[0005] Thus, it would be desirable to provide improved methods of bonding semiconductor elements to a substrate with the use of a reducing gas.

SUMMARY

[0006] According to a first asepct of the disclosure, a bonding system for bonding a semiconductor element to a substrate is provided. The bonding system includes a substrate oxide reduction chamber configured to receive a substrate. The substrate includes a plurality of first electrically conductive structures. The substrate oxide reduction chamber is configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures. The bonding system also includes a substrate oxide prevention chamber for receiving the substrate after the reducing gas contacts the plurality of first electrically conductive structures. The substrate oxide prevention chamber has an inert environment when receiving the substrate. The bonding system also includes a reducing gas delivery system for providing a reducing gas environment during bonding of a semiconductor element to the substrate. The semiconductor element includes a plurality of second electrically conductive structures. The plurality of first electrically conductive structures are configured to be bonded with corresponding ones of the plurality of second electrically conductive structures. The substrate oxide prevention chamber includes a bonding location for receiving the substrate during bonding of the semiconductor element to the substrate.

[0006a] In a second aspect, there is provided a bonding system for bonding a semiconductor element to a substrate, the bonding system comprising: a substrate oxide reduction chamber configured to receive a substrate, the substrate including a plurality of first electrically conductive structures, the substrate oxide reduction chamber configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures; a substrate oxide prevention chamber for receiving the substrate after the reducing gas contacts the plurality of first electrically conductive structures, the substrate oxide prevention chamber having an inert environment when receiving the substrate; a reducing gas delivery system for providing a reducing gas environment during bonding of a semiconductor element to the substrate, the semiconductor element including a plurality of second electrically conductive structures, the plurality of first electrically conductive structures being configured to be bonded with corresponding ones of the plurality of second electrically conductive structures; and a bond head including a bonding tool for bonding the semiconductor element to the substrate, the reducing gas delivery system being integrated with the bond head.

[0006b] In a third aspect, there is provided a bonding system for bonding a semiconductor element to a substrate, the bonding system comprising: a substrate oxide reduction chamber configured to receive a substrate, the substrate including a plurality of first electrically conductive structures, the substrate oxide reduction chamber configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures; a substrate oxide prevention chamber for receiving the substrate after the reducing gas contacts the plurality of first electrically conductive structures, the substrate oxide prevention chamber having an inert environment when receiving the substrate; a reducing gas delivery system for providing a reducing gas environment during bonding of a semiconductor element to the substrate, the semiconductor element including a plurality of second electrically conductive structures, the plurality of first electrically conductive structures being configured to be bonded with corresponding ones of the plurality of second electrically conductive structures; and a substrate support structure, the substrate support structure supporting the substrate during bonding of the semiconductor element to the substrate, wherein the reducing gas delivery system is integrated with the substrate support structure.

[0007] According to another exemplary embodiment of the disclsoure, a method of bonding a semiconductor element to a substrate is provided. The method includes the steps of: moving a substrate into a substrate oxide reduction chamber, the substrate including a plurality of first electrically conductive structures, the substrate oxide reduction chamber configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures; moving the substrate into a substrate oxide prevention chamber after the reducing gas contacts the plurality of first electrically conductive structures, the substrate oxide prevention chamber having an inert environment when receiving the substrate; and providing a reducing gas environment during bonding of a semiconductor element to the substrate, the semiconductor element including a plurality of second electrically conductive structures, the plurality of first electrically conductive structures being configured to be bonded with corresponding ones of the plurality of second electrically conductive structures.

[0008] According to yet another exemplary embodiment of the disclosure, a method of bonding a semiconductor element to a substrate is provided. The method includes the

What is Claimed:

1. A bonding system for bonding a semiconductor element to a substrate, the bonding system comprising:

a substrate oxide reduction chamber configured to receive a substrate, the substrate including a plurality of first electrically conductive structures, the substrate oxide reduction chamber configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures;

a substrate oxide prevention chamber for receiving the substrate after the reducing gas contacts the plurality of first electrically conductive structures, the substrate oxide prevention chamber having an inert environment when receiving the substrate; and

a reducing gas delivery system for providing a reducing gas environment during bonding of a semiconductor element to the substrate, the semiconductor element including a plurality of second electrically conductive structures, the plurality of first electrically conductive structures being configured to be bonded with corresponding ones of the plurality of second electrically conductive structures, wherein the substrate oxide prevention chamber includes a bonding location for receiving the substrate during bonding of the semiconductor element to the substrate.

2. The bonding system of claim 1 further comprising a substrate transfer system for transferring the substrate from the substrate oxide reduction chamber to the substrate oxide prevention chamber.

3. The bonding system of claim 1 wherein the substrate oxide prevention chamber is provided with nitrogen to create the inert environment.

4. The bonding system of claim 1 further comprising a material handling system for moving the substrate within the substrate oxide prevention chamber.

5. The bonding system of claim 1 further comprising a bond head including a bonding tool for bonding the semiconductor element to the substrate, wherein the reducing gas delivery system is integrated with the bond head.

6. The bonding system of claim 1 further comprising a substrate support structure, the substrate support structure supporting the substrate during

bonding of the semiconductor element to the substrate, wherein the reducing gas delivery system is integrated with the substrate support structure.

7. The bonding system of claim 1 wherein the semiconductor element is a semiconductor die.

8. The bonding system of claim 7 wherein the substrate is a semiconductor wafer.

9. The bonding system of claim 1 wherein the substrate is returned to the substrate oxide reduction chamber after being received by the substrate oxide prevention chamber.

10. The bonding system of claim 1 wherein at least a portion of the substrate oxide reduction chamber has a common boundary with the substrate oxide prevention chamber.

11. The bonding system of claim 1 wherein the substrate oxide reduction chamber is configured to receive another substrate after the substrate is moved to the substrate oxide prevention chamber.

12. A bonding system for bonding a semiconductor element to a substrate, the bonding system comprising:

a substrate oxide reduction chamber configured to receive a substrate, the substrate including a plurality of first electrically conductive structures, the substrate oxide reduction chamber configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures;

a substrate oxide prevention chamber for receiving the substrate after the reducing gas contacts the plurality of first electrically conductive structures, the substrate oxide prevention chamber having an inert environment when receiving the substrate;

a reducing gas delivery system for providing a reducing gas environment during bonding of a semiconductor element to the substrate, the semiconductor element including a plurality of second electrically conductive structures, the plurality of first electrically conductive structures being configured to be bonded with corresponding ones of the plurality of second electrically conductive structures; and

a bond head including a bonding tool for bonding the semiconductor element to the substrate, the reducing gas delivery system being integrated with the bond head.

13. The bonding system of claim 12 further comprising a substrate transfer system for transferring the substrate from the substrate oxide reduction chamber to the substrate oxide prevention chamber.

14. The bonding system of claim 12 further comprising a material handling system for moving the substrate within the substrate oxide prevention chamber.

15. The bonding system of claim 12 wherein the substrate oxide prevention chamber is provided with nitrogen to create the inert environment.

16. A bonding system for bonding a semiconductor element to a substrate, the bonding system comprising:

a substrate oxide reduction chamber configured to receive a substrate, the substrate including a plurality of first electrically conductive structures, the substrate oxide reduction chamber configured to receive a reducing gas to contact each of the plurality of first electrically conductive structures;

a substrate oxide prevention chamber for receiving the substrate after the reducing gas contacts the plurality of first electrically conductive structures, the substrate oxide prevention chamber having an inert environment when receiving the substrate;

a reducing gas delivery system for providing a reducing gas environment during bonding of a semiconductor element to the substrate, the semiconductor element including a plurality of second electrically conductive structures, the plurality of first electrically conductive structures being configured to be bonded with corresponding ones of the plurality of second electrically conductive structures; and

a substrate support structure, the substrate support structure supporting the substrate during bonding of the semiconductor element to the substrate, wherein the reducing gas delivery system is integrated with the substrate support structure.

17. The bonding system of claim 16 further comprising a substrate transfer system for transferring the substrate from the substrate oxide reduction chamber to the substrate oxide prevention chamber.

18. The bonding system of claim 16 further comprising a material handling system for moving the substrate within the substrate oxide prevention chamber.