

Description

Title of Invention: TEST PROBE AND METHOD OF MANUFACTURING THE SAME

Technical Field

- [1] The disclosure relates to a test probe for testing the electrical characteristics of a subject-to-be-tested, such as a semiconductor, and a method of manufacturing the same.

Background Art

- [2] A test probe includes a barrel shaped like a cylinder, a terminal partially inserted in and secured to a first end portion of the barrel, a plunger slidably inserted in a second end portion of the barrel, and a spring interposed between the terminal and the plunger within the barrel. The terminal comes into contact with a bump terminal of a subject-to-be-tested, and the plunger comes into contact with a pad terminal of a test circuit board. In this case, the terminal has a sharp tip to be stuck into the hemispherical bump terminal during a test. The sharp tip needs to be plated with hard metal because it wears out over many tests. However, the hard metal is difficult to form thickly due to its high internal stress, and a thin plating layer is less durability.

Disclosure of Invention

Technical Problem

- [3] An aspect of the disclosure is to provide a test probe with excellent durability and a method of manufacturing the same.

Solution to Problem

- [4] According to an embodiment of the disclosure, there is provided a test probe. The test probe includes: a barrel shaped like a barrel; and a terminal including a terminal body portion partially inserted in a first end of the barrel, and a contact portion extending integrally from the terminal body portion to come into contact with a bump terminal of a subject-to-be-tested. The contact portion includes: a tip supporting portion including a supporting main body provided on the terminal body portion and a tip base protruding from a first end of the supporting main body in a horn shape; and a tip portion plated on an outer surface of the tip base and an upper surface of the supporting main body surrounding a lower end of the tip base, with a material having a higher hardness than the tip supporting portion, and formed more thickly on an upper portion of the tip base than a lower portion.
- [5] The tip portion may be made of nickel boride (NiB), and the tip supporting portion may be made of nickel (Ni). Thus, the tip portion of hard NiB is plated on the tip

supporting portion of Ni, thereby improving durability and properties of bonding with the tip supporting portion.

- [6] At least one uneven engagement portion may be formed on an interface between the tip supporting portion and the tip portion. Thus, the tip portion is improved in resistance to peeling off from the tip supporting portion.
- [7] According to an embodiment of the disclosure, there is provided a method of manufacturing a test probe. The method of manufacturing a test probe includes: forming a first molding groove, a cross-sectional area of which decreases downward, on a sacrificial substrate; forming a second molding groove by stacking a dry film on the sacrificial substrate, and patterning the dry film to expose an overflow surface on the sacrificial substrate surrounding the first molding groove; forming a tip portion that is thicker a lower side than an upper side within the first molding groove by plating on the first molding groove and the overflow surface with a first material; and forming a tip supporting portion by plating on the tip portion with a second material having higher conductivity than the first material.
- [8] The forming the tip portion may be performed by electroless plating. Thus, the tip portion is improved in hardness.
- [9] The forming the tip supporting portion may be performed by electroplating. Thus, the tip supporting portion is quickly plated, thereby reducing manufacturing costs.

Advantageous Effects of Invention

- [10] According to an embodiment of the disclosure, the test probe is improved in durability by thickly plating an apex portion of the contact tip, which comes into contact with the counterpart terminal, with a hard metal film.

Brief Description of Drawings

- [11] FIG. 1 is a perspective view of a test probe according to a first embodiment of the disclosure.
- [12] FIG. 2 is an exploded perspective view of the test probe according to a first embodiment of the disclosure.
- [13] FIG. 3 is a cross-sectional view taken along line A-A of FIG. 1.
- [14] FIG. 4 is a detailed cross-sectional view of a terminal of FIG. 1.
- [15] FIG. 5 is a schematic view showing a method of manufacturing the terminal of FIG. 4.
- [16] FIG. 6 is a detailed view showing a method of manufacturing a tip portion of FIG. 5.
- [17] FIG. 7 is a detailed cross-sectional view of a terminal according to a second embodiment of the disclosure.
- [18] FIG. 8 is a schematic view showing a method of manufacturing the terminal of FIG. 7.

[19] FIG. 9 is a detailed view showing a method of manufacturing a tip portion of FIG. 8.

[20] FIG. 10 is a perspective view of a test probe according to a third embodiment of the disclosure.

[21] FIG. 11 is a perspective view of a terminal according to a fourth embodiment of the disclosure.

Best Mode for Carrying out the Invention

[22] Below, a test probe 1 and a method of manufacturing the same will be described in detail with reference to the accompanying drawings.

[23] FIG. 1 is a perspective view showing a test probe 1, FIG. 2 is an exploded perspective view of the test probe 1 of FIG. 1, FIG. 3 is a cross-sectional view taken along line A-A of FIG. 1, and FIG. 4 is a detailed cross-sectional view of a terminal 4 of FIG. 1.

[24] Referring to FIGS. 1 to 3, the test probe 1 includes a barrel 2 shaped like a cylinder, a plunger 3 partially inserted in a first end portion of the barrel 2, a terminal 4 partially inserted in a second end portion of the barrel 2, and a spring 5 interposed between the plunger 3 and the terminal 4 within the barrel 2. The plunger 3 is slidable within the barrel 2 while compressing and restoring the spring 5, and the terminal 4 is secured to and supported on the first end portion of the barrel 2.

[25] The barrel 2 is shaped like a tube, and made of conductive metal such as brass.

[26] The barrel 2 includes a tubular barrel main body 21, and skirt portions 22 separated from each other by three slits 23 cut away from the first end portion of the barrel main body 21 along a longitudinal direction. The number of slits 23 is not limited to three but may be two or four or more.

[27] The skirt portion 22 includes a skirt main body 221 extending in the longitudinal direction of the barrel main body 21; and a skirt diameter-reducing portion 222 bent from a tip area of the skirt main body 221 reduced in diameter in an axial line direction of the barrel 2, and having a contact end portion 222a facing the surface of the plunger 3.

[28] The skirt main body 221 may be thicker or thinner than the barrel main body 21. In this way, the thickness of the skirt main body 221 is adjusted, thereby controlling contact force with the plunger 3.

[29] The skirt diameter-reducing portion 222 is thicker than the skirt main body 221 or the barrel main body 21. In this way, the increase in the thickness of the skirt diameter-reducing portion 222 improves durability, enlarges the contact area between the plunger 3 and the contact end portion 222a, and enables the tip of the contact end portion 222a to be chamfered. As the tip of the contact end portion 222a is chamfered,

a tip edge of the skirt diameter-reducing portion 222 is prevented from damaging the plunger 3 during a sliding operation of the plunger 3.

- [30] The length of the contact end portion 222a in the axial line direction is larger than the thickness of the skirt main body 221. As a result, the contact area between the contact end portion 222a and the plunger 3 is increased, thereby improving the resistance characteristics during the test.
- [31] The plunger 3 includes a sliding portion 31 that slides being accommodated in the barrel main body 21, and a terminal contact portion 32 that extends from the sliding portion 31, is exposed through the skirt portion 22, and is in elastic contact with the skirt portion 22.
- [32] The sliding portion 31 has a diameter corresponding to the inner diameter of the barrel main body 21. The sliding portion 31 is formed to have a diameter smaller than or equal to that of the barrel main body 21 so as to slide within the barrel main body 21.
- [33] The terminal contact portion 32 has a diameter smaller than that of the sliding portion 31. The diameter of the terminal contact portion 32 is large enough to pass through the tip of the skirt portion 22 while being in contact with the tip of the skirt portion 22. An end portion of the terminal contact portion 32 comes into contact with the terminal (not shown) of the subject-to-be-tested.
- [34] Referring to FIG. 4, the terminal 4 includes a terminal body portion 41 partially inserted in the second end portion of the barrel 2, and a contact portion 42 stacked on the terminal body portion 41 to come into contact with a terminal 110 of the subject-to-be-tested 100.
- [35] The terminal body portion 41 includes a barrel insertion portion 41a inserted in the barrel 2 and having a diameter corresponding to the inner diameter of the barrel 2, and a barrel supporting portion 41b recessed from the outer side of the terminal body portion 41 along a circumferential direction to secure the terminal body portion 41 to the barrel 2.
- [36] The barrel insertion portion 41a is shaped like a cylinder, is in contact with the barrel 2, and has a diameter corresponding to the inner diameter of the barrel 2. The barrel insertion portion 41a gradually decreases in diameter along a downward direction, thereby having a difference dt in diameter between upper and lower ends thereof.
- [37] The barrel supporting portion 41b is recessed along a circumferential direction on the outer circumferential surface of the barrel insertion portion 41a so as to accommodate a protrusion formed by pressing and deforming the barrel 2 inward through dimpling.
- [38] The contact portion 42 includes a tip supporting portion 421, and a tip portion 422 provided at a first end of the tip supporting portion 421. There may be a plurality of tip portions 422.

- [39] The tip supporting portion 421 includes a flange 421a provided on the terminal body portion 41 and having a larger diameter than the terminal body portion 41, a supporting main body 421b provided on the flange 421a and having a predetermined height, and a tip base 421c provided on the supporting main body 421b and protruding in the shape of a horn. The tip supporting portion 421 may be made of, for example, nickel (Ni).
- [40] The diameter of the flange 421a is larger than the diameter of the barrel 2. Therefore, when the terminal body portion 41 is inserted in the barrel 2, the end portion of the barrel 2 blocks and restricts the insertion of the terminal body portion 41.
- [41] The supporting main body 421b is shaped like, for example, a quadrangular pillar or a cylinder, and has a height considering the height of the tip portion 422 based on test conditions.
- [42] The tip portion 422 may be made of a material having higher hardness than the tip supporting portion 421, for example, nickel boride (NiB). The tip portion 422 may be formed as plated on the outer surface of the tip base 421c.
- [43] The terminal 4 may further include a spring supporting portion provided in a lower end of the terminal body portion 41 and protruding having a smaller diameter than the barrel insertion portion 41a. The spring supporting portion is inserted in the first side of the spring 5 in FIG. 2 and supports the spring 5.
- [44] Referring to FIG. 4, the tip portion 422 is formed of hard metal, e.g., nickel boride (NiB) on the outer surface of the tip base 421c by electroplating or the electroless plating. In this case, the tip portion 422 is formed such that its upper portion Ht above the tip base 421c is thicker than its lower portion Lt close to the supporting main body 421b. The upper portion Ht including the apex of the tip portion 422 refers to a portion that is generally stuck into the bump terminal, and is thickly reinforced with hard metal, e.g., nickel boride (NiB) to improve wear resistance. The tip portion 422 may be firmly coupled to the tip base 421c by uneven engagement. Further, the outer surface of the tip base 421c is not only not polished but also rough and wavy, so that the tip portion 422 can be more firmly coupled to the tip base 421c and thus resistant to peeling. In addition, the tip portion 422 made of hard metal, i.e., nickel boride (NiB) is excellent in properties of bonding with the tip supporting portion 421 made of the same type, i.e., nickel (Ni).
- [45] FIG. 5 is a schematic view showing a method of manufacturing the terminal 4 of FIG. 4, and FIG. 6 is a detailed view showing a method of manufacturing the tip portion 422 of FIG. 5. Although a plurality of terminals 4 are manufactured on one sacrificial substrate 61 by the MEMS process simultaneously, only one terminal 4 is shown in FIG. 5 for the convenience of descriptions.
- [46] At operation S1, a first molding groove 61 shaped like, for example, a quadrangular pyramid is formed on one surface of the sacrificial substrate 60. The first molding

groove 61 having the quadrangular pyramid shape corresponds to the outer shape of the tip portion 422 shown in FIG. 4.

- [47] At operation S2, a conductive film 62, for example, a gold (Au) film is formed on one surface of the sacrificial substrate 60 by sputtering.
- [48] At operation S3, a first dry film 63 is stacked on the conductive film 62 of the sacrificial substrate 60, and a second molding groove 64 shaped like a cylinder is formed to expose the first molding groove 61 by pattern exposure and development.
- [49] At operation S4, a first layer 65 (corresponding to the tip portion 422 of FIG. 4) is formed by plating the inner surface of the first molding groove 61 with the material forming the tip supporting portion, i.e., metal harder than nickel (Ni), e.g., nickel boride (NiB) by electroless plating or electroplating.
- [50] At operation S4-1 shown in FIG. 6, an initial tip portion 65-1 is plated to an almost constant thin thickness on the first molding groove 61 at the beginning of the plating.
- [51] Then, when the plating continues for a predetermined period of time, at operation S4-2 shown in FIG. 6 the first molding groove 61 is filled from a lower portion thereof having a narrow area and thus the lower portion is plated thicker than an upper portion thereof. A plating solution in the first molding groove 61 and the second molding groove 64 lacks a plating metal component as the plating continues, and it is therefore required to repetitively stir the plating solution. Further, the plating solution supplied by the stirring is pushed into the lower portion of the first molding groove 61 so that the amount of precipitation can increase in the lower portion of the first molding groove 61.
- [52] At operation S5, the first dry film 63 on the sacrificial substrate 60 is removed.
- [53] At operation S6, the second dry film 66 is formed on the sacrificial substrate 60, and a third molding groove 67 is formed by additional pattern exposure and development to have a cylindrical shape, of which a cross-sectional area is more enlarged than the first molding groove 61.
- [54] At operation S7, a second layer 69 (corresponding to the supporting main body 421b and the tip base 421c of the tip supporting portion 421 in FIG. 4) is formed by filling a recessed portion 68 (where the tip base 421c of FIG. 4 is formed) and the third molding groove 67 with metal excellent in properties of bonding with nickel boride (NiB), has high conductivity and relatively low hardness, for example, nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the second dry film 66.
- [55] At operation S8, a third layer 72 (corresponding to the flange 421a of FIG. 4) is formed by stacking a third dry film 70 on the second dry film 66, forming a fourth molding groove 71 shaped like a cylinder, which has a smaller diameter than the third molding groove 67, by pattern exposure and development, and filling the metal,

e.g., nickel (Ni) into the fourth molding groove 71 by the electroplating or electroless plating, and grinding a portion of the metal protruding from the top surface of the third dry film 70.

- [56] At operation S9, a fourth layer 75 (corresponding to a portion of the barrel insertion portion 41a of FIG. 4) is formed by stacking a fourth dry film 73 on the third dry film 70, forming a fifth molding groove 74 shaped like a cylinder, which has a smaller diameter than the fourth molding groove 71, by pattern exposure and development, and filling the metal, e.g., nickel (Ni) into the fifth molding groove 74 by the electroplating, and grinding a portion of the metal protruding from the top surface of the fourth dry film 73.
- [57] At operation S10, a fifth layer 78 (corresponding to the barrel supporting portion 41b of FIG. 4) is formed by stacking a fifth dry film 76 on the fourth dry film 73, forming a sixth molding groove 77 shaped like a cylinder, which has a smaller diameter than the fifth molding groove 74, by pattern exposure and development, filling the sixth molding groove 77 with metal, e.g., nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the fifth dry film 76.
- [58] At operation S11, a sixth layer 81 (corresponding to the remaining portion of the barrel insertion portion 41a in FIG. 4) is formed by stacking a sixth dry film 79 on the fifth dry film 76, forming a seventh molding groove 80 shaped like a cylinder, which has a larger diameter than the sixth molding groove 77, by pattern exposure and development, filling the seventh molding groove 80 with metal, e.g., nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the sixth dry film 79.
- [59] Optionally, a seventh layer (corresponding to the spring supporting portion) may be formed by stacking a seventh dry film on the sixth dry film 79, forming an eighth molding groove shaped like a cylinder, which has a smaller diameter than the seventh molding groove 80, by pattern exposure and development, filling the eighth molding groove 80 with metal, e.g., nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the seventh dry film 79.
- [60] At operation S12, the sacrificial substrate 60, and the second to sixth dry films 66, 70, 73, 76 and 79 are removed to complete the terminal 4.
- [61] Finally, the terminal 4 may be externally plated with a highly conductive metal such as gold (Au).
- [62] In this way, the test probe 1 according to the first embodiment of the disclosure is improved in durability by increasing the thickness of the tip portion 422, which is plated on the tip base 421c, around the apex.

- [63] The foregoing method of manufacturing the test probe 1 according to the first embodiment of the disclosure may employ the electroplating or the electroless plating alone. Alternatively, the first layer 65 corresponding to the tip portion 422 may be plated by the electroless plating, and the other second to fifth layers 68, 71, 74 and 77 may be plated by the electroplating that is inexpensive and has a fast precipitation rate.
- [64] FIG. 7 is a detailed cross-sectional view of a terminal 8 according to a second embodiment of the disclosure. Below, repetitive descriptions to the test probe 4 according to the first embodiment shown in FIG. 4 will be omitted.
- [65] Referring to FIG. 7, a tip portion 822 is formed of hard metal (NiB) on the top surface of a tip base 821c and the top surface of the supporting main body 821b (corresponding to an overflow surface 94a of FIG. 8) by the electroplating or the electroless plating. In this case, the tip portion 822 is formed such that its upper portion Ht above the tip base 821c is thicker than its lower portion Lt close to a first end of a supporting main body 821b. The upper portion Ht including an apex portion of the tip portion 822 refers to a portion that is generally stuck into the bump terminal, and is thickly reinforced with hard metal (NiB) to improve wear resistance. The tip portion 822 may be firmly coupled to the tip base 821c by uneven engagement, and engagement between an end portion surface of the supporting main body 821c and the overflow portion 822b of the tip portion 822. Further, the end portion surface of the supporting main body 821c and the outer surface of the tip base 821c are not only not polished but also rough and wavy, so that the tip portion 822 can be more firmly coupled by the uneven engagement. Therefore, the tip portion 822 is firmly coupled to the tip base 821c and thus resistant to peeling. In addition, the tip portion 822 made of hard metal, i.e., nickel boride (NiB) is excellent in properties of bonding with the tip supporting portion 821 made of the same type, i.e., nickel (Ni).
- [66] FIG. 8 is a schematic view showing a method of manufacturing the terminal 8 of FIG. 7, and FIG. 9 is a detailed view showing a method of manufacturing the tip portion 822 of FIG. 8. Although a plurality of terminals 8 are manufactured on one sacrificial substrate 80 by the MEMS process simultaneously, only one terminal 8 is shown in FIG. 8 for the convenience of descriptions.
- [67] At operation S21, a first molding groove 91 shaped like, for example, a quadrangular pyramid is formed on one surface of the sacrificial substrate 90. The first molding groove 91 having the quadrangular pyramid shape corresponds to the outer shape of the tip portion 822 shown in FIG. 7.
- [68] At operation S22, a conductive film 92, for example, a gold (Au) film is formed on one surface of the sacrificial substrate 90 by sputtering.
- [69] At operation S23, a first dry film 93 is stacked on the conductive film 92 of the sacrificial substrate 90, and a second molding groove 94 shaped like a cylinder is

formed to expose the first molding groove 91 and the overflow surface 94a on the sacrificial substrate 90 surrounding the first molding groove 91 by pattern exposure and development.

- [70] At operation S24, a first layer 95 (corresponding to the tip portion 822 of FIG. 7) is formed by plating hard metal, e.g., nickel boride (NiB) on the inner surface of the first molding groove 91 and the overflow surface 94a of the second molding groove 94 through the electroless plating or the electroplating. The first layer 95 includes a recessed portion 95a recessed downward (i.e., a portion where the tip base 821 of FIG. 7 is formed).
- [71] At operation S24-1 shown in FIG. 9, the first layer 95 is plated to an almost constant thin thickness on the inner surface 91a of the first molding groove 91 and the overflow surface 94a of the second molding groove 94 at the beginning of the plating.
- [72] Then, when the plating continues for a predetermined period of time, at operation S24-2 shown in FIG. 9 the first molding groove 91 is filled from a lower portion thereof having a narrow area and thus the lower portion is plated thicker than an upper portion thereof. A plating solution in the first molding groove 91 and the second molding groove 94 lacks a plating metal component as the plating continues, and it is therefore required to repetitively stir the plating solution. Further, the plating solution supplied by the stirring is pushed into the lower portion of the first molding groove 91 so that the amount of precipitation can increase in the lower portion of the first molding groove 91.
- [73] At operation S25, a second layer 96 (corresponding to the supporting main body 821b and the tip base 821c of FIG. 7) is formed by filling a recessed portion 95a of the first layer 95 and the second molding groove 94 of the first dry film 93 with metal excellent in properties of bonding with nickel boride (NiB), has high conductivity and relatively low hardness, for example, nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the first dry film 63.
- [74] At operation S26, a third layer 99 (corresponding to the flange 821a of FIG. 7) is formed by stacking a second dry film 97 on the first dry film 93, forming a third molding groove 98 shaped like a cylinder, which has a larger diameter than the second molding groove 94, by pattern exposure and development, and filling the metal, e.g., nickel (Ni) into the third molding groove 98 by the electroplating or electroless plating, and grinding a portion of the metal protruding from the top surface of the second dry film 97.
- [75] At operation S27, a fourth layer 102 (corresponding to a portion of the barrel insertion portion 81a of FIG. 7) is formed by stacking a third dry film 100 on the second dry film 97, forming a fourth molding groove 101 shaped like a cylinder, which

has a smaller diameter than the third molding groove 98, by pattern exposure and development, and filling the metal, e.g., nickel (Ni) into the fourth molding groove 101 by the electroplating, and grinding a portion of the metal protruding from the top surface of the third dry film 100.

- [76] At operation S28, a fifth layer 105 (corresponding to the barrel supporting portion 81b of FIG. 7) is formed by stacking a fourth dry film 103 on the third dry film 100, forming a fifth molding groove 104 shaped like a cylinder, which has a smaller diameter than the fourth molding groove 101, by pattern exposure and development, filling the fifth molding groove 104 with metal, e.g., nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the fourth dry film 103.
- [77] At operation S29, a sixth layer 108 (corresponding to the remaining portion of the barrel insertion portion 81a in FIG. 7) is formed by stacking a fifth dry film 106 on the fourth dry film 103, forming a sixth molding groove 107 shaped like a cylinder, which has a larger diameter than the fifth molding groove 104, by pattern exposure and development, filling the sixth molding groove 107 with metal, e.g., nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the fifth dry film 106.
- [78] At operation S30, the sacrificial substrate 90, and the first to fifth dry films 93, 97, 100, 103 and 106 are removed to complete the terminal 8.
- [79] Optionally, a seventh layer (corresponding to the spring supporting portion) may be formed by stacking a sixth dry film on the fifth dry film 106, forming a seventh molding groove shaped like a cylinder, which has a smaller diameter than the sixth molding groove 107, by pattern exposure and development, filling the seventh molding groove with metal, e.g., nickel (Ni) by the electroplating or the electroless plating, and grinding a portion of the metal protruding from the top surface of the sixth dry film.
- [80] Finally, the terminal 8 may be externally plated with a highly conductive metal such as gold (Au).
- [81] In this way, the test probe 1 according to the second embodiment of the disclosure is improved in durability by increasing the thickness of the tip portion 422, which is plated on the tip base 421c, around the apex.
- [82] The foregoing method of manufacturing the test probe 1 according to the second embodiment of the disclosure may employ the electroplating or the electroless plating alone. Alternatively, the first layer 95 corresponding to the tip portion 822 may be plated by the electroless plating, and the other second to fifth layers 96, 99, 102, 105 and 108 may be plated by the electroplating that is inexpensive and has a fast precipitation rate.

- [83] FIG. 10 is a perspective view of a test probe 1 according to a third embodiment of the disclosure. Below, repetitive descriptions to the test probe 1 shown in FIGS. 1 to 3 will be omitted.
- [84] Referring to FIG. 10, the test probe 1 includes the barrel 2, the plunger 3 partially inserted in the first end portion of the barrel 2, and a terminal assembly 110 partially inserted in the second end portion of the barrel 2.
- [85] The terminal assembly 110 includes a tubular terminal supporting tube 111, and a terminal 112 coupled to the terminal supporting tube 111. The terminal 112, which has a structure similar to that of the terminal 4 shown in FIGS. 1 to 3, may be partially inserted in and secured to the terminal supporting tube 111 instead of the barrel 2.
- [86] FIG. 11 is a perspective view of a terminal 12 according to a fourth embodiment of the disclosure.
- [87] The terminal 12 includes a terminal body portion 121 partially inserted in the second end portion of the barrel 2, and a contact portion 122 stacked on the terminal body portion 121 to come into contact with the terminal of the subject-to-be-tested.
- [88] The contact portion 122 includes a flange 122a, a supporting main body 122b provided on the flange 122 and shaped like a quadrangular pillar or a cylinder, and a tip portion 122c provided on the supporting main body 122b and shaped like a quadrangular pyramid, a cone, or a polygonal pyramid other than the quadrangular pyramid. There may be 2, 3 or 5 or more tip portions 122c.
- [89] Although a few embodiments of the disclosure have been illustrated and described above, the disclosure is not limited to the foregoing specific embodiments. Various modifications can be made in the embodiments by those skilled in the art without departing from the scope of the disclosure as claimed in Claims, and these modified embodiments should not be understood separately from the technical spirits or prospects of the disclosure.

Claims

- [Claim 1] A test probe comprising:
a barrel shaped like a barrel; and
a terminal comprising a terminal body portion partially inserted in a first end of the barrel, and a contact portion extending integrally from the terminal body portion to come into contact with a bump terminal of a subject-to-be-tested, wherein
the contact portion comprises:
a tip supporting portion comprising a supporting main body provided on the terminal body portion and a tip base protruding from a first end of the supporting main body in a horn shape; and
a tip portion plated on an outer surface of the tip base and an upper surface of the supporting main body surrounding a lower end of the tip base, with a material having a higher hardness than the tip supporting portion, and formed more thickly on an upper portion of the tip base than a lower portion.
- [Claim 2] The test probe of claim 1, wherein
the tip portion is made of nickel boride (NiB), and
the tip supporting portion is made of nickel (Ni).
- [Claim 3] The test probe of claim 1, further comprising at least one uneven engagement portion formed on an interface between the tip supporting portion and the tip portion.
- [Claim 4] A method of manufacturing a test probe, comprising:
forming a first molding groove, a cross-sectional area of which decreases downward, on a sacrificial substrate;
forming a second molding groove by stacking a dry film on the sacrificial substrate, and patterning the dry film to expose an overflow surface on the sacrificial substrate surrounding the first molding groove;
forming a tip portion that is thicker a lower side than an upper side within the first molding groove by plating on the first molding groove and the overflow surface with a first material; and
forming a tip supporting portion by plating on the tip portion with a second material having higher conductivity than the first material.
- [Claim 5] The method of claim 4, wherein the forming the tip portion is performed by electroless plating.

[Claim 6]

The method of claim 5, wherein the forming the tip supporting portion is performed by electroplating.