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Maintaining Acceptable Level of MEMS Strip Warpage through Package Thickness Control

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Keywords— *MEMS strip warpage; package thickness control; model validation; finite element modeling.*

I. OVERVIEW

- MEMS (micro-electro-mechanical system) semiconductor package is assembled in a single panel large substrate strip format as shown in Fig. 1.
- Package molding or encapsulation is done using compression molding process.

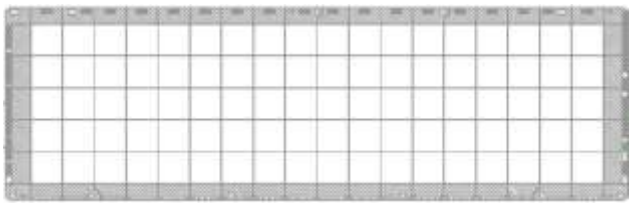

Fig. 1. Single panel large substrate strip for MEMS package.

II. PROBLEM IDENTIFICATION

- Strip warpage is a common problem when molding a MEMS package in a single panel substrate configuration.
- With higher level of strip warpage, there would be difficulty in processing the strips as it would cause machine errors during assembly.
- Other related problems like package crack could also be encountered.

III. WARPAGE MODELING

- Warpage modeling was conducted to analyze the impact of package thickness.
- The modeling would simulate the strip warpage after cool down from molding or post mold cure (PMC) temperature to room temperature.
- The MEMS package modeled using finite element modeling technique is shown in Fig. 2.
- Shorter strip slice was used due to the large number of elements involved.
- The whole strip warpage warpage was then calculated using curve fitting of the strip slice model results.

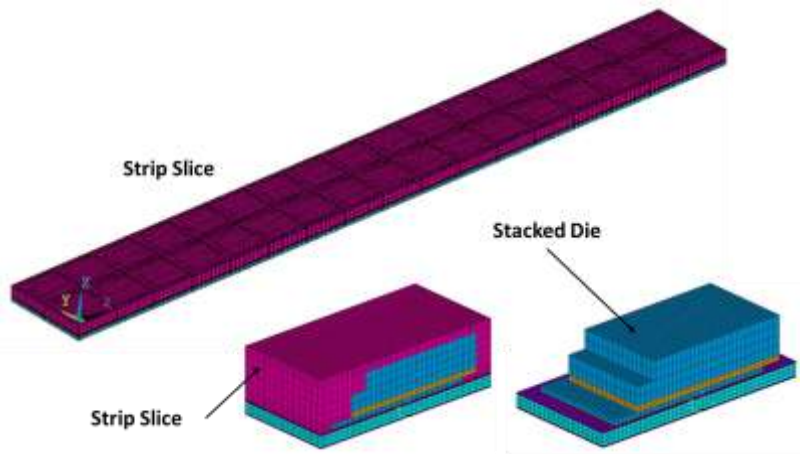

Fig. 2. Finite element model of the MEMS package molded strip.

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IV. Process and Package Improvement Solution

- Based on the results shown in Fig. 3, the predicted strip warpage is around 3.31 mm for a 0.985 mm package thickness and this is closely correlated to the actual strip warpage measured.
- Fig. 4 also shows that modeling results are very close to actual measured warpage and this implies that the model is quite accurate as supported by such model validation with actual data.
- It could be observed that strip warpage is lower with thicker package.
- This means that strip warpage could be maintained at an acceptable or lower value by controlling the package thickness
- The lower warpage could be achieved by targeting the higher side of the package thickness range or producing thicker MEMS package but still within the package thickness specification or tolerance.

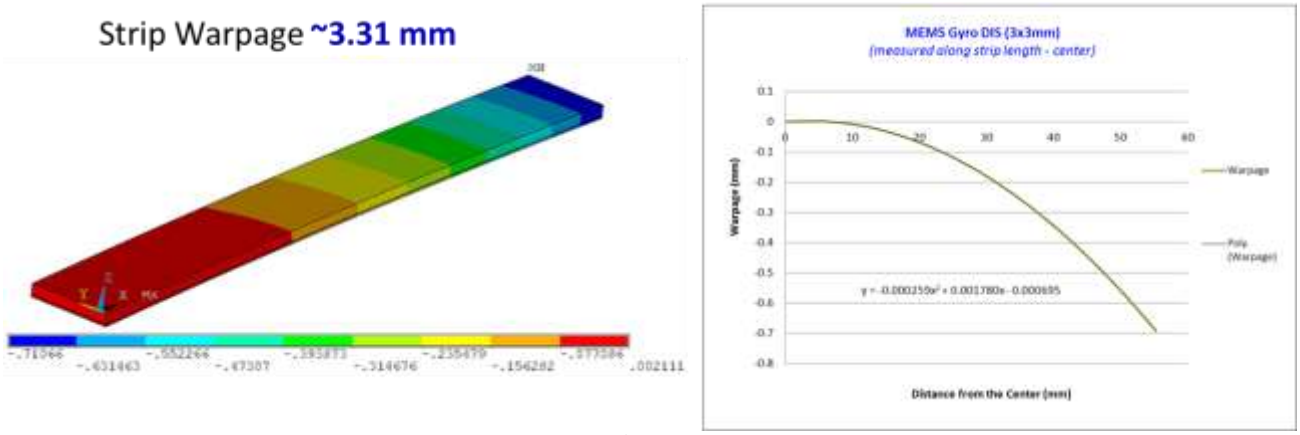

Fig. 3. Strip warpage modeling result for a MEMS package thickness = 0.985 mm.

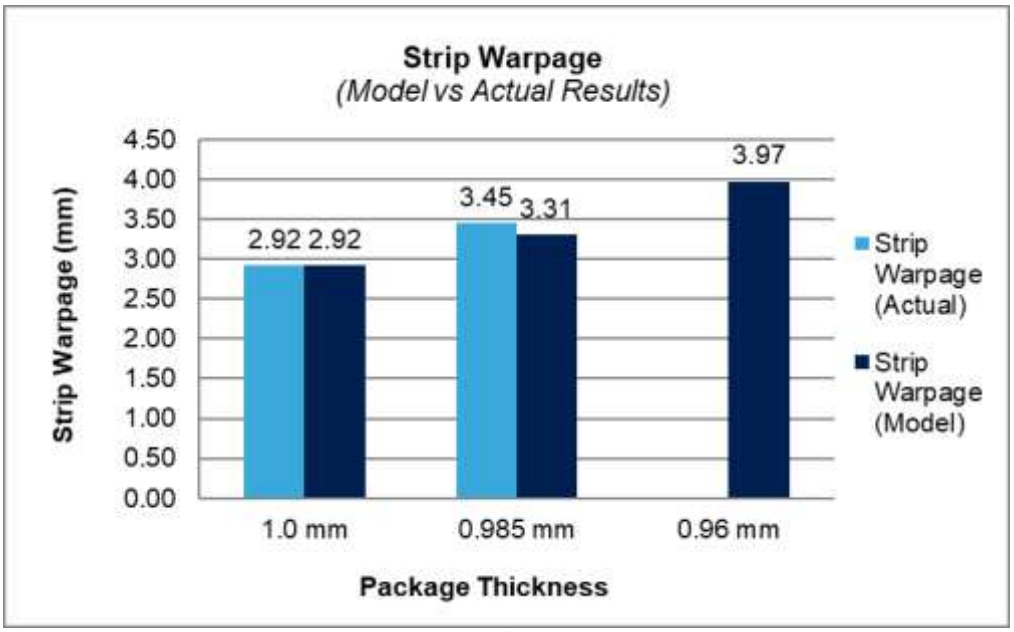

Fig. 4. Comparison of strip warpage results.

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