

Stress Transmission During Punching Operation of a Smart Card Module

Jefferson S. Talledo

Central Engineering and Development NPI, Back-End Manufacturing & Technology, STMicroelectronics, Inc.
Calamba City, Laguna, Philippines 4027

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I. OVERVIEW

- A smart card module considered here has a flexible leadframe in continuous reel format.
- Punching is needed to isolate distinct contact areas as shown in Fig. 1.

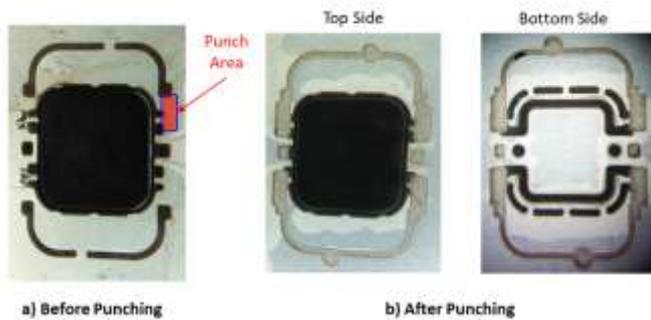


Fig. 1. Smart card module.

II. PROBLEM IDENTIFICATION

- A smart card module damage was encountered during manufacturing.
- The damage was in the form of a resin crack at the resin edge and a silicon die crack as indicated in Fig. 2.

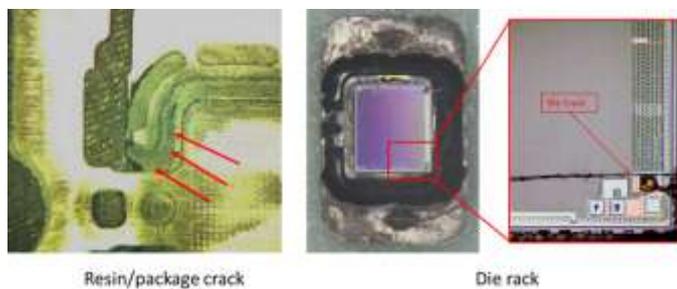


Fig. 2. Module damage.

III. FINITE ELEMENT ANALYSIS (FEA)

- Possible sources of stress causing the module damage were investigated.
- Finite element analysis was then conducted to assess the stress transmission and location of high stress induced by punching operation, which was the manufacturing step most likely to cause the problem.

- A punching operation was simulated on a finite element model of the module structure as shown in Fig. 3.

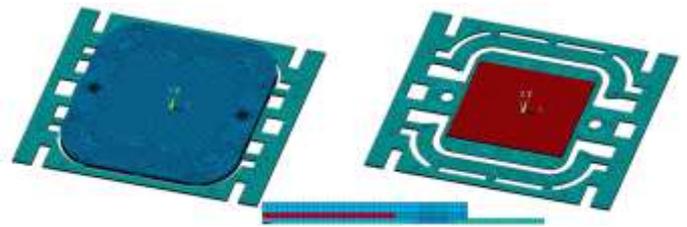


Fig. 3. Finite element model of the smart card module.

IV. PROCESS SOLUTION AND IMPROVEMENT

- Fig. 4 shows that the punching operation causes transmission of the stress to the resin edge and then to the silicon die inside the resin.
- Finite element analysis result was able to demonstrate that the punching operation was the one causing high stress to the module areas where the damage was also observed.
- From the FEA result, it is clear that the punching operation needs to be improved such that the stress transmission is minimized by ensuring that leadframe shear cutting is the main mechanism at play (good clamping, tight clearance between punch tool and die hole, punch tool not worn out).

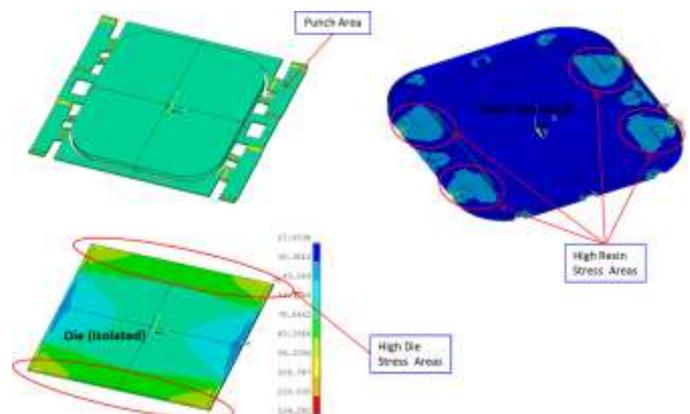


Fig. 4. Contour plots showing the stress transmission and location of high stress for the resin and the silicon die.