Claims

[Claim 1]

A method of manufacturing a semiconductor device, the method comprising:

preparing a reinforced wafer having a laminated structure, the laminated structure comprising a wafer including an element forming surface and a back surface opposite from the element forming surface, a supporting substrate, and a temporary adhesive layer located between the element forming surface side of the wafer and the supporting substrate;

forming a thinned wafer by grinding the wafer in the reinforced wafer from the back surface side of the wafer;

bonding an element forming surface side of a base wafer to the back surface side of the thinned wafer of the reinforced wafer via an adhesive, the base wafer including the element forming surface and a back surface opposite from the element forming surface; and

removing the supporting substrate by releasing a temporary adhesion in the temporary adhesive layer located between the supporting substrate and the thinned wafer in the reinforced wafer;

wherein a temporary adhesive for forming the temporary adhesive layer contains a polyvalent vinyl ether compound, a compound including two or more hydroxy groups or carboxy groups that are capable of forming an acetal bond by reacting with a vinyl ether group of the polyvalent vinyl ether compound so as to form a polymer with the polyvalent vinyl ether compound, and a thermoplastic resin; and

the adhesive contains a polymerizable group-containing polyorganosilsesquioxane, and

wherein

the bonding comprises a curing treatment to cure the adhesive at a temperature lower than a softening point of the polymer, and

the removing comprises a softening treatment to soften the temporary adhesive layer at a temperature higher than the softening point of the polymer.

~~[Claim 2]~~

~~The method of manufacturing a semiconductor device according to claim 1, wherein~~

~~the bonding comprises a curing treatment to cure the adhesive at a temperature lower than a softening point of the polymer, and~~

~~the removing comprises a softening treatment to soften the temporary adhesive layer at a temperature higher than the softening point of the polymer.~~

[Claim ~~3~~2]

The method of manufacturing a semiconductor device according to claim 1~~ or 2~~, the method further comprising:

preparing at least one additional reinforced wafer having a laminated structure, the laminated structure comprising a wafer including an element forming surface and a back surface opposite from the element forming surface, a supporting substrate, and a temporary adhesive layer formed of the temporary adhesive, the temporary adhesive layer being located between the element forming surface side of the wafer and the supporting substrate;

forming a thinned wafer by grinding the wafer in each of the at least one additional reinforced wafer from the back surface side of the wafer;

at least one additional bonding to bond the back surface side of the thinned wafer in the additional reinforced wafer to the element forming surface side of the thinned wafer that is on the base wafer via the adhesive; and

at least one removing performed for each of the at least one additional bonding to remove the supporting substrate by releasing a temporary adhesion in the temporary adhesive layer located between the supporting substrate and the thinned wafer in the additional reinforced wafer.

[Claim ~~4~~3]

The method of manufacturing a semiconductor device according to claim ~~3~~2, wherein

the at least one additional bonding comprises a curing treatment to cure the adhesive at a temperature lower than a softening point of the polymer, and

the removing performed for each of the additional bonding comprises a softening treatment to soften the temporary adhesive layer at a temperature higher than the softening point of the polymer.

[Claim ~~5~~4]

The method of manufacturing a semiconductor device according to any one of claims 1 to ~~4~~3, the method further comprising forming a through electrode inside a wafer laminate that is obtained through the removing step, the through electrode extending from an element forming surface of a thinned wafer located at one end of the wafer laminate in a lamination direction through an element forming surface of a base wafer located at another end of the wafer laminate.

[Claim ~~6~~5]

The method of manufacturing a semiconductor device according to any one of claims 1 to ~~5~~4, the method further comprising thinning the base wafer by grinding the back surface side of the base wafer.

[Claim ~~7~~6]

The method of manufacturing a semiconductor device according to any one of claims 1 to ~~4~~3, the method further comprising:

forming a through electrode inside a wafer laminate that is obtained through the removing step, the through electrode extending from an element forming surface of a thinned wafer located at one end of the wafer laminate in a lamination direction through a position passing an element forming surface of a base wafer located at another end of the wafer laminate; and

base wafer thinning to thin the base wafer by grinding the back surface side of the base wafer so as to expose the through electrode on the back surface side.

[Claim ~~8~~7]

The method of manufacturing a semiconductor device according to claim ~~7~~6, the method further comprising bonding an element forming surface side of a thinned wafer located at one end of a wafer laminate in a lamination direction, the wafer laminate being obtained through one of the base wafer thinning steps, to an element forming surface side of a thinned wafer located at one end of a wafer laminate in a lamination direction, the wafer laminate being obtained through the other one of the base wafer thinning steps.

[Claim ~~9~~8]

The method of manufacturing a semiconductor device according to claim ~~7~~6, the method further comprising bonding an element forming surface side of a thinned wafer located at one end of a wafer laminate in a lamination direction, the wafer laminate being obtained through one of the base wafer thinning steps, to a back surface side of a base wafer located at one end of a wafer laminate in a lamination direction, the wafer laminate being obtained through the other one of the base wafer thinning steps.

[Claim ~~10~~9]

The method of manufacturing a semiconductor device according to claim ~~7~~6, the method further comprising bonding a back surface side of a base wafer located at one end of a wafer laminate in a lamination direction, the wafer laminate being obtained through one of the base wafer thinning steps, to a back surface side of a base

wafer located at one end of a wafer laminate in a lamination direction, the wafer laminate being obtained through the other one of the base wafer thinning steps.