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Analyzing Failure in a Micromodule Package using Stress Modeling Approach

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I. Overview

- A micromodule package considered here uses potting compound as encapsulation material.
- Protected by the potting is an IC (integrated circuit) silicon die attached to the substrate as shown in Fig. 1.

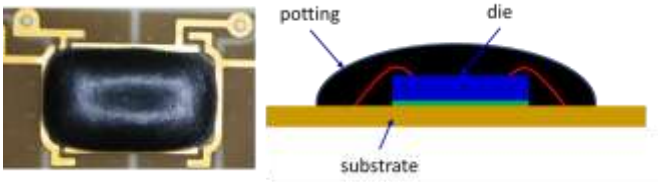

Fig. 1. Micromodule package with potting.

II. Problem Identification

- An electrical failure was reported and subsequent inspection of the package did not show any potting or encapsulation crack.
- However, circular die crack was discovered after package decapsulation of the failing units as displayed in Fig. 2.

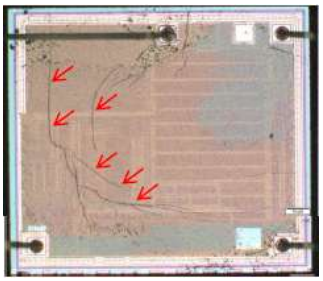

Fig. 2. Circular die crack.

III. Stress Modeling

- Mechanical modeling using finite element method was conducted with different loading conditions throughout the assembly process to identify the root cause of the die crack encountered.
- Fig. 3 shows one of the conditions in which an external force is applied to the top surface of the potting.

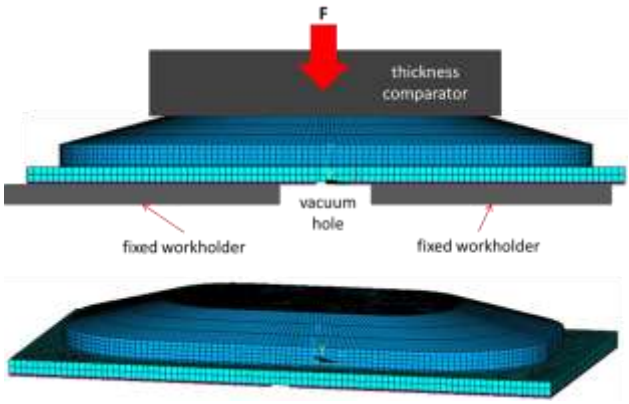

Fig. 3. Package finite element model.

IV. Process Solution and Improvement

- Stress result in Fig. 4 shows that one of the modeled loading conditions produces stress that matches well with the die crack signature observed.
- It was found out that the vacuum hole of the fixed workholder or support plate and an excessive force applied at one of the assembly process steps induces such die crack.
- Die stress reached the die fracture strength before the potting stress reached its breaking strength so that no potting crack was seen.
- With the root cause found and confirmed with stress modeling, corrective action to reduce and regulate the applied force or prevent excessive package compression at the assembly station identified was implemented to eliminate die crack.

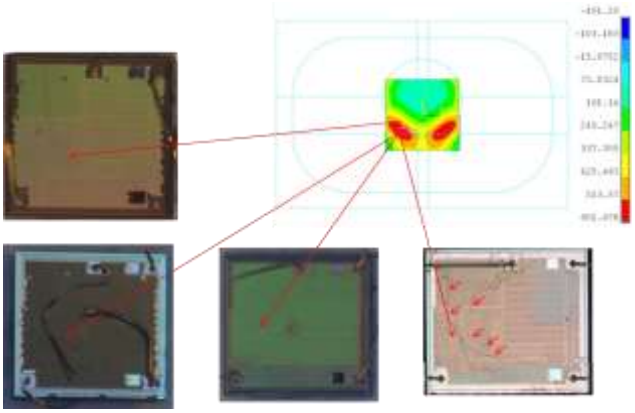

Fig. 4. Stress analysis result showing location of maximum die stress and mapping with actual die crack.

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