

through 17 are exposed, so that the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 are formed (penetrating parts formation process).

[0172] In this manner, the impurity doped insulating film 61 having doped regions which correspond to parts forming the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 is etched by wet-etching process, so that the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 are formed. As a result, the impurity doped insulating film 61 can have the etching rate at a part of the top surface 61A side of the impurity doped insulating film 61 being greater than the etching rate at a part near the bottom 61B side of the impurity doped insulating film 61, thus the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 can be formed to have gentle slopes.

[0173] Further, in the penetrating parts formation process, the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 are formed to have the line lengths of E, F, G, H being greater than the thickness M4 of the impurity doped insulating film 61 by a factor of a square root of two, in which the lines E, F, G, H are drawn between the crossing points E₁, F₁, G₁, H₁ where the orthogonal planes of the top plane 11A of the diaphragm 11 meet with the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 and the crossing points E₂, F₂, G₂, H₂ where the orthogonal planes of the top plane 11A of the diaphragm 11 meet with the bottoms of the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2.

[0174] Like this manner, forming the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 to have the line lengths of E, F, G, H being greater than the thickness M4 of the impurity doped insulating film 61 by a factor of a square root of two, the angles formed between the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 and the bottom 61B of the impurity doped insulating film 61 can be formed being smaller than 45 degrees, in which the lines E, F, G, H are drawn between the crossing points E₁, F₁, G₁, H₁ where the orthogonal planes of the top plane 11A of the diaphragm 11 meet with the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 and the crossing points E₂, F₂, G₂, H₂ where the orthogonal planes of the top plane 11A of the diaphragm 11 meet with the bottoms of the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2.

[0175] Next in the process shown in FIG. 43, the resist film 41 shown in FIG. 42 is removed. In the process shown in FIG. 44, the metallic film 79 is formed to cover the structure of FIG. 39 (metallic film formation process). The metallic film 79 is patterned, and the wiring patterns 21 through 24 are formed. For the metallic film 79, for example, an Al film may be used. When an Al film is used for the metallic film 79, the metallic film 79 may be formed by a sputtering method, for example. For using Al film as the metallic film 79, the thick-

ness of the metallic film 79 on the top surface 61A of the impurity doped insulating film 61 may be approximately 0.5 μm, for example.

[0176] Like this manner, the angle formed between the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 and the bottom 61B of the impurity doped insulating film 61 is equal or less than 45 degrees, and the metallic film 79 is formed for the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2, and so that a sufficiently thick metallic film 79 (to be effective to prevent the wiring patterns 21 through 24 from forming discontinuities) can be formed for the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2. Thereby, the wiring patterns 21 through 24 formed for the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 may be prevented from forming discontinuities.

[0177] Following this process, similar manufacturing processes shown in FIG. 19 through FIG. 21 described in the first embodiment are performed, and the wiring patterns 21 through 24, the protection film 26, the diaphragm 11, and the diaphragm support member 12 are formed, and then the semiconductor pressure sensor 60 is manufactured.

[0178] According to the semiconductor pressure sensor of this embodiment of the present invention, by making the lines E, F, G, H to be greater than the thickness M4 of the impurity doped insulating film 61 by a factor of a square root of two, in which the lines E, F, G, H are drawn between the crossing points E₁, F₁, G₁, H₁ where the orthogonal planes of the top plane 37A of the semiconductor substrate 37 meet with top ends of the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 and the crossing points E₂, F₂, G₂, H₂ where the orthogonal planes of the top plane 37A of the semiconductor substrate 37 meet with the bottoms of the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2. As a result, the angles formed between the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 and the bottom 61E of the impurity doped insulating film 61 become smaller than 45 degrees. Thereby, a sufficiently thick metal film 79 (base material of the wiring patterns 21 through 24) can be formed at the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2, so that the wiring patterns 21 through 24 formed at the side planes 71-1A, 71-2A, 72-1A, 72-2A, 73-1A, 73-2A, 74-1A, 74-2A of the penetrating parts 71-1, 71-2, 72-1, 72-2, 73-1, 73-2, 74-1, 74-2 can be prevented from forming discontinuities.

[0179] The preferred embodiments of the present invention are described above, however, the present invention is not limited to the specifically disclosed embodiments, and variations and modifications may be made without departing from the scope of the present invention. For example, for the semiconductor pressure sensors 10, 50, 60 of the first through third embodiments, one example is described that the penetrating parts 31-1, 31-2, 32-1, 32-2, 33-1, 33-2, 34-1, 34-2, 53-1, 53-2, 54-1, 54-2, 55-1, 55-2, 56-1, 56-2, 71-1, 71-2, 72-1,