

Understanding the Strip Warpage Failure Mechanism After Die Attach Cure

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I. OVERVIEW

- With the need to use thinner laminate substrates and thinner dies, package assembly becomes very challenging.
- During the die attach process, die is bonded to the substrate in array format as shown in Fig. 1.
- After the thin die is attached to the thin substrate, the whole strip is placed in a die attach cure oven.

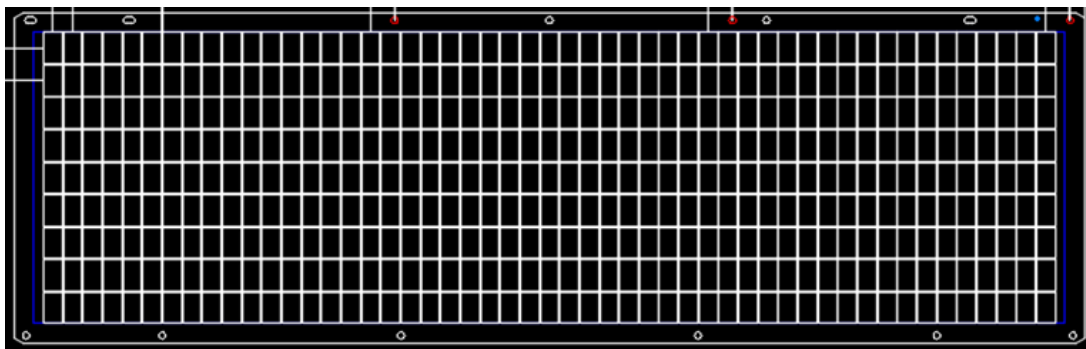


Fig. 1. Substrate strip in array format.

II. PROBLEM IDENTIFICATION

- Excessive strip warpage was encountered after the die attach cure process as shown in Fig. 2.
- When there is excessive strip warpage, the assembly process could encounter machine errors or the strip might be damaged or crumpled.

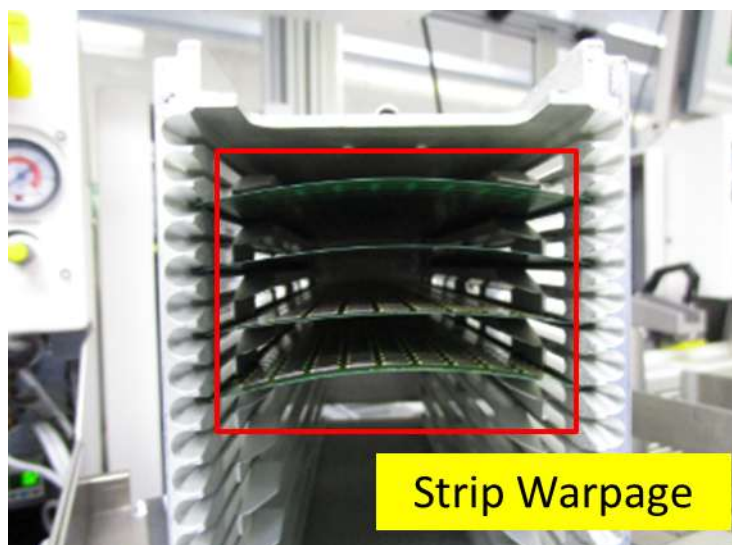


Fig. 2. Excessive strip warpage observed after die attach cure.

III. STRIP WARPAGE MODELING

- Strip warpage modeling was performed using finite element method to understand the strip warpage failure mechanism after die attach cure process.

- To minimize modeling computation time, a strip slice was used as shown in Fig. 3.

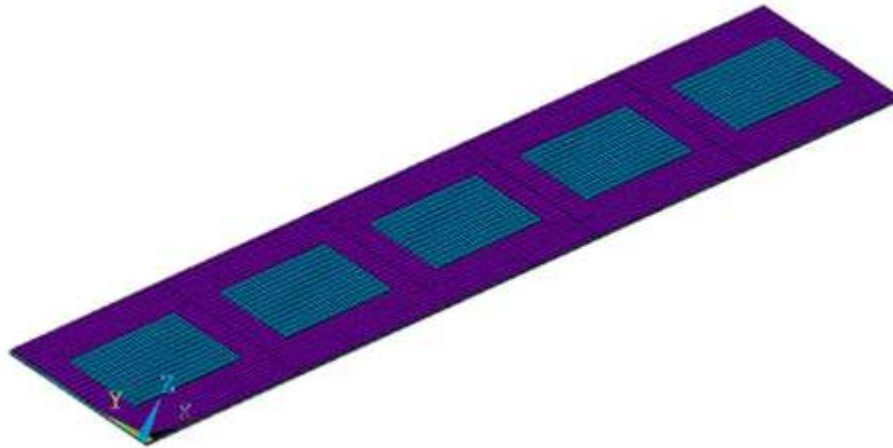


Fig. 3. Finite element model of the substrate strip slice with die already bonded.

IV. MODELING RESULT AND EXPLANATION OF THE FAILURE MECHANISM

- Actual strip warpage was in agreement with modeling result and provided a validation to the created model.
- With the die attached on the bonding side of the substrate, a “frowning” warpage was observed after die attach cure process as shown in Fig. 4.

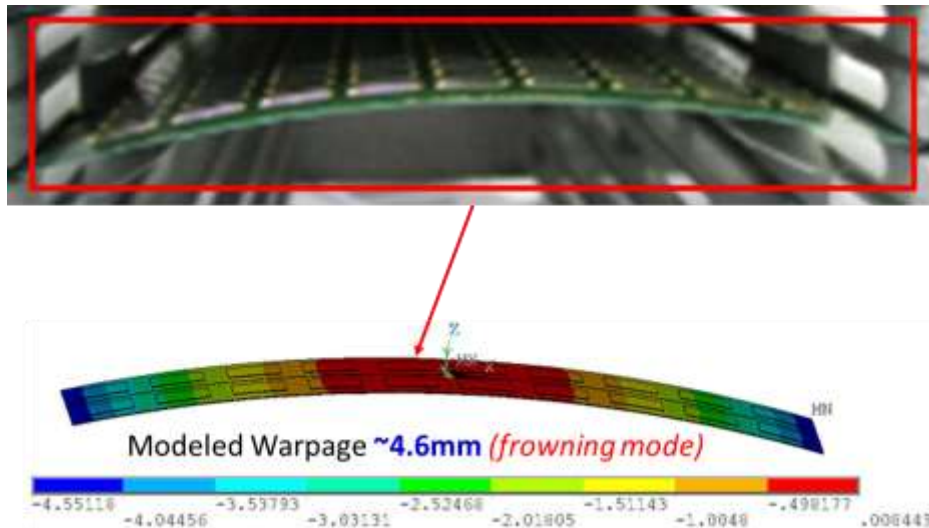


Fig. 4. Strip warpage based on the modeling and compared with actual warpage.

- As supported by modeling, the strip warpage happens after cool down from die attach cure oven temperature to room temperature as shown in Fig. 5.
- At die attach cure temperature, the strip is relatively flat (approximately zero warpage).
- However, during cool down, the substrate contracts more than the silicon die since the substrate CTE (coefficient of thermal expansion) is higher than that of the silicon die.
- As the die-bonded strip contracts, a “frowning” warpage is formed.
- The warpage becomes higher with thinner dies due to the reduced mechanical resistance of the die to the contraction force of the substrate that tends to deform or warp the whole strip.

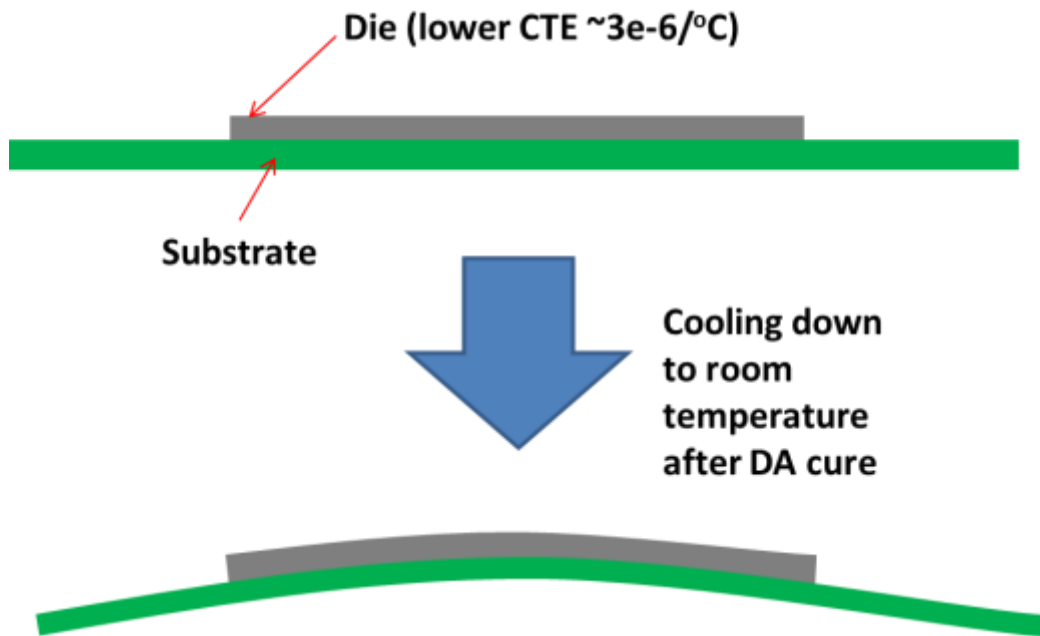


Fig. 5. Strip warpage failure mechanism.