

laser interferometer thickness changes into the nanometer range can be detected and ascertained. A measurement of the substrate stack thickness along the measurement direction takes place by the relative movement between the bonded substrate stack and the laser interferometer. Layer thickness maps and the maximum and minimum layer thickness, and thus the TTV, can be determined from the profile which has been obtained in this way.

The knowledge of the TTV is important mainly for those processes which are applied to the product substrate after bonding, mainly back-thinning and etching processes. An overly large TTV provides specifically for nonuniform thickness removal and thus leads to destruction of the product substrate in the worst case.

Embodiments of the invention disclose a process and a device with which the thickness variation can be reduced, and therefore improved.

According to a first aspect of the present invention, there is provided a method for equalizing thickness variation of a wafer stack in a post-bond process, the method comprising: providing a wafer stack comprised of a product wafer and a carrier wafer connected by means of an inter connect layer; determining X-Y-positions of local thickness peaks by measuring local thicknesses of the wafer stack at a plurality of different X-Y-positions; applying local mechanical pressure to the local thickness peaks of the wafer stack by means of an application apparatus having at least one application unit; and equalizing the local thickness peaks in a controlled manner by use of the at least one application unit, the product wafer disposed to local deformations by the at least one application unit, wherein the at least one application unit applies local mechanical pressure to the surface of the product wafer.

According to a second aspect of the present invention, there is provided a device for equalizing the thickness variation of a wafer stack in a post-bond process, the device comprising: a wafer chuck for accommodating a wafer stack comprised of a product wafer and a carrier wafer connected by means of an inter connect layer; an application apparatus, having at least one application unit for applying local mechanical pressure to local thickness peaks of the wafer stack; a measuring device for determining X-Y-positions of the thickness peaks by measuring local thicknesses of the wafer stack at a plurality of different X-Y-positions, wherein the local thickness peaks are equalized in a controlled manner by the at least one application unit, wherein the product wafer is disposed to local deformations by the at least one application unit applying the local mechanical pressure, and wherein the at least one application unit applies the local mechanical pressure to the surface of the product wafer.

All combinations of at least two of the features given in the specification, the claims and/or the figures also fall within the scope of the invention. At the given value ranges, values within the indicated limits will also be considered to be disclosed as boundary values and will be claimed in any combination. To the extent features disclosed for the device can also be construed as method features, they are also to apply according to the method and vice versa.

The basic idea of embodiments of this invention is to equalize the thickness variation of a substrate stack which is connected by means of an interconnect layer, of a first substrate, in particular a carrier substrate, and a second substrate, in particular a product substrate,

CLAIMS

1. A method for equalizing thickness variation of a wafer stack (1) in a post-bond process, the method comprising:
 - providing a wafer stack (1) comprised of a product wafer (4) and a carrier wafer (2) connected by means of an inter connect layer (3);
 - determining X-Y-positions of local thickness peaks (12) by measuring local thicknesses of the wafer stack (1) at a plurality of different X-Y-positions;
 - applying local mechanical pressure to the local thickness peaks (12) of the wafer stack (1) by means of an application apparatus (11, 11', 11'') having at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}); and
 - equalizing the local thickness peaks (12) in a controlled manner by use of the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}), the product wafer (4) disposed to local deformations by the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}), wherein the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) applies local mechanical pressure to the surface of the product wafer (4).
2. The method as claimed in claim 1, wherein the interconnect layer (3) is deformed at when applying the mechanical pressure.
3. The method as claimed in one of the preceding claims, wherein the application apparatus (11, 11', 11'') applies the local mechanical pressure exclusively to the local thickness peaks (12).
4. The method as claimed in one of the preceding claims, wherein X-Y-positions of the local thickness peaks (12) are determined by use of a measuring unit prior to applying the local mechanical pressure to the local thickness peaks (12).
5. The method as claimed in one of the preceding claims, wherein the application apparatus (11, 11', 11'') has a plurality of the application units (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}).
6. The method as claimed in one of the preceding claims, wherein the application apparatus (11, 11', 11'') has a membrane (14), which covers the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}).

7. The method as claimed in one of the preceding claims, wherein the thickness variation in the wafer stack is reduced by half by applying the local mechanical pressure to the local thickness peaks (12).
8. The method as claimed in claim 4, wherein X-Y-positions of the local thickness peaks (12) are determined optically.
9. The method as claimed in claim 4, wherein X-Y-positions of the local thickness peaks (12) are determined acoustically.
10. The method as claimed in claim 5, wherein the plurality of the application units (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) are triggered separately.
11. The method as claimed in claim 5, wherein the plurality of the application units (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) are arranged discretely.
12. The method as claimed in claim 7, wherein the thickness variation in the wafer stack is reduced by 75% by applying the local mechanical pressure to the local thickness peaks (12).
13. The method as claimed in claim 7, wherein the thickness variation in the wafer stack is reduced by 90 % by applying the local mechanical pressure to the local thickness peaks (12).
14. The method as claimed in claim 7, wherein the thickness variation in the wafer stack is reduced by 95% by applying the local mechanical pressure to the local thickness peaks (12).
15. A device for equalizing the thickness variation of a wafer stack (1) in a post-bond process, the device comprising:
 - a wafer chuck (8) for accommodating a wafer stack (1) comprised of a product wafer (4) and a carrier wafer (2) connected by means of an inter connect layer (3);
 - an application apparatus (11, 11', 11'') having at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) for applying local mechanical pressure to local thickness peaks (12) of the

wafer stack;

a measuring device for determining X-Y-positions of the thickness peaks (12) by measuring local thicknesses of the wafer stack (1) at a plurality of different X-Y-positions,

wherein the local thickness peaks (12) are equalized in a controlled manner by the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}),

wherein the product wafer (4) is disposed to local deformations by the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) applying the local mechanical pressure, and

wherein the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) applies the local mechanical pressure to the surface of the product wafer (4).

16. The device as claimed in claim 15, wherein the device further comprises a measuring unit (5) for determining the X-Y-positions of the local thickness peaks (12).

17. The device as claimed in claim 15 or 16, wherein the application apparatus (11, 11', 11'') comprises a plurality of the application units (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}).

18. The device as claimed in one of claims 15 to 17, wherein the application apparatus (11, 11', 11'') comprises a membrane (14), which covers the at least one application unit (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}).

19. The device as claimed in claim 16, wherein X-Y-positions of the local thickness peaks (12) are determined optically.

20. The device as claimed in claim 16, wherein X-Y-positions of the local thickness peaks (12) are determined acoustically.

21. The device as claimed in claim 17, wherein the plurality of the application units (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) are triggered separately.

22. The device as claimed in claim 17, wherein the plurality of the application units (9, 9', 9'', 9''', 9^{IV}, 9^V, 9^{VI}) are arranged discretely.