Method for a solder-in-lid IHS using multiple attachment methods

Disclosed is a method for a solder-in-lid integrated heatsink (IHS) using multiple attachment methods. Benefits include improved functionality, improved performance, and improved cost effectiveness.

Background

Conventionally, solder thermal interface material (STIM) porosity in assembled semiconductor packages can decrease thermal performance. The conventional process uses indium foil and IHS lids as separate components. The indium pick-and-place machine requires a substantial amount of floor space.

As a conventional solution, a solder-in-lid IHS is made using cold-forming. However, it has high-volume manufacturing scalability issues, including shelf-life limitations, excessive TIM spread, and process complexity. As a result, this solution is unsuccessful.

STIM voiding is reduced by creating a 6-mils to 8-mils indium bondline thickness (BLT) in the assembled package. Thinner bondlines are required to increase thermal performance.

An additional technique to reduce voiding is to modify the solder shape from a flat preform to a rounded feature, such as a hemisphere. This shape increases the solder flow, displacing flux from the interface.

The conventional process uses individual IHS-lids and indium foil. Both sides of the indium foil are bonded. Solder porosity can form at either of the interfaces during reflow (see Figure 1).

General description

The disclosed method is a solder-in-lid integrated heatsink (IHS) using multiple attachment methods.

The key elements of the disclosed method include:

- Solder preform attached to an IHS
- Multiple attachment methods

Advantages

The disclosed method provides advantages, including:

- Improved functionality due to providing a solder-in-lid IHS
- Improved functionality due to providing several attachment methods and processes
- Improved performance due to reducing STIM voiding
- Improved cost effectiveness due to decreasing the number of incoming solder and IHS parts

Detailed description

The disclosed method is a solder-in-lid IHS made using multiple attachment methods. The indium-to-die interface is reflowed and bonded, reducing STIM porosity in the assembled package (see Figure 2).

The disclosed method includes several attachment methods and processes, including the following:

- Cold welding
  - Explosive bonding
  - Ultrasonic welding
  - Cladding
- Liquid state welding
  - Gas metal arc welding
  - Gas tungsten arc welding
  - Flux cored arc welding
  - Shielded metal arc welding
  - Submerged arc welding
  - Resistance spot welding
  - Electron beam welding
  - Magnetically-impelled arc butt welding
- Use of various heating sources for reflow
  - IR
  - Induction heating
  - Convection
  - Microwave heating
- Spray coating
  - Thermal spray coatings
  - Combustion wire thermal spray coating
  - Combustion powder thermal spray coating
  - Arc wire thermal spray coating
  - Plasma thermal spray coating
  - High-velocity oxygen fuel thermal spray coating
  - Detonation thermal spray coating
  - Cold spray coatings
- Diffusion bonding
  - In a vacuum
  - In an inert atmosphere
  - In a reducing atmosphere (such as H_2 gas)

The disclosed method can be implemented using the following steps:

1. Mechanical joining
2. Solid state bonding
   a. Cold welding
   b. Diffusion bonding

    c. Forge welding
    d. Friction welding
3. Liquid state welding
    a. Resistance welding
    b. Electrical arc welding
    c. Thermal welding (chemical heat source)
    d. High energy beam welding (electron or laser beam)
4. Wave soldering
5. Reflowing of paste or a perform onto the lid (with or without flux), using various heating sources
6. Spray coating
7. Diffusion bonding of the solder to the lid
8. Transient liquid phase bonding of the solder to the lid
9. Soldering and Brazing a solder perform to the lid using a lower melting point solder (lower than the main solder)
10. Adding solder to a lid, using chemical vapor deposition
11. Chemical vapor infiltration to attach solder to the lid
12. Stencil printing of solder paste onto a lid

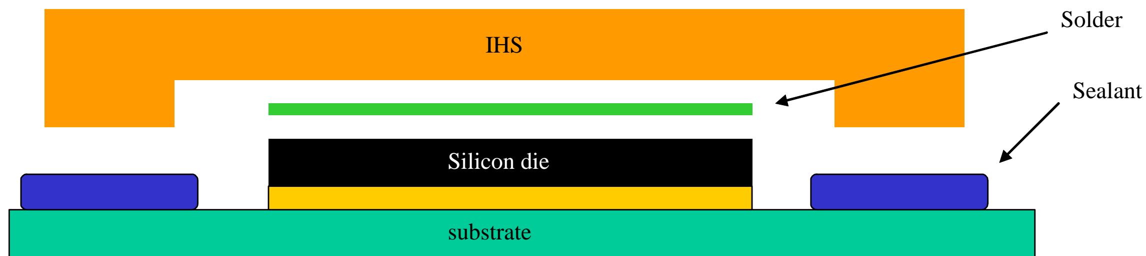

Fig. 1

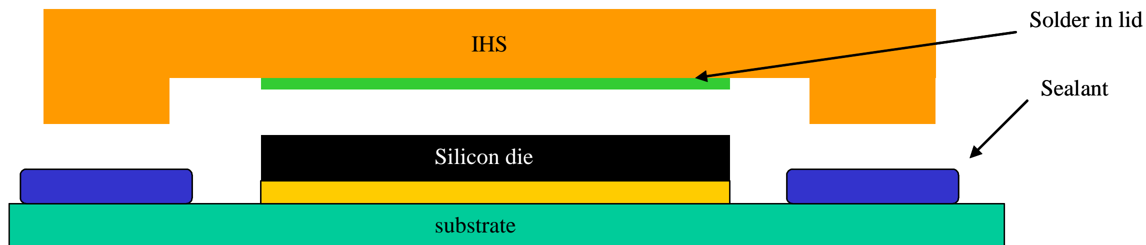

Fig. 2

Disclosed anonymously