

densify the film and establish intimate connection between the material and the connected parts. Under the applied heat and pressure, the film sinters and connects the die to the substrate. The resulting joint between the die and the substrate is metallic silver with the structure and properties shown with reference to FIG. 1.

In many semiconductor packages, an electrical connection of the device is provided through clip bonding to the top of the die. This arrangement ensures low electrical resistance of the package and improved performance compared to wire bonding. Clip bonding is done by soldering a copper clip to one or both bond pads and their corresponding leads. The process typically uses high lead solder material and requires a good control of the soldering process, especially the positioning of the die and clips during the molten phase of the solder reflow process.

SUMMARY

A process for die and clip attachment using sinterable silver films is well suited for high volume manufacturing of discrete packages. The process utilizes technology of dispensable tack agent to position the dies and clips on the lead frame before sintering. The clips can also be used in a matrix connected to a lead frame. The following sintering step can be done in any commercially available sinter press.

In one aspect of the present disclosure is directed to a method of die and clip attachment comprising: providing a clip, a die and a substrate; laminating a sinterable silver film on the clip and the die; depositing a tack agent on the substrate; placing the die on the substrate via the tack agent and the silver film; placing the clip on the die via the silver film and placing the clip on the substrate via the tack agent and the silver film to create a substrate, die and clip package; and sintering the substrate, die and clip package, wherein the tack agent provides temporary attachment of the die and the clip to the substrate

Embodiments of the present disclosure further may include laminating the sinterable silver film with an application of a pressure of 2-3 MPa or higher and a temperature of 130 °C applied for 30 seconds. The die can be laminated individually or as a whole wafer followed by dicing. The clip can be laminated individually or in the form of a copper plate followed by dicing or stamping. Laminating the sinterable silver film can be done in a lamination press capable of providing specified pressure and temperature or in a die bonding machine. The laminated die may be collected and stored in a waffle pack or on a dicing tape. The laminated clip may be collected and stored on

CLAIMS

1. A method of die and clip attachment comprising:
providing a clip, a die and a substrate;
laminating a sinterable silver film on the clip and the die;
depositing a tack agent on the substrate;
placing the die on the substrate via the tack agent and the silver film;
placing the clip on the die via the silver film and placing the clip on the substrate
via the tack agent and the silver film to create a substrate, die and clip package; and
sintering the substrate, die and clip package,
wherein the tack agent provides temporary attachment of the die and the clip to
the substrate.
2. The method of claim 1, wherein laminating the sinterable silver film
includes an application of a pressure of 0.5-20 MPa and a temperature between 100-
200 °C for less than 1 second to 90 seconds.
3. The method of claim 1, wherein laminating the sinterable silver film
includes an application of a pressure of 2-3 MPa or higher and a temperature of 130 °C
applied for 30 seconds.
4. The method of claim 1, wherein the die is laminated individually or as a
whole wafer followed by dicing.
5. The method of claim 1, wherein the clip is laminated individually or in the
form of a copper plate followed by dicing or stamping.
6. The method of claim 1, wherein laminating the sinterable silver film is
achieved in a lamination press capable of providing specified pressure and temperature or
in a die bonding machine.
7. The method of claim 1, wherein the laminated die is collected and stored
in a waffle pack or on a dicing tape.

8. The method of claim 1, wherein the laminated clip is collected and stored on the tape, reel or waffle pack.

9. The method of claim 1, wherein the tack agent is dispensed on the substrate to place and held in position the components of the package before the components have been moved to the sintering press.

10. The method of claim 1, wherein the tack agent evaporates during the sintering of the substrate, die and clip package without interference with the sintering process.

11. The method of claim 1, wherein the die is placed on the substrate with a die bonder, and secured in the position with the tack agent.

12. The method of claim 1, wherein the clip is placed on the substrate with a pick and place machine or an epoxy die bonder, and secured in the position with the tack agent.

13. The method of claim 1, wherein sintering the substrate, die and clip package includes a sintering press having a pressure tool and a heated platen.

14. The method of claim 13, wherein sintering includes an application of a pressure from 3-25 MPa and a temperature between 190-300 °C from 1-180 seconds.

15. The method of claim 13, wherein sintering includes application of a pressure of 10 MPa and a temperature of 250 °C for 60 seconds.

16. The method of claim 1, further comprising multiple clips, and wherein the clips are laminated with the sinterable silver film in a form of a matrix connected to the substrate.

17. The method of claim 16, wherein a spacing between the clips is matched to dies positioned on the substrate.