Claims

What is claimed:

1. A method of making a semiconductor device, comprising:

providing a carrier with a die attach area;

disposing a semiconductor die over the die attach area;

disposing a modular interconnect unit over the carrier in a peripheral region around the semiconductor die;

depositing an encapsulant over the carrier, semiconductor die, and modular interconnect unit;

removing a first portion of the encapsulant to expose the semiconductor die while leaving a second portion of the encapsulant over the modular interconnect unit;

removing the carrier; and

forming an interconnect structure over the semiconductor die or modular interconnect unit.

2. The method of claim 1, wherein the modular interconnect unit includes a core with a vertical interconnect structure formed through the core and overlapping the core by 0-200 micrometers.

3. The method of claim 2, wherein the vertical interconnect structure includes an opening filled with a conductive paste or a polymer plug.

4. The method of claim 1, wherein the modular interconnect unit is offset from the semiconductor die.

5. The method of claim 1, wherein the modular interconnect unit has a square shape, rectangular shape, cross-shape, angled or L-shape, circular shape, or oval shape.

6. The method of claim 1, further including removing the second portion of the encapsulant to expose the modular interconnect unit.

7. A method of making a semiconductor device, comprising:

providing a plurality of individual modular interconnect units;

disposing a first individual modular interconnect unit of the plurality of individual modular interconnect units offset from a semiconductor die in a peripheral region around the semiconductor die;

depositing an encapsulant over the semiconductor die and first individual modular interconnect unit; and

removing the encapsulant to expose the semiconductor die.

8. The method of claim 7, wherein the first individual modular interconnect unit includes a core with a vertical interconnect structure formed through the core.

9. The method of claim 7, wherein the first individual modular interconnect unit has a square shape, rectangular shape, cross-shape, angled or L-shape, circular shape, or oval shape.

10. The method of claim 7, further including forming an insulating layer over a back surface of the semiconductor die prior to exposing the first individual modular interconnect unit with respect to the encapsulant.

11. The method of claim 7, wherein removing the encapsulant further includes:

removing a first portion of the encapsulant from over the semiconductor die to expose a back surface of the semiconductor die while leaving a second portion of the encapsulant over the first individual modular interconnect unit; and

removing the second portion of the encapsulant to expose the first individual modular interconnect unit.

12. The method of claim 7, wherein the first individual modular interconnect unit forms a part of an interlocking pattern around the semiconductor die.

13. The method of claim 7, further including forming an insulating layer over the semiconductor device to reduce warpage.

14. A method of making a semiconductor device, comprising:

providing a semiconductor die;

disposing a modular interconnect unit in a peripheral region around the semiconductor die and offset from the semiconductor die; and

depositing an encapsulant over the semiconductor die and modular interconnect unit.

15. The method of claim 14, wherein the modular interconnect unit includes a core with a conductive interconnect structure formed through the core.

16. The method of claim 15, wherein the conductive interconnect structure includes a metal cap and a protective layer formed over the metal cap.

17. The method of claim 15, wherein the modular interconnect unit includes multiple rows of vertical interconnect structures or bumps.

18. The method of claim 14, wherein the modular interconnect unit has a square shape, rectangular shape, cross-shape, angled or L-shape, circular shape, or oval shape.

19. The method of claim 14, further including forming an insulating layer over a back surface of the semiconductor die prior to exposing the modular interconnect unit with respect to the encapsulant.

20. The method of claim 14, further including forming an insulating layer over the semiconductor device to reduce warpage.

21. A semiconductor device, comprising:

a semiconductor die;

a modular interconnect unit disposed in a peripheral region around the semiconductor die with a height of the modular interconnect unit less than a height of the semiconductor die; and

an encapsulant deposited around the semiconductor die and modular interconnect unit.

22. The semiconductor device of claim 21, wherein the modular interconnect unit includes a core with a vertical interconnect structure formed through the core.

23. The semiconductor device of claim 21, wherein the modular interconnect unit has a square shape, rectangular shape, cross-shape, angled or L-shape, circular shape, or oval shape.

24. The semiconductor device of claim 21, wherein the modular interconnect unit forms a part of an interlocking pattern around the semiconductor die.

25. The semiconductor device of claim 21, further including an insulating layer formed over the semiconductor device to reduce warpage.

26. The semiconductor device of claim 22, wherein the vertical interconnect structure includes a conductive material and a filler material.

27. A method of making a semiconductor device, comprising:

providing a modular interconnect unit including a vertical interconnect structure; and

disposing a semiconductor die around the modular interconnect unit.

28. The method of claim 27, wherein the modular interconnect unit has a square shape, rectangular shape, cross-shape, angled or L-shape, circular shape, or oval shape.

29. The method of claim 27, wherein the vertical interconnect structure includes a first conductive material and a filler material.

30. The method of claim 29, wherein the filler material is an insulating material.

31. The method of claim 29, wherein the filler material is a second conductive material.

32. The method of claim 29, wherein the filler material is void.