International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Modeling Wire Bonding on Overhang Die to Ensure No Die Crack in Thin BGA Packages

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Keywords*— *Overhang die; wire bonding; die crack; thin BGA package; mechanical modeling; finite element model.

I. OVERVIEW

- In the design and development of a thin BGA (ball grid array) semiconductor package, the trend is to use thinner dies stacked one on top of another.
- In addition to challenges with handling thinner dies, the design of the die bond pad layout and package size reduction require the use of overhang die configuration as shown in Fig. 1.
- The wire bonding capillary applies force (30 gf) to the bond pad on the end of the overhang die (70 µm thickness) to bond the wire for electrical connection.

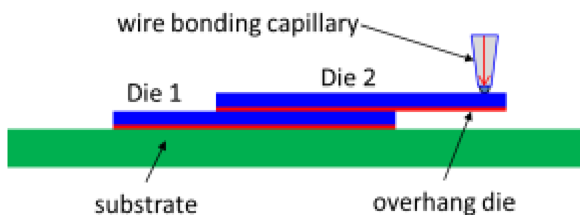

Fig. 1. Stacked overhang die.

II. MODELING WIRE BONDING

- With overhang die configuration, there is risk of die crack occurring when force is applied during wire bonding.
- Modeling using finite element method (Fig. 2) was conducted to ensure that the thin overhang die would not break or crack. Different values of force were also used to determine the wire bonding force at which crack would happen.

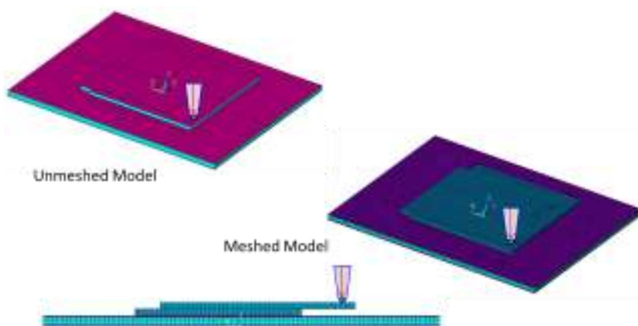

Fig. 2. Finite element model

III. MODELING RESULTS AND FINAL ASSESSMENT

- Modeling shows that maximum die stress (indicated in red arrow, Fig. 3) occurs in the die area above the bottom die.
- The induced die stress in the overhang die due to the wire bonding force applied is still well below the die strength (i.e. the stress at which die breaks). This implies that no die crack is expected with the given force and overhang die configuration.

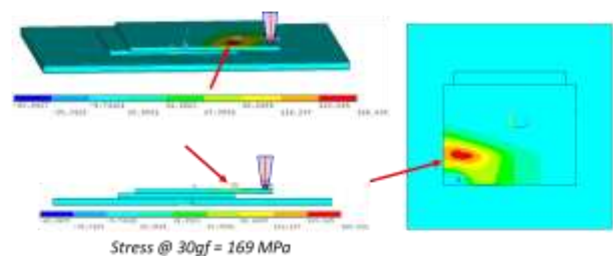

Fig. 3. Die stress result.

- Die stress results with different force values (Fig. 4) indicate that the existing wire bond force of 30gf would induce overhang die stress of 169 MPa, which is far below the minimum die strength of 350 MPa.
- Results also show that the overhang die would only start to break when the wire bonding force is increased to 62gf.
- Therefore, the 30gf wire bonding force is very safe and this is validated and supported by data showing no due crack during actual wire bonding process.

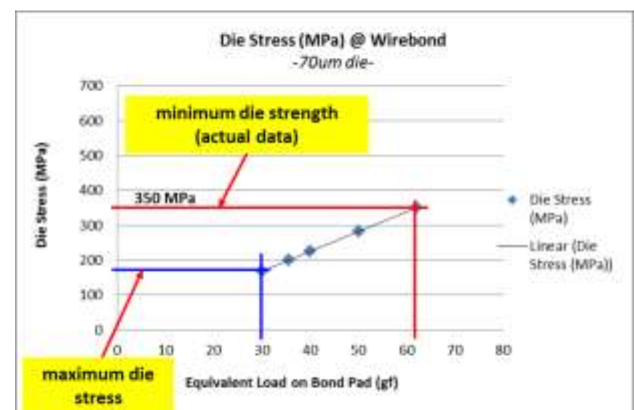

Fig. 4. Force vs maximum die stress.

Jefferson S. Talledo, "Modeling wire bonding on overhang die to ensure no die crack in thin BGA packages," *International Research Journal of Advanced Engineering and Science*, Volume 4, Issue 3, pp. 569, 2019.