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Modeling Study on Die Attach Glue Voids in Very Thin Smart Card Module

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I. Overview

- A very thin smart card module considered in this study uses die attach glue to bond the thin silicon die to the leadframe die pad as shown in Fig. 1.
- The metal leadframe in a continuous reel format is so thin that it already becomes flexible.
- After die attach and wire bonding, the module is molded with epoxy molding compound or resin using a high pressure molding equipment.

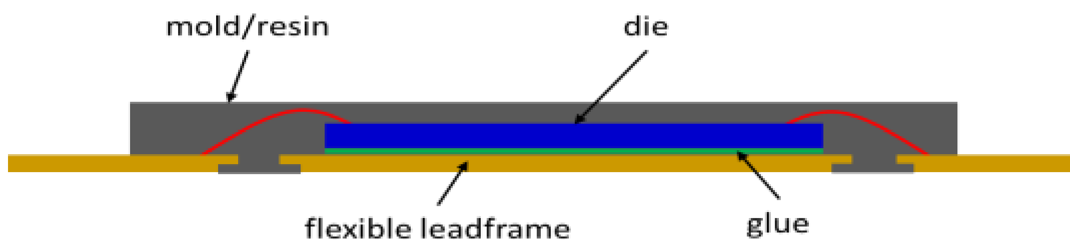

Fig. 1. Smart card module.

II. Problem Identification

- After the assembly of the smart card module, failure was encountered and die crack was observed in the bottom area of the die as manifested in Fig. 2.
- From failure analysis, it was established that glue void was also present at the location where die crack was seen.

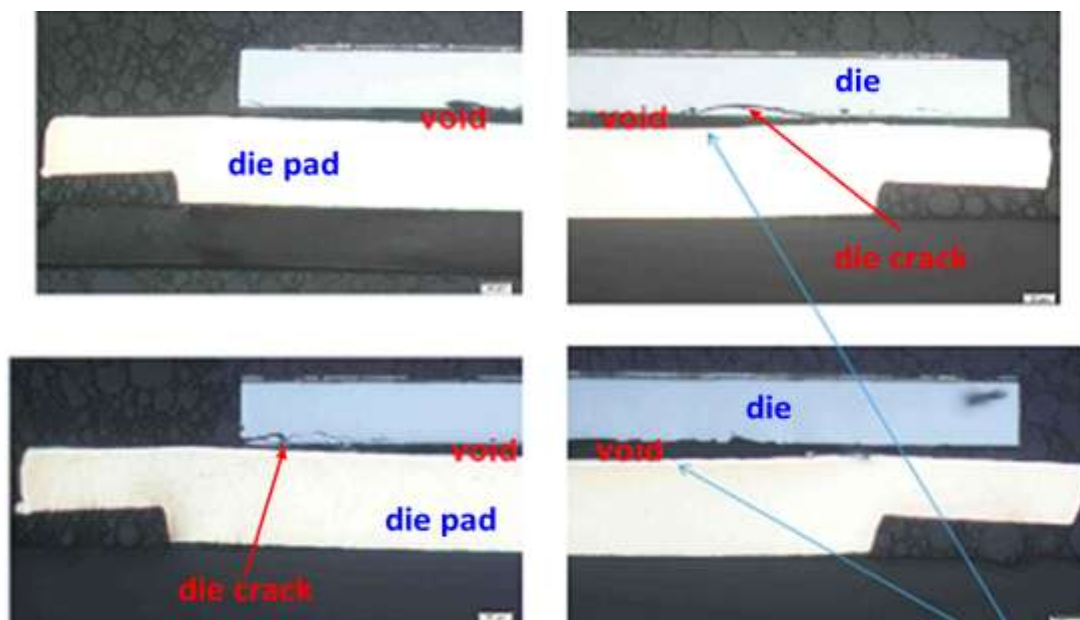

Fig. 2. Glue voids/gaps between the die and die pad; die cracks at the location of the voids.

III. Finite Element Modeling

- Finite element modeling was conducted to assess the stress levels with different percentages of glue coverage.
- The voids are the areas with no glue present or they are the empty spaces between the die and leadframe die pad when there is incomplete glue coverage.
- Four different models were analysed and silicon die stress was extracted.

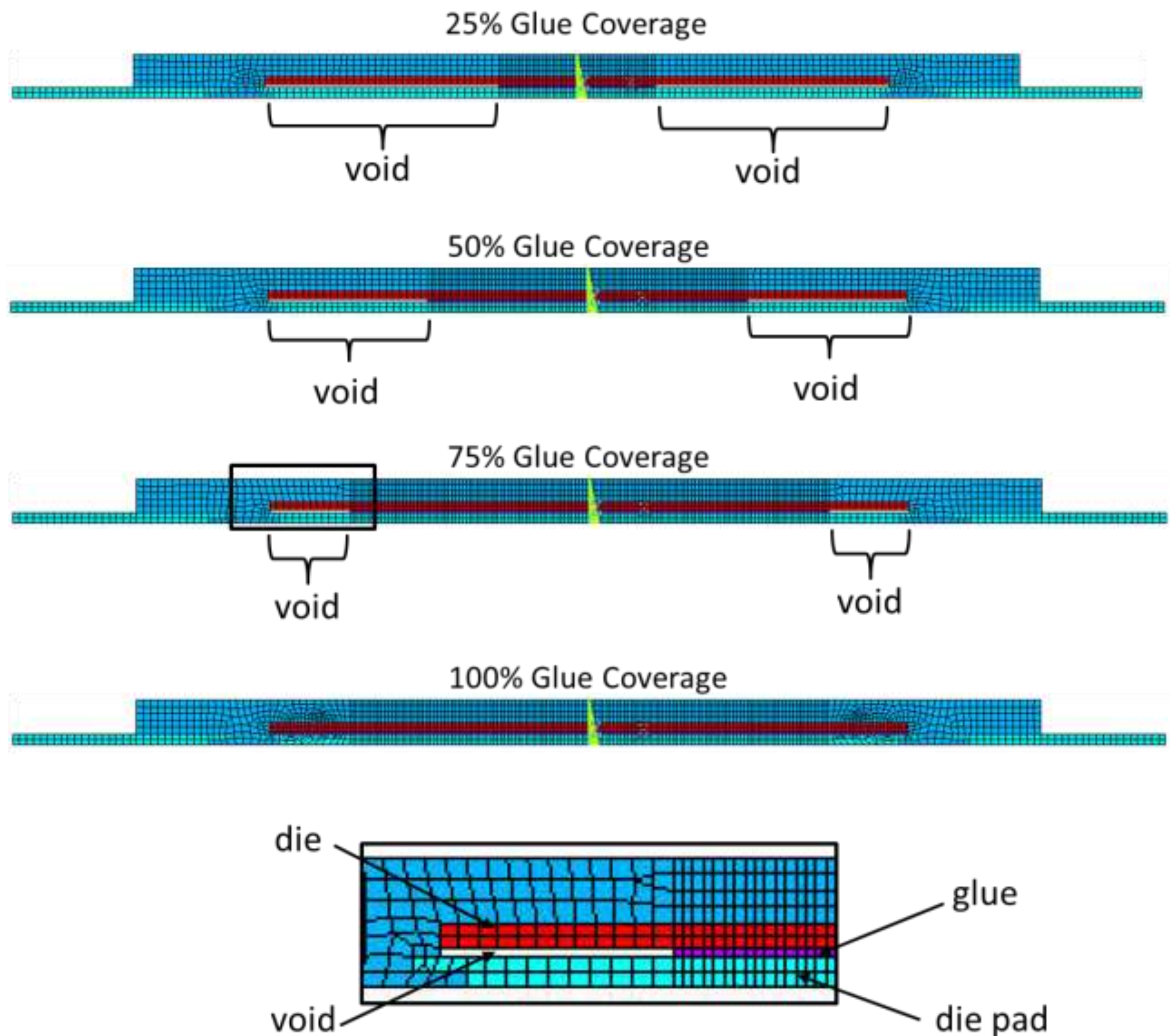

Fig. 3. Finite element model of the very thin smart card module.

IV. Process Solution and Improvement

- Based on the modeling results (Fig. 4), lower glue coverage percentage does not increase thermo-mechanical die stress as package is cooled down from molding temperature to room temperature.
- However, during the molding process, there is a significant increase in the silicon die stress as the glue coverage goes down as shown in Fig. 5.
- This implies that the high molding pressure is inducing significantly higher die stress when there is not enough glue under the die.

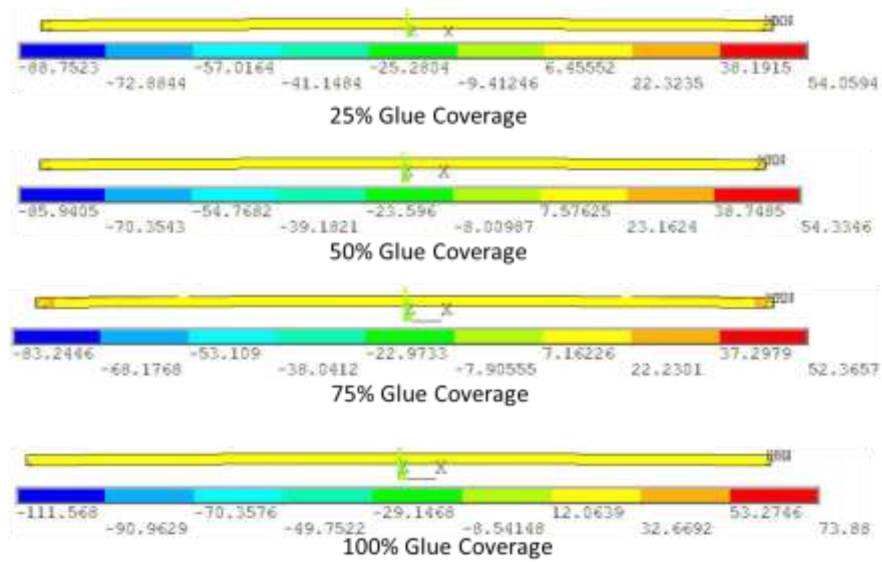

Fig. 4. Modeling result of the thermo-mechanically induced stress in the die due to CTE (coefficient of thermal expansion) mismatch.

- The location of maximum die stress also coincides with the actual die crack location and further validates that voids or incomplete glue coverage results in high die stress during the molding process.
- Based on the analysis, it is clear that die crack could be eliminated by preventing incomplete glue coverage or glue voids. This could be done by improving the die attach process.

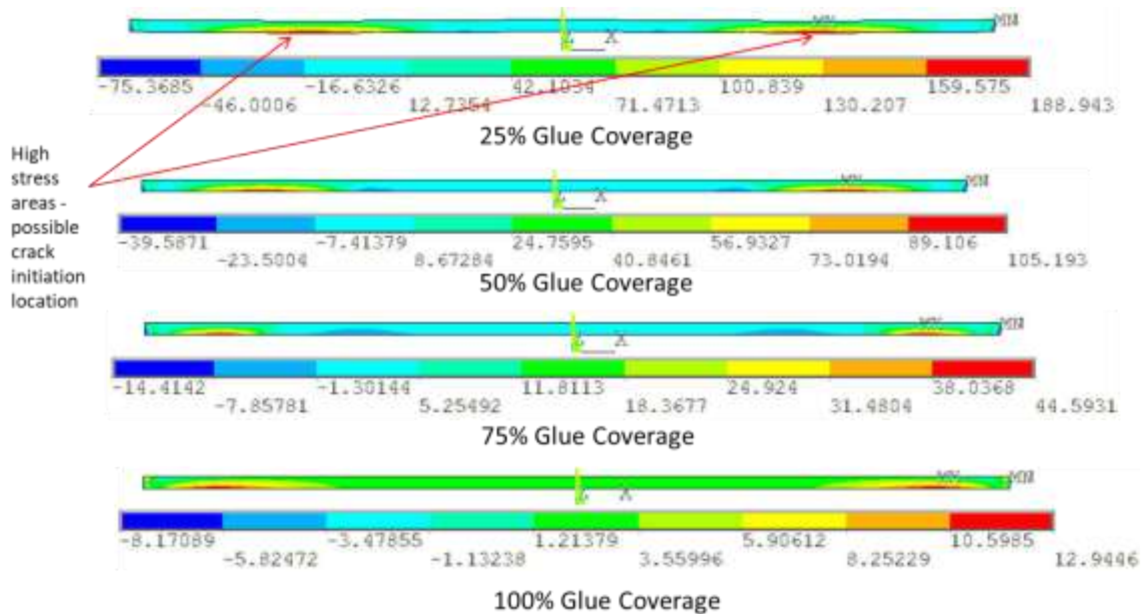

Fig. 5. Modeling result of the die stress induced due to high molding pressure applied during module molding or encapsulation.