METHOD OF DEPOSITING ENCAPSULANT ALONG SIDES AND SURFACE EDGE OF SEMICONDUCTOR DIE IN EMBEDDED WLCSP

Field of the Invention

The present invention relates in general to semiconductor devices and, more particularly, to a semiconductor device and method of depositing an encapsulant over the sides and an exposed portion of an active surface of a semiconductor die in a fan-out wafer level chip scale packages (Fo-WLCSP).

Background of the Invention

Semiconductor devices are commonly found in modern electronic products. Semiconductor devices vary in the number and density of electrical components. Discrete semiconductor devices generally contain one type of electrical component, e.g., light emitting diode (LED), small signal transistor, resistor, capacitor, inductor, and power metal oxide semiconductor field effect transistor (MOSFET). Integrated semiconductor devices typically contain hundreds to millions of electrical components. Examples of integrated semiconductor

Claims

What is claimed:

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

providing a substrate;

disposing a semiconductor die over the substrate with an interconnect structure of the semiconductor die between the substrate and the semiconductor die;

depositing a first encapsulant over the substrate and semiconductor die;

singulating the first encapsulant and substrate;

disposing the substrate, semiconductor die, and first encapsulant over a carrier;

depositing a second encapsulant over the substrate, semiconductor die, first encapsulant, and carrier, wherein the second encapsulant covers a side surface of the substrate and a side surface of the first encapsulant;

removing the carrier; and

singulating the second encapsulant after removing the carrier.

2. The method of claim 1, further including depositing the first encapsulant between the semiconductor die and the substrate.

3. The method of claim 1, further including:

depositing the second encapsulant to include a surface contacting the carrier; and

removing a portion of the second encapsulant to form a recess in the surface of the second encapsulant prior to singulating the second encapsulant.

4. The method of claim 3, further including removing the portion of the second encapsulant using laser direct ablation (LDA).

5. The method of claim 1, further including disposing an interconnect structure over the substrate after depositing the second encapsulant.

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

providing a semiconductor die;

providing a substrate separate from the semiconductor die;

disposing the semiconductor die over the substrate;

depositing a first encapsulant between the substrate and semiconductor die;

depositing a second encapsulant over the semiconductor die and substrate with a surface of the second encapsulant that is coplanar with the substrate; and

forming a recess in the surface of the second encapsulant.

7. The method of claim 6, further including singulating the first encapsulant and the substrate prior to depositing the second encapsulant.

8. The method of claim 6, further including depositing the first encapsulant over the semiconductor die.

9. The method of claim 6, further including forming the recess using laser direct ablation (LDA).

10. The method of claim 6, further including disposing an interconnect structure over the substrate after depositing the second encapsulant.

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

providing a substrate;

disposing a semiconductor die over the substrate;

depositing a first encapsulant between the semiconductor die and substrate and over a side surface of the semiconductor die;

singulating the substrate along with the first encapsulant after depositing the first encapsulant to create a side surface of the substrate that is coplanar with a side surface of the first encapsulant; and

depositing a second encapsulant to cover the side surface of the substrate and the side surface of the first encapsulant after singulating the first encapsulant and substrate, wherein the second encapsulant is electrically insulating and contacts a top surface of the first encapsulant.

12. The method of claim 11, further including depositing the first encapsulant over a back surface of the semiconductor die.

13. The method of claim 11, further including forming a recess in the second encapsulant.

14. The method of claim 11, further including forming an interconnect structure over the substrate opposite the semiconductor die.

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

providing a substrate;

disposing a semiconductor die over the substrate;

depositing a first encapsulant between the substrate and semiconductor die;

singulating the substrate after depositing the first encapsulant, wherein singulating creates a side surface of the substrate that is coplanar with a side surface of the first encapsulant; and

depositing a second encapsulant over the semiconductor die after singulating the substrate, wherein the second encapsulant covers the side surface of the first encapsulant and the side surface of the substrate.

16. The method of claim 15, further including depositing the first encapsulant over the semiconductor die.

17. The method of claim 15, further including forming a recess in the second encapsulant.

18. The method of claim 15, further including forming an interconnect structure over the substrate opposite the semiconductor die.

19. The method of claim 15, further including depositing the second encapsulant over a side surface of the substrate.

20. The method of claim 15, wherein the second encapsulant is electrically insulating.

21. The method of claim 15, wherein the second encapsulant contacts a surface of the first encapsulant opposite the semiconductor die.