

TITLE OF INVENTION: PROBE CARD

TECHNICAL FIELD

[0001] The present invention relates to a probe card, and more particularly, to an improvement of a probe card including an upper guide plate and a lower guide plate for guiding probes.

BACKGROUND ART

[0002] A probe card is an inspection device used when inspecting electrical characteristics of semiconductor devices formed on a semiconductor wafer, and includes a plurality of probes that are brought into contact with electrode pads on the semiconductor wafer, respectively. The probe card includes an upper guide plate that guides probe base portions of the probes and a lower guide plate that guides probe tip portions of the probes. During inspection, the electrode pads are pressed against the tips of the probes, and the probes buckle and deform between the upper guide plate and the lower guide plate due to needle pressure received from the electrode pads, whereby the probes and the electrode pads can be reliably brought into conduction.

[0003] During inspection, an electrical signal flows through the probes and heat is generated. As the temperature rises, the probes increase in resistance value and decrease in electrical capacity. As a result, there arises a problem that inspection accuracy decreases, and therefore it is necessary to improve the heat dissipation characteristics of the probes.

[0004] A probe card including a cooling structure for cooling probes has been conventionally proposed (for example, Patent Literature 1). The probe card described in Patent Literature 1 includes a cooling structure in a space between an upper guide plate that guides probe base portions of the probes and a lower guide plate that guides probe tip portions of the probes. The cooling structure is a structure including a flow path for a cooling medium, and an example of a laminate formed by bonding a plurality of thin metal plates is shown. Also, an example is shown in which a gel-like deformation-permitting material is filled between the upper guide plate and the lower guide plate.

[0005] However, when such a cooling structure is employed, there is a problem that the conductivity between the probes and the electrode pads decreases. Vertical probes secure sufficient needle pressure by deformation of the probes and secure conductivity with respect

to the electrode pads. Therefore, by employing a cooling structure including a flow path for a cooling medium, deformation of the probes is hindered, and a problem arises that it is difficult to secure sufficient conductivity.

CITATION LIST

PATENT LITERATURE

[0006] Patent Literature 1: Japanese Patent Application Laid-Open No. 2013-088257

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0007] The present invention has been made in view of the above circumstances, and an object thereof is to improve heat dissipation efficiency for discharging heat from the probes. In particular, an object thereof is to improve heat dissipation characteristics of the probe card without hindering buckling deformation of the probes during inspection.

SOLUTION TO THE PROBLEM

[0008] A probe card according to the first embodiment of the present invention includes a plurality of probes, an upper guide plate in which a plurality of first through holes that guide probe base portions of the probes are formed, a lower guide plate in which a plurality of second through holes that guide probe tip portions of the probes are formed, disposed facing the upper guide plate, and forming a buckling chamber between the upper guide plate for the probes to buckle, and a plurality of sliding members in each of which a plurality of third through holes through which the probes penetrate are formed, stacked in the buckling chamber, and slidable with respect to each other.

[0009] By adopting such a configuration, the sliding member slides in accordance with buckling deformation of the probe. Therefore, the probe during inspection can be brought into contact with the sliding member without hindering buckling deformation of the probe. Therefore, heat of the probe can be conducted to the sliding member and further dissipated to the outside of the buckling chamber via the upper guide plate or the lower guide plate. Therefore, heat dissipation efficiency of the guide unit can be improved.

[0010] A probe card according to the second embodiment of the present invention is configured such that, in addition to the above configuration, each of the sliding members has a thermal conductivity of $3.32 \text{ W/m}\cdot\text{K}$ or more. By adopting such a configuration, heat dissipation efficiency of the guide unit can be improved.

[0011] A probe card according to the third embodiment of the present invention is configured such that, in addition to the above configuration, each of the sliding members has a

coefficient of friction of less than 0.11. By adopting such a configuration, the plurality of sliding members can be stacked slidably, and the sliding member can be prevented from hindering buckling deformation.

[0012] A probe card according to the fourth embodiment of the present invention is configured such that, in addition to the above configuration, the plurality of sliding members have a same shape. By adopting such a configuration, there is no need to prepare sliding members having different shapes, and manufacturing cost can be reduced.

[0013] A probe card according to the fifth embodiment of the present invention is configured such that, in addition to the above configuration, a sliding member of the sliding members disposed near a vertical center of the buckling chamber has a thickness thinner than a sliding member of the sliding members disposed adjacent to the upper guide plate or the lower guide plate.

[0014] By adopting such a configuration, by making the thickness of the sliding member thinner near the vertical center of the buckling chamber where buckling deformation of the probe becomes largest, followability of the sliding member with respect to buckling deformation of the probe can be improved, and the sliding member can be prevented from hindering buckling deformation of the probe.

[0015] A probe card according to the sixth embodiment of the present invention, in addition to the above configuration, further includes an intermediate guide plate in which a plurality of fourth through holes that guide the probes are formed, disposed between the upper guide plate and the lower guide plate, wherein each of the fourth through holes is larger than each of the first through holes and each of the second through holes, and the buckling chamber is divided into an upper buckling chamber and a lower buckling chamber by the intermediate guide plate, and the plurality of sliding members are distributively disposed in the upper buckling chamber and in the lower buckling chamber.

[0016] By adopting such a configuration, heat of the sliding member can be discharged to the outside of the buckling chamber via the intermediate guide plate, and heat dissipation efficiency of the guide unit can be improved. Also, by making each of the fourth through holes larger than each of the first through holes and each of the second through holes, the intermediate guide plate can be prevented from hindering buckling deformation of the probe.

[0017] A probe card according to the seventh embodiment of the present invention is configured such that, in addition to the above configuration, each of the third through holes of a sliding member of the sliding members disposed near a vertical center of the buckling

chamber is larger than each of the third through holes of a sliding member of the sliding members disposed adjacent to the upper guide plate or the lower guide plate.

[0018] By adopting such a configuration, by making each of the third through holes larger near a vertical center of the buckling chamber where buckling deformation of the probe becomes largest, the sliding member can be prevented from hindering buckling deformation of the probe.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0019] According to the present invention, heat dissipation efficiency for discharging heat from the probes can be improved. In particular, heat dissipation characteristics of the probe card can be improved without hindering buckling deformation of the probes during inspection.

BRIEF DESCRIPTION OF DRAWINGS

[0020] [FIG. 1] is a diagram showing a configuration example of a probe card 100 according to the first embodiment of the present invention.

[FIG. 2] is a diagram showing a state of the probe card 100 of FIG. 1 during inspection.

[FIG. 3] is a diagram showing a state during assembly of the guide unit 3.

[FIG. 4] is a diagram showing a configuration example of a probe card 101 according to the second embodiment of the present invention.

[FIG. 5] is a diagram showing a configuration example of a probe card 102 according to the third embodiment of the present invention.

[FIG. 6] is a diagram showing a configuration example of a probe card 103 according to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] First Embodiment

FIG. 1 is a diagram showing a configuration example of a probe card 100 according to the first embodiment of the present invention, and is a cross-sectional view when the probe card 100 installed horizontally is cut along a vertical plane. The probe card 100 includes sliding members 5 for efficiently dissipating heat from the probes 6 to the outside of the guide unit 3.

[0022] The probe card 100 is attached to a card holder 21 such that an installation surface of the probes 6 faces a semiconductor wafer 200 on a stage 20. By moving the stage 20 up and down, the tips of the probes 6 can be brought into contact with electrode pads 201 on the

semiconductor wafer 200. The probe card 100 includes a main substrate 10, a reinforcing plate 11, a guide unit 3, a plurality of sliding members 5, and a plurality of probes 6.

[0023] (1) Main Substrate 10, Reinforcing Plate 11

The main substrate 10 is a wiring board that is detachably attached to a wafer prober, and for example, a disk-shaped glass epoxy substrate is used. The main substrate 10 is disposed horizontally with an outer peripheral edge portion of a lower surface supported by the card holder 21 of the wafer prober. A reinforcing plate 11 for suppressing distortion of the main substrate 10 is attached to a central portion of an upper surface of the main substrate 10, and a plurality of external terminals 10e to which signal terminals of a tester device (not shown) are connected are provided at an outer peripheral edge portion of the upper surface. Probe electrodes 10p for connecting the probes 6 are provided at a central portion of the lower surface of the main substrate 10.

[0024] (2) Guide Unit 3

The guide unit 3 is a probe support member that positions the probes 6 in a horizontal plane. The probes 6 are supported by the guide unit 3 such that the tips thereof can move up and down, and elastically contact the electrode pads 201. The guide unit 3 includes an upper guide plate 31a and a lower guide plate 31b disposed parallel to the main substrate 10, and a guide spacer 32 disposed between the upper guide plate 31a and the lower guide plate 31b, and is attached to the lower surface of the main substrate 10 by a guide unit mounting portion 12. A plurality of sliding members 5 are stacked slidably in a buckling chamber 33 of the guide unit 3.

[0025] The upper guide plate 31a is a guide plate that guides the probe base portions 61 of the probes 6, and is disposed so as to be spaced downward from the main substrate 10 via the guide unit mounting portion 12 and to face the main substrate 10. An insulating plate-shaped member having a plurality of first through holes 41 formed therein, for example, a ceramic plate, is used for the upper guide plate 31a. The first through holes 41 are holes penetrating the upper guide plate 31a in a thickness direction thereof, and the probes 6 are inserted therethrough. The probe base portions 61 are disposed in the first through holes 41, and positions of the probe base portions 61 in the horizontal plane are defined by the first through holes 41.

[0026] The lower guide plate 31b is a guide plate that guides the probe tip portions 62 of the probes 6, and is disposed so as to be further spaced downward from the upper guide plate 31a via the guide spacer 32 and to face the upper guide plate 31a. An insulating plate-shaped member having a plurality of second through holes 42 formed therein, for example, a ceramic

plate, is used for the lower guide plate 31b. The second through holes 42 are holes penetrating the lower guide plate 31b in a thickness direction thereof, and the probes 6 are inserted therethrough, and the probe tip portions 62 are disposed in the second through holes 42. The probe tip portions 62 are supported movably up and down by the second through holes 42, and positions thereof in the horizontal plane are defined.

[0027] The guide spacer 32 is a spacer interposed between the upper guide plate 31a and the lower guide plate 31b, and disposes the upper guide plate 31a and the lower guide plate 31b so as to face each other at a predetermined distance, thereby forming the buckling chamber 33.

[0028] The buckling chamber 33 is a space for the probes 6 to buckle and deform by overdrive during inspection, and is formed as a space sandwiched between the upper guide plate 31a and the lower guide plate 31b. In the buckling chamber 33, a plurality of sliding members 5 are disposed by being stacked, and a plurality of probes 6 are disposed so as to penetrate the sliding members 5.

[0029] (3) Sliding Member 5

The sliding member 5 is an insulating plate-shaped member that dissipates heat from the probes 6 to the outside of the buckling chamber 33, and is disposed so as to face the upper guide plate 31a and the lower guide plate 31b. In the buckling chamber 33, a plurality of sliding members 5 having the same shape are stacked with main surfaces thereof facing each other. A plurality of third through holes 43 are respectively formed in the sliding members 5. The third through holes 43 are holes penetrating the sliding member 5 in a thickness direction thereof, and the probes 6 are inserted therethrough. The probes 6 are sequentially inserted through the third through holes 43 of the plurality of sliding members 5 stacked in the buckling chamber 33, and penetrate these sliding members 5. The first through holes 41 to the third through holes 43 can be configured to have, for example, circular cross-sections of the same diameter.

[0030] The sliding members 5 are stacked slidably, and main surfaces thereof have a shape smaller than a horizontal cross-section of the buckling chamber 33. Therefore, the sliding members 5 move in the horizontal plane in accordance with deformation of the probes 6 during inspection. The sliding members 5 have a shape thinner than the upper guide plate 31a or the lower guide plate 31b, and flexible thin films, for example, sheet-shaped or film-shaped members, can be used.

[0031] By forming the sliding member 5 using a material having a small coefficient of friction, friction between the sliding members 5 during horizontal movement can be reduced,

and the sliding members 5 can be disposed slidably. The sliding member 5 is preferably formed using a material having a coefficient of friction of less than 0.11, and for example, a polyimide resin can be used.

[0032] Also, by forming the sliding member 5 using a material having good thermal conductivity, heat dissipation efficiency from the buckling chamber 33 can be improved. For the sliding member 5, a material having a thermal conductivity of 3.32 W/m·K or more, for example, a fluoro-resin filled with a thermally conductive filler, can be used.

[0033] Furthermore, by forming the sliding member 5 using an insulating material, a horizontal cross-section of the probes 6 can be surrounded by an insulating substance, and high-frequency characteristics of the probes 6 can be improved as compared with a conventional configuration in which adjacent probes 6 are separated only by air. In particular, by forming the sliding member 5 using a dielectric having a desired dielectric constant, optimal high-frequency characteristics can be obtained.

[0034] (4) Probe 6

The probe 6 is a vertical probe that extends in a direction intersecting the main substrate 10 and buckles and deforms by overdrive during inspection. The probe 6 is made of a conductive material having an elongated shape, an upper end thereof is connected to a probe electrode 10p, and a lower end thereof contacts the electrode pad 201 on an object to be inspected. The probe 6 is inserted through the first through holes 41 to the third through holes 43. As a material of the probe 6, a metal material having both good elastic characteristics and good conductive characteristics, such as a nickel (Ni) alloy or a palladium (Pd) alloy, is used.

[0035] The probe 6 includes a probe base portion 61 on a main substrate side, a probe tip portion 62 on an electrode pad side, and a deformation portion 63 sandwiched between the probe base portion 61 and the probe tip portion 62. The probe base portion 61 is provided with a locking portion 64 for preventing falling off.

[0036] The probe 6 buckles and deforms by stress (needle pressure) received from the electrode pad 201 during inspection. By buckling deformation of the probe 6 in the buckling chamber 33, the tip of the probe 6 moves up and down according to an overdrive amount, and the probe 6 can be elastically brought into contact with the electrode pad 201. That is, by buckling deformation of the probe 6, the probe 6 can be brought into contact with the electrode pad 201 with a predetermined needle pressure, thereby securing conductivity.

[0037] The first through hole 41 and the second through hole 42 through which the same probe 6 is inserted are disposed offset from each other by the same distance in the same direction (offset direction D) in the horizontal plane, and all the probes 6 are gently bent in

the same direction during non-inspection. Therefore, during inspection, all the probes 6 buckle and deform in the offset direction D in the horizontal plane.

[0038] FIG. 2 is a diagram showing a state of the probe card 100 of FIG. 1 during inspection. A state during overdrive is shown in which, from the state of FIG. 1, the stage 20 is raised to bring the electrode pads 201 into contact with the probes 6, and then the stage 20 is further raised to cause the probes 6 to buckle and deform.

[0039] When the probe 6 is brought into contact with the electrode pad 201, by stress received from the electrode pad 201, the tip rises and the probe 6 buckles and deforms in the buckling chamber 33. By buckling deformation of the probe 6, a side surface of the probe 6 abuts against an inner surface of the third through hole 43, and the sliding member 5 moves horizontally by being pushed by the probe 6.

[0040] At this time, all the probes 6 buckle and deform in the same direction, that is, in the offset direction D. On the other hand, the sliding member 5 has a shape in which a length in the offset direction D is smaller than the buckling chamber 33, is movable in the offset direction D, and is stacked slidably in the buckling chamber 33. Therefore, the sliding member 5 can move in accordance with buckling deformation of the probe 6, and is less likely to hinder the buckling deformation of the probe 6.

[0041] Since the probe 6 during inspection is in a state of being buckled and deformed and in contact with the sliding member 5, heat generated in the probe 6 is easily conducted to the sliding member 5, and the heat of the probe 6 can be efficiently dissipated to the outside of the buckling chamber 33. The heat conducted from the probe 6 to the sliding member 5 is further conducted to the guide unit 3, released from the guide unit 3 to the atmosphere, or further conducted to the main substrate 10. For example, the heat is conducted between adjacent sliding members 5 and conducted to the upper guide plate 31a or the lower guide plate 31b. Conducted heat of the lower guide plate 31b is conducted to the main substrate 10 via the guide spacer 32 and the guide unit mounting portion 12.

[0042] By inserting the probe 6 through the third through hole 43 of the sliding member 5, an interval between adjacent probes 6 in the buckling chamber 33 can be maintained even during buckling deformation. Therefore, contact between adjacent probes 6 can be prevented.

[0043] By forming the sliding member 5 using a dielectric, high-frequency characteristics can be improved. When a high-frequency signal is transmitted to the probes 6 disposed at a narrow pitch via an air layer, impedance mismatch occurs. By disposing the sliding member 5 having a predetermined dielectric constant between such probes 6, impedance can be matched and high-frequency characteristics can be improved.

[0044] By disposing more sliding members 5 in the buckling chamber 33 so as to increase a total volume, heat dissipation efficiency of the probe 6 can be further improved, and high-frequency characteristics can be further improved. Note that, in order to enable the sliding member 5 to move smoothly, a total thickness of the sliding members 5 needs to be smaller than a distance between the upper guide plate 31a and the lower guide plate 31b.

[0045] Parts (a) to (d) of FIG. 3 are diagrams showing a state during assembly of the guide unit 3. A method for inserting the probes 6 through the first through holes 41 to the third through holes 43 is shown in time series.

[0046] Part (a) of FIG. 3 shows a state in which positioning of the guide plates 31a and 31b and the sliding members 5 is performed using positioning pins 7 in order to insert the probes 6. The positioning pin 7 is a pin extending linearly, and by inserting the positioning pin 7 through positioning through holes 45, positioning of the guide plates 31a and 31b and the sliding members 5 is performed.

[0047] The positioning through hole 45 is a through hole penetrating the guide plates 31a and 31b and the sliding members 5 in a thickness direction thereof. A plurality of positioning through holes 45 are respectively provided in the guide plates 31a and 31b and the sliding members 5. If the guide plates 31a and 31b and the sliding members 5 are disposed so that the positioning through holes 45 coincide, the first through holes 41 to the third through holes 43 also coincide. Therefore, if the positioning pin 7 is inserted through the positioning through holes 45, the first through holes 41 to the third through holes 43 are aligned in a straight line, and it becomes possible to insert the probes 6.

[0048] Part (b) of FIG. 3 shows a state in which the probes 6 are inserted. The probes 6 in a linear form are inserted through the first through holes 41 to the third through holes 43 aligned in a straight line. The probe 6 is inserted from the upper guide plate 31a side, and the locking portion 64 abuts against an upper surface of the upper guide plate 31a and is locked so as not to fall off.

[0049] Parts (c) and (d) of FIG. 3 show a state in which the first through hole 41 and the second through hole 42 are offset. By removing the positioning pins 7 from the positioning through holes 45 and horizontally moving the lower guide plate 31b in the offset direction D, the first through hole 41 and the second through hole 42 can be disposed in an offset manner. By offsetting the first through hole 41 and the second through hole 42, the probe 6 is deformed, and the sliding members 5 move in accordance with the deformation. By attaching the guide unit 3 assembled in this manner to the main substrate 10, the probe card 100 shown in FIG. 1 is obtained.

[0050] The probe card 100 according to the present embodiment includes a plurality of probes 6, an upper guide plate 31a that guides the probe base portions 61 of the probes 6, a lower guide plate 31b that guides the probe tip portions 62 of the probes 6, and a plurality of sliding members 5. A buckling chamber 33 for the probes 6 to buckle is formed between the upper guide plate 31a and the lower guide plate 31b, and the sliding members 5 are stacked in the buckling chamber 33 and are slidable with respect to each other.

[0051] By adopting such a configuration, heat of the probe 6 can be efficiently dissipated via the sliding member 5. Also, contact between adjacent probes 6 during buckling can be prevented. Furthermore, high-frequency characteristics of the probe 6 can be improved.

[0052] Second Embodiment

In the first embodiment, an example in which a plurality of sliding members 5 have the same shape was described. In contrast, in the present embodiment, a case in which thicknesses of a plurality of sliding members 5 are different will be described.

[0053] FIG. 4 is a diagram showing a configuration example of a probe card 101 according to the second embodiment of the present invention, and similar to FIGS. 1 and 2, part (a) in the figure shows a state before inspection, and part (b) shows a state during inspection.

[0054] When compared with the probe card 100 (first embodiment) of FIGS. 1 and 2, the probe card 101 differs in that thicknesses of the plurality of sliding members 5 are not the same. In the probe card 100, since all the sliding members 5 have the same shape, there is no need to prepare sliding members 5 having different shapes, and manufacturing cost can be reduced. In contrast, in the probe card 101, by making thicknesses of the sliding members 5 disposed near a vertical center of the buckling chamber 33 thinner, the sliding member 5 moves more easily, thereby improving followability of the sliding member 5 with respect to deformation of the probe 6.

[0055] The thickness of the sliding member 5 is inversely proportional to a distance from the upper guide plate 31a or the lower guide plate 31b. That is, the sliding member 5 adjacent to the upper guide plate 31a or the lower guide plate 31b is thickest, and becomes thinnest near a vertical center of the buckling chamber 33. The thickness of the sliding member 5 may be of two types or may be of three or more types. Note that shapes of main surfaces of the plurality of sliding members 5 are the same.

[0056] Buckling deformation of the probe 6 during inspection becomes maximum near a vertical center of the buckling chamber 33. Therefore, by making the thickness of the sliding member 5 thinner near the vertical center of the buckling chamber 33, the sliding member 5 can be made to follow the deformation portion 63 of the probe 6 that has buckled and

deformed greatly more favorably, a contact area between the probe 6 and the sliding member 5 can be increased, and thermal conductivity can be improved.

[0057] Third Embodiment

In the above embodiments, an example in which the guide unit 3 does not have an intermediate guide plate was described. In contrast, in the present embodiment, a case in which the guide unit 3 has an intermediate guide plate 31c will be described.

[0058] FIG. 5 is a diagram showing a configuration example of a probe card 102 according to the third embodiment of the present invention, and part (a) in the figure shows a state before inspection, and part (b) shows a state during inspection. When compared with the probe card 100 (first embodiment) of FIG. 1, the probe card 102 differs in that the guide unit 3 has an intermediate guide plate 31c.

[0059] The intermediate guide plate 31c is a guide plate that guides the deformation portion 63 of the probe 6, and is disposed between the upper guide plate 31a and the lower guide plate 31b. The intermediate guide plate 31c is disposed so as to be spaced downward from the upper guide plate 31a via an upper guide spacer 32a and to face the upper guide plate 31a. The lower guide plate 31b is disposed so as to be spaced downward from the intermediate guide plate 31c via a lower guide spacer 32b and to face the intermediate guide plate 31c. That is, the buckling chamber 33 is divided into an upper buckling chamber 33a and a lower buckling chamber 33b by the intermediate guide plate 31c.

[0060] An insulating plate-shaped member having a plurality of fourth through holes 44 formed therein, for example, a ceramic plate, is used for the intermediate guide plate 31c. The fourth through hole 44 is a hole penetrating the intermediate guide plate 31c in a thickness direction thereof, and the probe 6 is inserted therethrough. The deformation portion 63 of the probe 6 is disposed in the fourth through hole 44. The fourth through hole 44 has a shape that does not hinder buckling deformation of the probe 6. For example, a cross-section of the fourth through hole 44 has an elongated shape in the offset direction D, and a length in the offset direction D is made equal to or greater than a maximum displacement amount of the probe 6 at an installation height of the intermediate guide plate 31c, while a width in a direction intersecting the offset direction D can be made the same as the first through hole 41 and the second through hole 42.

[0061] In the upper buckling chamber 33a, a plurality of sliding members 5 are respectively stacked slidably. Similarly, in the lower buckling chamber 33b, a plurality of sliding members 5 are respectively stacked slidably. Heat conducted from the probe 6 to these sliding members 5 can be dissipated via the intermediate guide plate 31c in addition to being

dissipated via the upper guide plate 31a and the lower guide plate 31b. Conducted heat of the sliding members 5 in the upper buckling chamber 33a is conducted to the main substrate 10 via the upper guide spacer 32a and the upper guide plate 31a. Therefore, heat dissipation efficiency can be improved as compared with a case in which the intermediate guide plate 31c is not provided.

[0062] Fourth Embodiment

In the above embodiments, examples in which a plurality of sliding members 5 have the same shape were described. In contrast, in the present embodiment, a case in which sizes of the third through holes 43 are different will be described.

[0063] FIG. 6 is a diagram showing a configuration example of a probe card 103 according to the fourth embodiment of the present invention, and part (a) in the figure shows a state before inspection, and part (b) shows a state during inspection. When compared with the probe card 100 (first embodiment) of FIGS. 1 and 2, the probe card 103 differs in that sizes of the third through holes 43 are not the same. In the probe card 103, by making sizes of the third through holes 43 different, the sliding member 5 is prevented from hindering buckling deformation of the probe 6.

[0064] In the sliding member 5, a cross-section of the third through hole 43 becomes larger so as to be inversely proportional to a distance from the upper guide plate 31a or the lower guide plate 31b. That is, a cross-section of the third through hole 43 of the sliding member 5 adjacent to the upper guide plate 31a or the lower guide plate 31b is smallest, and a cross-section of the third through hole 43 of the sliding member 5 disposed near a vertical center of the buckling chamber 33 is largest. The size of the third through hole 43 may be of two types or may be of three or more types. Note that a size of the third through holes 43 formed in the same sliding member 5 is the same.

[0065] Buckling deformation of the probe 6 during inspection becomes largest near a vertical center of the buckling chamber 33. Therefore, by making a cross-sectional area of the third through hole 43 of the sliding member 5 disposed near the vertical center of the buckling chamber 33 larger, the sliding member 5 becomes less likely to hinder buckling deformation during inspection.

REFERENCE SIGN LIST

[0066] 100-103 Probe card

10 Main substrate

10e External terminal

10p Probe electrode

11	Reinforcing plate
12	Guide unit mounting portion
3	Guide unit
31a	Upper guide plate
31b	Lower guide plate
31c	Intermediate guide plate
32	Guide spacer
32a	Upper guide spacer
32b	Lower guide spacer
33	Buckling chamber
33a	Upper buckling chamber
33b	Lower buckling chamber
41	First through hole
42	Second through hole
43	Third through hole
44	Fourth through hole
45	Positioning through hole
5	Sliding member
6	Probe
61	Probe base portion
62	Probe tip portion
63	Deformation portion
64	Locking portion
7	Positioning pin
D	Offset direction

CLAIMS

[Claim 1] A probe card comprising:

a plurality of probes;

an upper guide plate in which a plurality of first through holes that guide probe base portions of the probes are formed;

a lower guide plate in which a plurality of second through holes that guide probe tip portions of the probes are formed, disposed facing the upper guide plate, and forming a buckling chamber between the upper guide plate for the probes to buckle; and

a plurality of sliding members in each of which a plurality of third through holes through which the probes penetrate are formed, stacked in the buckling chamber, and slidable with respect to each other.

[Claim 2] The probe card according to claim 1, wherein

each of the sliding members has a thermal conductivity of $3.32 \text{ W/m}\cdot\text{K}$ or more.

[Claim 3] The probe card according to claim 1, wherein

each of the sliding members has a coefficient of friction of less than 0.11.

[Claim 4] The probe card according to any one of claims 1 to 3, wherein

the plurality of sliding members have a same shape.

[Claim 5] The probe card according to any one of claims 1 to 3, wherein

a sliding member of the sliding members disposed near a vertical center of the buckling chamber has a thickness thinner than a sliding member of the sliding members disposed adjacent to the upper guide plate or the lower guide plate.

[Claim 6] The probe card according to any one of claims 1 to 3, further comprising:

an intermediate guide plate in which a plurality of fourth through holes that guide the probes are formed, disposed between the upper guide plate and the lower guide plate, wherein

each of the fourth through holes is larger than each of the first through holes and each of the second through holes, and

the buckling chamber is divided into an upper buckling chamber and a lower buckling chamber by the intermediate guide plate, and the plurality of sliding members are distributively disposed in the upper buckling chamber and in the lower buckling chamber.

[Claim 7] The probe card according to any one of claims 1 to 3, wherein each of the third through holes of a sliding member of the sliding members disposed near a vertical center of the buckling chamber is larger than each of the third through holes of a sliding member of the sliding members disposed adjacent to the upper guide plate or the lower guide plate.