10P are as follows.

[0026] The support structural body 14 has strength sufficient to support the probe tip portion 11 when the power source probe 10P is brought into contact with an electrode of
15 a semiconductor device by probe pressure equivalent to that applied on the signal probe 10S.

[0027] In the electric path structural body 15, the resistor portion 16 having a small sectional area and a predetermined length is provided such that a resistance value
20 set according to the sectional area and the length is, for example, 200 to 300 Ω , and no electric path is formed except for the resistor portion 16.

[0028] In the probe 10 according to embodiment 1, to obtain a predetermined resistance value, the sectional area
25 of the electric path in which current flows needs to be

smaller and the electric path needs to be longer. Thus, the probe base portion 12 is separated into the probe base portion 12A of the support structural body 14 having mechanical strength and the probe base portion 12B of the electric path structural body 15 having a function of supplying current, and the resistor portion 16 having a predetermined resistance value is provided at the probe base portion 12B of the electric path structural body 15.

[0029] That is, the sectional area orthogonal to a direction in which current flows in the electric path structural body 15 forming the electric path, is formed smaller, and at this part, a resistance member is provided, whereby the resistor portion 16 is provided in series to the electric path of the electric path structural body 15, so that the probe 10 having the resistor portion 16 therein can be provided.

[0030] Embodiment 2

Embodiment 1 has shown the probe 10 in which the probe base portion 12 of the probe 10 is separated into the support structural body 14 and electric path structural body 15 by disposing a space therebetween, and the support structural body 14 is fixed to the floating electrode 102F.

[0031] In a probe 10 according to embodiment 2, the functions of the support structural body 14 and the electric path structural body 15 are separated as in embodiment 1, but

the probe base portion 12A of the support structural body 14 and the probe base portion 12B of the electric path structural body 15 are structured to be integrated by an insulating portion 20. For the insulating portion 20, resin
5 or metal hydroxides are used.

[0032] That is, as shown in FIG. 4, the insulating portion 20 is provided at the probe base portion 12 of the probe 10, whereby the sectional area of the electric path of the electric path structural body 15 is limited.

10 [0033] The resistor portion 16 is provided in series to the electric path of the electric path structural body 15, and the probe base portion 12B of the electric path structural body 15 extends to the probe base portion 12A of the support structural body 14, to form a conductive area 21.
15 Thus, the probe base portion 12 of the probe 10 is structured such that the probe base portion 12A of the support structural body 14 and the probe base portion 12B of the electric path structural body 15 are integrated with each other.

20 [0034] In this case, the support structural body 14 is configured to support the probe tip portion 11 of the probe 10 by the probe middle portion 13, the insulating portion 20, and the probe base portion 12A. In addition, the electric path structural body 15 is configured by the probe middle
25 portion 13, the resistor portion 16, and the probe base

portion 12B.

[0035] In the probe 10 according to embodiment 2, the functions of the support structural body 14 and the electric path structural body 15 are separated, and the insulating
5 portion 20 is provided at the support structural body 14, so that electricity is not conducted to the probe base portion 12A of the support structural body 14. Since the support structural body 14 and the electric path structural body 15 are integrated with each other at the probe base portion 12,
10 fixation of the probe 10 to the probe card 100 is performed by single soldering.

[0036] In embodiment 2, a structure that the support structural body 14 and the electric path structural body 15, which are separate, are integrated by the insulating portion
15 20 is shown. In a modification of embodiment 2, as shown in FIG. 5, the support structural body 14 and the electric path structural body 15 may be separated by providing a space 22 therebetween, and then may be integrated at the probe base portion 12.

20 [0037] In this manner, in the case where the support structural body 14 and the electric path structural body 15 are integrated with each other at the probe base portion 12, a mechanically strong structural body can be achieved. In addition, in the case where the space 22 is provided between
25 the support structural body 14 and the electric path

structural body 15, a space is provided around the resistor portion 16, so that an effect of preventing heat occurring in the resistor portion 16 from being transmitted directly to the support structural body 14 can be obtained.

5 [0038] Embodiment 3

A probe 10 according to embodiment 3 will be described with reference to FIG. 6 and FIG. 7. FIG. 6 is a front view of the probe 10, and FIG. 7 is a sectional view as seen along a dotted-dashed line in a direction of an arrow A.

10 In the probe 10 according to the embodiment 3, as shown in FIG. 6 and FIG. 7, the support structural body 14 and the electric path structural body 15 are formed on different planes.

[0039] As shown in FIG. 6, the support structural body 14 and the electric path structural body 15 overlap with each other. That is, the support structural body 14 and the electric path structural body 15 are formed on different planes. An insulating coat 17 is provided between the probe middle portion 13 and the probe base portion 12 of the support structural body 14. The insulating coat 17 is an insulating sputtering thin film formed of, for example, SiN or DLC. The electric path from the probe tip portion 11 to the probe base portion 12 is interrupted by the insulating coat 17.

25 [0040] In addition, a solder portion 23 is provided at the

probe base portion 12. The solder portion 23 is used to attach the probe 10 to a substrate of the probe card 100.

[0041] An insulating layer 18 is provided on a surface of the support structural body 14, and the electric path structural body 15 for electrical connection between the probe middle portion 13 and the probe base portion 12 is provided on a surface of the insulating layer 18. The electric path structural body 15 is a resistance wiring layer formed of a high-resistance sputtering film provided on the surface of the insulating layer 18 provided at a predetermined area of the support structural body 14.

[0042] As shown in FIG. 7, the support structural body 14 is one flat plate. Thus, the probe tip portion 11 can be strongly supported against force that is applied in the vertical direction of the probe 10. The electric path structural body 15 is the resistance wiring layer formed of the high-resistance sputtering film provided on the surface of the insulating layer 18 provided at the predetermined area of the support structural body 14.

[0043] In the probe 10 of embodiment 3, insulation is performed by using the insulating coat 17 near the probe base portion 12. The support structural body 14 is insulated near the probe base portion 12, whereby a probe with the probe tip portion 11 having the same characteristics (probe pressure, scrub mark, etc.) as those of a signal probe can be achieved.

In addition, the resistor portion 16 of the electric path structural body 15 is formed according to a wiring shape of a resistance film pattern, so that an effect that a desired shape can be set is provided.

5 [0044] Next, the outline of a step of producing the probe of embodiment 3 will be described.

FIG. 8 shows steps of producing the probe of embodiment 3. As shown in FIG. 8a, the probe 10 body is produced by a MEMS technique and an upper layer thereof is polished, and then the insulating coat 17 is formed at the
10 probe base portion 12 by sputtering as shown in FIG. 8b. Then, the probe base portion 12 is formed on the insulating coat 17 as shown in FIG. 8c.

[0045] Next, as shown in FIG. 8d, the insulating layer 18
15 is formed so as to cover a portion from the probe middle portion 13 to the insulating coat 17 and the probe base portion 12. As the insulating layer 18, for example, a photosensitive insulating film can be used. Next, as shown in FIG. 8e, a start point is set to the probe middle portion
20 13 and an end point is set to the probe base portion 12, and a pattern of a conductive path of the resistance sputtering film is provided on the insulating layer 18. The pattern of the resistance sputtering film forms the electric path structural body 15. Next, as shown in FIG. 8f, the solder
25 portion 23 is provided at the probe base portion 12.

[0046] The power source probe 10P produced as described above is fixed by the solder 104 to the power source electrode 102P provided on the space transformer 101 of the probe card 100 as shown in FIG. 9, separately from the signal probe 10S. The signal probe 10S is fixed to the signal electrode 102S.

[0047] As shown in FIG. 9, since the power source probe 10P has the same shape as the signal probe 10S, a mounting device to be used to mount the signal probe to the probe card can be used to mount the power source probe, and thus operation efficiency can be enhanced.

[0048] Embodiment 4

A probe 10 of embodiment 4 is shown in FIG. 10. The probe of embodiment 4 has the probe base portion 12 improved compared to the probe of embodiment 3.

[0049] In the probe 10 of embodiment 4, the insulating layer 18 is provided in an area from the probe middle portion 13 to the probe base portion 12 on the support structural body 14 composed of the probe tip portion 11, the probe middle portion 13, and the probe base portion 12; an insulating coat 174 is provided to the probe base portion 12; a leg 124 protruding from the outer profile of the probe 10 is provided on a surface of the insulating coat 174; and the probe middle portion 13 and the leg 124 are connected by a resistance wiring layer 154 provided on the surface of the

insulating layer 18.

[0050] In the probe 10 of embodiment 4, the insulating coat 174 is used to separate the support structural body 14 and the electric path structural body 15 from each other, and
5 the support structural body 14 is structured so as to include no insulating coat 174, so that the mechanical strength of the support structural body 14 can be stabilized.

[0051] The electric path structural body 15 includes the resistance wiring layer 154 provided on the surface of the
10 insulating layer 18, and the leg 124. A solder portion 234 is provided at the leg 124.

That is, the leg 124 is connected to the power source electrode of the probe card by the solder portion 234.

[0052] The probe 10 of embodiment 4 is different from the
15 probe 10 of embodiment 3, in the insulating coat 174 and the leg 124 provided to the probe 10. The other components are not changed. In the probe of embodiment 4, the insulating coat 174, at the probe base portion 12, of the support structural body 14 of the probe 10 is not provided as a
20 measure for further increasing the mechanical strength of the support structural body 14, and the configuration of the probe 10 of embodiment 3 and that of the probe 10 of embodiment 1 are combined with each other.

[0053] Embodiment 5

25 A probe 10 of embodiment 5 is shown in FIG. 11.

The probe of embodiment 5 is formed such that the direction of a leg is different from that in embodiment 4. The other components are not changed.

[0054] That is, the probe of embodiment 5 is a cantilever-type probe, and the directions of an insulating coat 175 and a leg 125 provided to the probe 10 coincide with the orientation of a beam of the cantilever-type probe. In the cantilever-type probe, the probe tip portion 11 of the probe 10 extends as a beam from the probe middle portion 13 in a predetermined direction. Here, a direction in which the leg 125 protrudes and a direction in which the probe tip portion of the probe protrudes from the probe middle portion are the same, whereby an effect that an occupancy area of the probe to be disposed on the probe card can be reduced is provided.

15 A solder portion 235 is provided at the leg 125.

[0055] In the above embodiments, the case in which the resistor is added to the power source probe has been described. However, a signal probe for supplying a test signal to the semiconductor device from a tester also needs to have a resistor having a predetermined resistance value. In this case, the resistance value is a large value, for example, $300\ \Omega \pm 20\%$, and with the configuration described in the embodiment, the resistor can be added.

[0056] Although the disclosure is described above in terms of various exemplary embodiments and implementations, it

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should be understood that the various features, aspects, and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but
 5 instead can be applied, alone or in various combinations to one or more of the embodiments of the disclosure.

It is therefore understood that numerous modifications which have not been exemplified can be devised without departing from the scope of the present disclosure.
 10 For example, at least one of the constituent components may be modified, added, or eliminated. At least one of the constituent components mentioned in at least one of the preferred embodiments may be selected and combined with the constituent components mentioned in another preferred
 15 embodiment.

DESCRIPTION OF THE REFERENCE CHARACTERS

[0057]	100	probe card
	10	probe
20	10P	power source probe
	10S	signal probe
	11	probe tip portion
	12, 12A, 12B	probe base portion
	13	probe middle portion
25	14	support structural body

	15	electric path structural body
	16	resistor portion
	17, 174, 175	insulating coat
	18	insulating layer
5	20	insulating portion
	21	conductive area
	22	space
	23, 234, 235	solder portion
	124	leg
10	101	space transformer
	102F	floating electrode
	102P	power source electrode
	104	solder
	124, 125	leg
15	154	resistance wiring layer

CLAIMS

[Claim 1] A probe comprising:

a support structural body supporting a probe body;

and

5 an electric path structural body forming an electric path from a probe tip portion to a probe base portion of the probe body, wherein

the probe base portion of the probe body is separated into a probe base portion of the support structural body and a probe base portion of the electric path structural
10 body, and

a resistor portion having a predetermined resistance value is provided in series to the electric path of the electric path structural body.

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[Claim 2] The probe according to claim 1, wherein the support structural body and the electric path structural body are formed on the same plane.

20 [Claim 3] The probe according to claim 2, wherein

the support structural body includes an insulating portion forming the probe base portion of the support structural body, and the probe body, and

the probe tip portion of the probe body and the
25 probe base portion of the support structural body are

insulated from each other by the insulating portion.

[Claim 4] The probe according to claim 3, wherein a space is provided between the insulating portion of the support
5 structural body and the resistor portion of the electric path structural body.

[Claim 5] The probe according to claim 1, wherein the support structural body and the electric path structural body are
10 formed on different planes.

[Claim 6] The probe according to claim 5, wherein
an insulating layer is provided on a surface of the support structural body, and
15 the electric path structural body is provided on a surface on the insulating layer.

[Claim 7] The probe according to claim 5, wherein an insulating coat is provided between a probe middle portion
20 and the probe base portion of the support structural body, and insulation is provided therebetween by using the insulating coat.

[Claim 8] The probe according to claim 6, wherein
25 the electric path structural body is a conductive

path connecting a probe middle portion and the probe base portion of the support structural body through a resistance wiring layer which is provided on a surface of the insulating layer provided on the surface of the support structural body.

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[Claim 9] The probe according to claim 6, wherein the electric path structural body is connected to a leg insulated from the support structural body and protruding from the probe base portion.

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[Claim 10] The probe according to claim 9, wherein a direction in which the leg protrudes and a direction in which the probe tip portion of the probe protrudes from the probe middle portion are the same.

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