

[4] The PTFE sheet according to any one of above-described [1] to [3], in which the tool may be configured to mount the die on a bonding region of the mounting body by heating the die and the adhesive member using a vacuum adsorption tool, and the PTFE sheet may serve as a filter which inhibits fume gases generated when the die or the adhesive material is heated entering a suction hole of the tool.

[0012]

[5] A method of mounting a die including a step of preparing a die including a bump formation surface on which a plurality of bump electrodes is formed, a step of preparing a polytetrafluoroethylene (PTFE) sheet in which PTFE fibers having a diameter of 1 μm or less are spun, a Gurley value is in a range of 1 to 3, and a shrinkage factor in a direction perpendicular to a sheet winding direction when heated to 300°C is 10% or less, a step of disposing a vacuum adsorption tool having an adsorption surface above the die such that the adsorption surface faces the bump formation surface, a step of sandwiching the PTFE sheet between the adsorption surface and the bump formation surface and adsorbing the die using the vacuum adsorption tool, and a step of mounting the die adsorbed by the vacuum adsorption tool on a bonding region of a substrate via an adhesive material, in which the PTFE sheet has a thickness equal to or greater than a protrusion height of the bump electrode on the bump formation surface.

[Advantageous Effects of Invention]

[0013]

According to the present invention, stabilization of vacuum adsorption and improvement in maintainability can be achieved.

[Brief Description of Drawings]

[0014]

Fig. 1 is a view illustrating a bonding device used for a method of mounting a

[0044]

The porous sheet 44 is made of a soft material compared to both the bump electrode 106 and the adsorption surface 24 in order to at least partially absorb a protrusion height of the bump electrode 106 due to the first surface 102a when the die 5 100 is mounted on the substrate 110. For example, a compressive stress of the porous sheet 44 is 0.12 MPa, which is smaller than a compressive stress of 110 GPa of copper or a compressive stress of 80 GPa of gold used for the bump. Therefore, the porous sheet 44 is more easily deformed than a metal used for the bump electrode such as copper or gold. Further, the compressive stress of the porous sheet 44 is calculated from a 10 gradient between a load and a strain amount when the porous sheet 44 is pressed with a predetermined load.

[0045]

The porous sheet 44 is a spun sheet in which polytetrafluoroethylene (PTFE) nanofibers are spun. The porous sheet 44 having a pore diameter of about 1 to 2 μm , a 15 thickness of about 50 μm , and a Gurley value of 1 to 2 ($\text{s}/100 \text{ cc}/\text{in}^2$) may be used. The PTFE nanofibers can be made to have a small Gurley value (that is, improved air permeability) despite being thick. Also, the porous sheet 44 using the PTFE nanofibers can reduce heat shrinkage and suppress sheet deformation such as curling of the sheet even when it is heated to 260°C to 300°C.

20 [0046]

The porous sheet 44 has a shrinkage factor of 0% at 250°C, 0% to 0.5% at 300°C, and 5% to 9% at 350°C in the width direction (Y direction) perpendicular to the winding direction (X direction), and has a shrinkage factor of 4.2% to 5.7% at 250°C, 4.7% to 5.8% at 300°C, and 12.4% to 14.0% at 350°C in the winding direction. On the 25 other hand, a stretched sheet whose shape is fixed by stretching PTFE at a low

temperature and then applying heat below a melting point has a shrinkage factor of 29.9% to 31.9% at 250°C, 35.0% to 38.0% at 300°C, and 48.7% to 53.3% at 350°C in the width direction, and has a shrinkage factor of 30% to 42% at 250°C, 36% to 47% at 300°C, and 50% to 55% at 350°C in the sheet winding direction. That is, as compared with the stretched sheet, the porous sheet 44 has a shrinkage factor of about 1/5 in the width direction and has a shrinkage factor of about 1/4 in the sheet winding direction.

[0047]

Further, since the porous sheet 44 wound on the roll as in the present embodiment is long in the winding direction, even when the porous sheet 44 shrinks in the winding direction, the shrinkage does not affect an effect of inhibiting the adhesive material creeping up, which will be described below.

[0048]

In the manufacturing process of the semiconductor device described in the present embodiment, the die 100 and an adhesive material 114 are heated to 250°C to 300°C by a heater incorporated in the vacuum adsorption tool 22. At this time, the heater and the vacuum adsorption tool 22 are heated to about 300°C to 350°C, which is higher than a target temperature for heating the die 100, and the porous sheet 44 is also exposed to heat of 300°C to 350°C.

[0049]

As illustrated in Fig. 4, when the die 100 is mounted on the substrate 110, the porous sheet 44 is used for inhibiting a liquid adhesive material 114 or a film-like adhesive material 114 melted by heat creeping up and adhering to the adsorption surface 24 of the vacuum adsorption tool 22 or an upper surface of the die 100. When the adhesive material 114 adheres to the die 100, it causes poor bonding of the electrodes or the like. Further, when the adhesive material 114 adheres to the adsorption surface 24,

the adhesive material 114 adhered thereto is transferred to the die 100 and causes a defect in the same manner.

[0050]

The die 100 may be stacked not only on the substrate 110 but also on another die
5 100 that has already been mounted on the substrate 110. In this case, the porous sheet 44 inhibits the adhesive material 114 on the substrate 110 or the adhesive material 114 for bonding the dies 100 adhering to the adsorption surface 24 or the die 100.

[0051]

In order to inhibit the adhesive material 114 adhering to the adsorption surface
10 24 and the die 100 by the porous sheet 44, the entire adsorption surface 24 and the die 100 are necessary to be covered. However, when a material having a large shrinkage factor is used due to heat of about 300°C applied to the porous sheet 44, it is expected that a part of the adsorption surface 24 or the die 100 will be exposed and the adhesive material 114 will adhere to the surface thereof.

15 [0052]

Also, if a material that deforms into a curl or the like is used for the porous sheet 44, when the porous sheet 44 comes into contact with the adsorption surface 24, when the die 100 is mounted, or the like, it is expected that the porous sheet 44 will be rolled up, a part of the adsorption surface 24 or the die 100 will be exposed, and the adhesive
20 material 114 will adhere to the surface thereof. Further, it is conceivable that, when the porous sheet 44 to which the adhesive material 114 has adhered is deformed, the adhesive material 114 may adhere to an unexpected position and cause a defect of the die 100.

[0053]

25 Returning to the flowchart of Fig. 2, next, the porous sheet 44 is sandwiched

measured. The vacuum pressure was measured by a pressure gauge (not illustrated) disposed downstream of the suction hole of the adsorption tool. As a result of the measurement, the differential pressure was 7.0 kPa when the nanofiber sheet according to the example was used and was 4.2 kPa when the stretched sheet according to the comparative example was used.

[0073]

Thicknesses of the sheets used when the differential pressure of the vacuum pressure was measured were 56 μm in the example and 25 μm in the comparative example. That is, the nanofiber sheet according to the example has a higher differential pressure regardless of being about twice as thick as the stretched sheet according to the comparative example. That is, since the nanofiber sheet according to the example has a smaller pressure loss than the stretched sheet according to the comparative example, the nanofiber sheet can effectively and reliably adsorb the bump formation surface of the die 100. Also, since the nanofiber sheet according to the example has a small pressure loss, even when a thicker nanofiber sheet is applied, the nanofiber sheet can adsorb the bump formation surface of the die 100.

[0074]

As described above, the nanofiber sheet according to the example has a significantly reduced shrinkage factor compared to the widely used stretched PTFE sheet. As described in the embodiment, when the sheet is used for the purpose of inhibiting the adhesion due to creeping up of the adhesive material, it is necessary to dispose a sheet having a sufficient size in consideration of the shrinkage factor and a device for conveying the sheet, causing waste of a space for the device. Further, in order to suppress shrinkage of the sheet, a mechanism such as a clamper for restraining the sheet is required, and time and effort for changing a process such as lowering a temperature of

the heater are required. When the nanofiber sheet according to the example is used, it is possible to effectively inhibit adhesion of the adhesive material without changing a layout of the device and a process of mounting the die.

[0075]

5 [Table 1]

Sample			250°C			300°C			350°C		
			Before	After	Shrinkage factor	Before	After	Shrinkage factor	Before	After	Shrinkage factor
Example	1	A	100	100	1.0%	100.5	101	-0.5%	100.5	93	7.5%
		B	96	91	5.2%	97.7	92	5.8%	97	84.5	14.0%
		C	100	100	0.0%	100.5	100.5	0.0%	100	93.5	9.0%
		D	96	90.5	5.7%	97.5	92.5	4.7%	96.5	84.5	13.5%
	2	A	100	100	0.0%	100.5	101	-0.5%	100.5	95.5	5.0%
		B	96	92	4.2%	96	92	5.2%	97	84.5	12.9%
		C	100	100	0.0%	100.5	100.5	-0.5%	100	93.5	6.5%
		D	96	91.5	4.7%	95.5	92.5	4.7%	96.	84.5	12.4%
Comparative example	1	A	120	85	29.2%	117	66	43.6%	119	58	51.3%
		B	119	68	42.9%	120	-	cannot be measured	119	50	58.0%
		C	120	85	29.2%	120	78	35.0%	120	56	53.3%
		D	119	67	43.7%	118	-	cannot be measured	119	50	58.0%
	2	A	117	71	39.3%	121	75	38.0%	119	60	49.6%
		B	119	81	31.9%	119	60	49.6%	115.5	55	52.4%
		C	117	68	41.9%	118	76	35.6%	119	61	48.7%
		D	118	81	31.4%	121	63	47.9%	118.5	55	53.6%

[0076]

Implementation aspects described through the embodiments of the

above-described invention can be used in combination or with modifications or

10 improvements as appropriate depending on applications, and the present invention is not limited to the description of the embodiments described above. It is apparent from the description of the scope of the claims that embodiments with such combinations, modifications, or improvements can also be included in the technical scope of the present invention.