

Claims

1. A method of manufacturing an individual die having a target die bowing value from a bonded wafer using a wafer bonding process, the method comprising:

- (a) bonding a first wafer to a second wafer to create an intermediate bonded structure;
- (b) measuring an amount of bowing of a first surface of the intermediate bonded structure;
- (b1) retrieving a target wafer bowing value from a database as a function of the target die bowing value, wherein the database comprises empirical data collected from other bonded wafers previously processed through the wafer bonding process, the collected data correlating a wafer bowing value with a die bowing value;
- (c) applying a bowing compensation layer of material to a second surface of the intermediate bonded structure if a difference between the measured bowing amount and the retrieved target bowing value is not less than or equal to a predetermined threshold value;
- (d) repeating (b) and (c) until the difference is less than or equal to the predetermined threshold value;
- (e) at least one of adding or removing a layer or adding or removing material to or from the first or second wafers, of the intermediate bonded structure to obtain the bonded wafer; and
- (f) dicing the bonded wafer apart to obtain the individual die having the target die bowing value,

wherein (c) applying the bowing compensation layer of material to the second surface of the intermediate bonded structure comprises:

retrieving, from the database, an amount of bowing compensation necessary to modify the intermediate bonded structure to change the measured bowing amount to be within the predetermined threshold value of the target bowing value; and

applying a subsequent bowing compensation layer of material corresponding to the necessary bowing compensation amount.

2. The method of claim 1, wherein applying a bowing compensation layer of material to the second surface of the intermediate bonded structure comprises:

applying one of: a film providing a tensile force or a film providing a compressive force.

3. The method of claim 1, wherein performing additional processing of the intermediate bonded structure to obtain the bonded wafer does not change a structure of the bowing compensation layer of material.
4. The method of claim 1, wherein applying the bowing compensation layer of material to a second surface of the intermediate bonded structure comprises applying a subsequent bowing compensation layer of material to a bowing compensation layer of material already provided on the second surface.
5. The method of claim 1, wherein the second surface of the intermediate bonded structure is an external surface of the intermediate bonded structure.
6. The method of claim 1, wherein measuring the amount of bowing of the first surface of the intermediate bonded structure is one of:
 - made after an annealing operation is performed;
 - made after a grinding operation is performed but before chemical or mechanical polishing/planarization (CMP); or
 - made after a detector thinning operation is performed.
7. A method of manufacturing an individual die, having a target die bowing value, from a bonded wafer using a wafer bonding process, the method comprising:
 - (a) bonding a first wafer to a second wafer to create an intermediate bonded structure;
 - (b) retrieving, from a database, a target wafer bowing range of values that corresponds to the target die bowing value, wherein the database comprises empirical data collected from other bonded wafers previously processed through the wafer bonding process, the collected data correlating a wafer bowing range of values with a die bowing value;
 - (c) measuring an amount of bowing of a first surface of the intermediate bonded structure;
 - (d) comparing the measured bowing amount to the retrieved target wafer bowing range of values;
 - (e) applying a bowing compensation layer of material to a second surface of the intermediate bonded structure if the measured bowing amount is not within the retrieved target bowing range of values;

(f) repeating (c) – (e) until the measured bowing amount is within the retrieved target bowing range of values;

(g) at least one of adding or removing a layer or adding or removing material to or from the first or second wafers of the intermediate bonded structure to obtain the bonded wafer; and

(h) dicing the bonded wafer apart to obtain the individual die having the target die bowing value,

wherein applying the bowing compensation layer of material to the second surface of the intermediate bonded structure comprises:

retrieving, from the database, an amount of bowing compensation necessary to modify the intermediate bonded structure to change the measured bowing amount to be within the retrieved target bowing range of values; and

applying a subsequent bowing compensation layer of material corresponding to the necessary bowing compensation amount.

8. The method of claim 7, wherein performing additional processing of the intermediate bonded structure to obtain the bonded wafer does not change a structure of the bowing compensation layer of material.

9. The method of claim 7, wherein the second surface of the intermediate bonded structure is an external surface of the intermediate bonded structure.

10. The method of claim 7, wherein measuring the amount of bowing of the first surface of the intermediate bonded structure is one of:

made after an annealing operation is performed;

made after a grinding operation is performed but before chemical or mechanical polishing/planarization (CMP); or

made after a detector thinning operation is performed.

11. A method of manufacturing a plurality of dies, each die having a target die bowing value, the method comprising:

(a) bonding a first wafer to a second wafer to create an intermediate bonded wafer structure;

(b) measuring an amount of bowing of a first surface of the intermediate bonded wafer structure;

(b1) retrieving a target wafer bowing value from a database as a function of the target die bowing value, wherein the database comprises empirical data collected from other bonded wafers previously processed through the wafer bonding process, the collected data correlating a wafer bowing value with a die bowing value;

(c) applying a bowing compensation structure to a second surface of the intermediate bonded structure if a difference between the measured bowing amount and the retrieved target bowing value is not less than or equal to a predetermined threshold value;

(d) repeating (b) and (c) until the difference is less than or equal to the predetermined threshold value;

(e) at least one of adding or removing a layer or adding or removing material to or from the first or second wafers of the intermediate bonded structure to obtain a bonded wafer structure; and

(f) dicing the bonded wafer structure apart to obtain the plurality of individual dies, each die having the target die bowing value, wherein applying the bowing compensation structure to the second surface of the intermediate bonded structure comprises: retrieving, from the database, an amount of bowing compensation necessary to modify the intermediate bonded structure to change the measured bowing amount to be within the predetermined threshold value of the target bowing value; and applying a subsequent bowing compensation layer of material corresponding to the necessary bowing compensation amount.

12. The method of claim 11, wherein applying the bowing compensation structure to the second surface of the intermediate bonded structure comprises:

applying one or more of: a film providing a tensile force or a film providing a compressive force.

13. The method of claim 11, wherein performing additional processing steps on the intermediate bonded structure to obtain the bonded wafer does not change the bowing compensation structure.

14. The method of claim 11, wherein the bowing compensation structure comprises a plurality of bowing compensation layers of material.

15. The method of claim 11, wherein measuring the amount of bowing of the first surface of the intermediate bonded structure is one of:

made after an annealing operation is performed;

made after a grinding operation is performed but before chemical or mechanical polishing/planarization (CMP); or

made after a detector thinning operation is performed.