Using a Normalized Stress Index in Solving Die Attach Glue Crack Problem

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I. OVERVIEW

- QFN (quad flat no lead) package is a popular type of leadframe-based semiconductor package. The silicon die is attached to the leadframe die pad using die attach glue material as shown in Fig. 1.
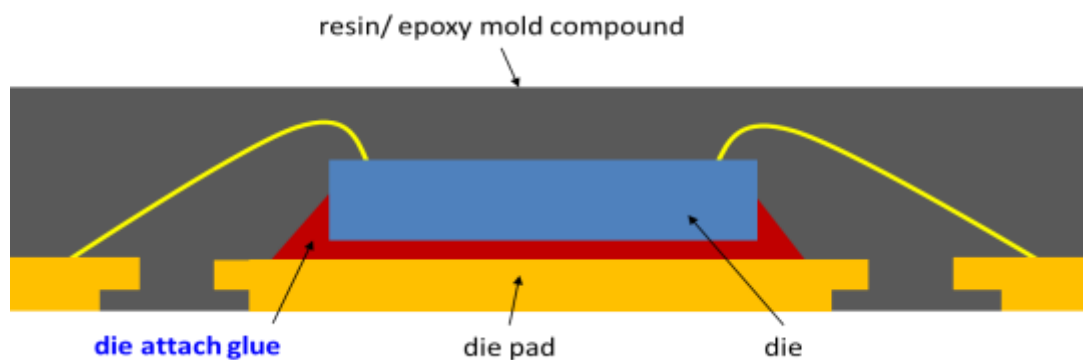

Fig. 1. QFN package.

- The whole package is composed of materials having different CTEs (coefficients of thermal expansion) causing stress during temperature changes (e.g. thermal cycling).

II. PROBLEM IDENTIFICATION

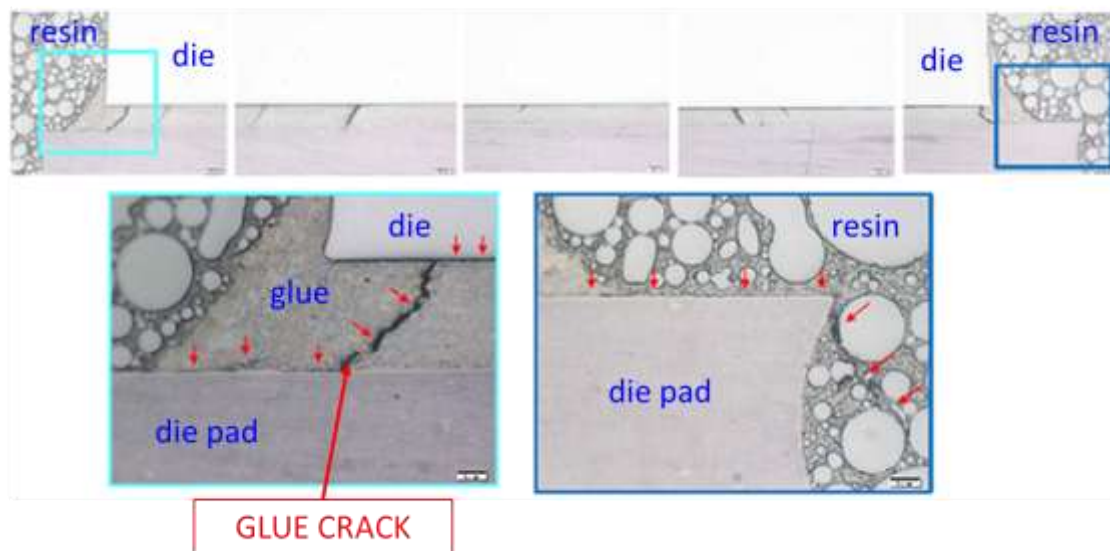- Glue crack was seen in a QFN package after thermal cycling as indicated in Fig. 2.

Fig. 2. Die attach glue crack observed after thermal cycling.

- It was also noticed that there was no delamination that initiated at the die pad edge interface.

- However, it seemed that the glue crack propagated towards the die pad edge.

III. STRESS ANALYSIS

- To effectively understand the mechanism of glue crack, finite element analysis (FEA) was conducted considering temperature loading.
- Glue stress was analysed to determine the location of maximum stress and compare with the actual glue crack.
- As shown in Fig. 3, maximum stress is coinciding with the location of the actual glue crack.
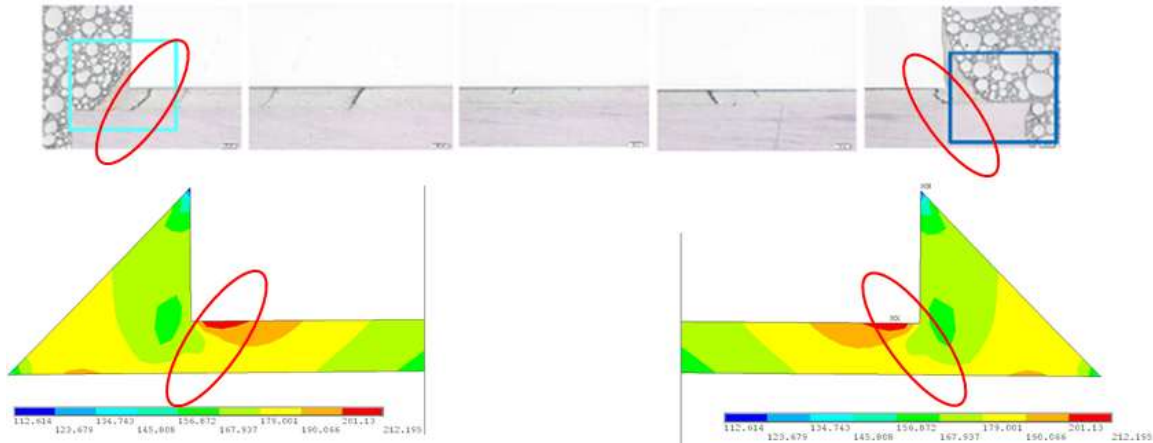

Fig. 3. Stress analysis result showing location of maximum glue stress coinciding with the glue crack location.

IV. PACKAGE DESIGN SOLUTION AND IMPROVEMENT

- Since the stress analysis confirmed that the glue crack was induced by thermal cycling, different types of glue materials for the package design solution were then explored and analyzed.
- With the existing glue material (A) that had the glue crack problem, two additional glue materials (B and C) were used in the stress analysis and the glue stress result was normalized against the corresponding adhesion strength (die shear strength). The lower the stress index, the better.
- From the normalized stress index comparison (Fig. 4), it shows that glue material C is the best solution.
- After implementing the change in glue material, no more glue crack was encountered and the problem was solved, which validated the effectiveness of using the normalized stress index.
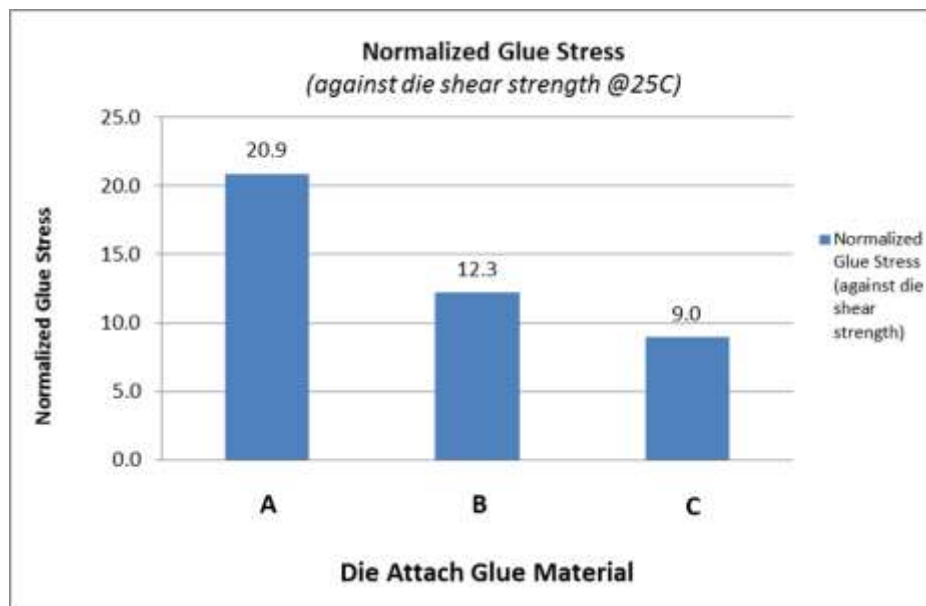- The solution would have been wrong if the glue stress was not normalized against the strength.

Fig. 4. Comparison of the normalized glue stress index.