Optimization of Dispensing Parameter to Eliminate the Excessive Epoxy Dispense in Die Attach

Michael D. Capili1*

1STMicroelectronics Inc., Philippines.

Author’s contribution
The sole author designed, analyzed, interpreted, and prepared the manuscript.

ABSTRACT
Excessive epoxy flow on the dispensing nozzle may result in epoxy tailings due to unoptimized dispensing parameters. This may cause various problems related to epoxy dispensing, such as epoxy splatter, epoxy on lead, and epoxy bridging. This research study is conducted to eliminate the cause of epoxy related defects. Optimization of dispensing parameter using Design of Experiment as a methodology to reduce the excessive epoxy PPM rate. And base on the DOE main effect plot, excessive epoxy dispense PPM reduces as Snuffback time increases or faster.

Keywords: Die attach; epoxy splatter; excessive epoxy.

1. INTRODUCTION
The Die attach process, also known as die bonding, is the process of attaching (or bonding) a die (or chip) to a substrate, leadframe, or another die [1]. This process can take on many forms and can be applied in many ways. The common die attach material is Epoxy [2].

Epoxy dispensed through a dispensing needle or nozzle by controlling volume on the substrate [3]. The location of the dispensing is controlled by the vision control system in the die attach equipment as illustrated in Fig. 1.

The excessive epoxy flow on the dispensing nozzle may result in epoxy tailings [4], as shown in Fig. 2, due to unoptimized dispensing parameters. This may cause various problems related to epoxy dispensing, such as epoxy splatter, epoxy on lead, and epoxy bridging [5].
This study is conducted to eliminate the cause of epoxy related defects.

**Fig. 1. Epoxy dispense process**

**Fig. 2. Excessive epoxy tailing failure mechanism**

**2. PROBLEM DEFINITION**

Epoxy Tailing is the excessive epoxy volume during the dispensing process [4] as shown in Fig. 3. And this excess of epoxy will splatter to leads, die, and pad as shown in Fig. 4. Epoxy Spatter was induced during the epoxy dispense pattern on the leadframe extending from the center to lead.

**Fig. 3. Excessive epoxy / epoxy spatter**

**Fig. 4. Excessive epoxy at EOL visual inspection**

**3. METHODOLOGY**

One of the solutions is to optimize the Epoxy dispensing parameter. Below is the Diagram of experimental research using Design of Experiment (DOE) [6] shown in Fig. 5.

**Fig. 5. Diagram of experimental study**

What is Design of Experiments (DOE)? Design of experiments (DOE) [7] is defined as a branch of applied statistics that deals with planning, conducting, analyzing, and interpreting controlled tests to evaluate the factors that control the value of a parameter or group of parameters. DOE is a powerful data collection and analysis tool that can be used in a variety of experimental situations.

It allows for multiple input factors to be manipulated, determining their effect on a desired output (response). By manipulating multiple inputs at the same time, DOE can identify important interactions that may be missed when experimenting with one factor at a time. All possible combinations can be investigated (full factorial) or only a portion of the possible combinations (fractional factorial).

A strategically planned and executed experiment may provide a great deal of information about the effect on a response variable due to one or more factors. Many experiments involve holding certain factors constant and altering the levels of another variable.
Input Variables are the Burst Time, Standby Height to Leadframe, Process Speed, and Snuffback Time. There are the factors that can induce excessive epoxy if not controlled on an optimized setting. Below is the table for Summary of Design of Experiment (DOE) [8,9] shown in Table 1.

Table 1. Design of the experiment

<table>
<thead>
<tr>
<th>Input variable</th>
<th>Parameter range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burst time</td>
<td>20 to 90</td>
</tr>
<tr>
<td>Standby Ht to LF</td>
<td>9 to 10</td>
</tr>
<tr>
<td>Process speed</td>
<td>35 to 50</td>
</tr>
<tr>
<td>Snuffback time</td>
<td>-10 to -30</td>
</tr>
</tbody>
</table>

4. RESULTS AND DISCUSSION

Based on the Pareto and Normal probability plots in Fig. 6, the main significant predictor is Snuffback time [10].

Based on Minitab Factorial Regression [8] in Table 2, the R-sq (adj) of the model is equal to 90.98%, which means a strong linear trend among factors and the response variable. And the P-value = 0.000 the model is significant for predicting the variability of the response variable [11,12].

In Fig. 7, based on the main effect plot, Excessive Epoxy PPM reduce as Snuffback time increases or faster.

Fig. 6. Pareto and normal probability plot

Fig. 7. Main effect plot for Epoxy on Leads

Fig. 8. Regression test
A regression test was performed to validate if Snuffback time would induce Excessive Epoxy on Leads compared to Fast Snuffback time in Figure 8. In statistical modeling, regression analysis is a set of statistical processes for estimating the relationships between a dependent variable and one or more independent variables. There is a strong positive relationship between Snuffback time and EOL PPM due to Excessive epoxy as indicated by the correlation value 82% changed in EOL PPM can be explained by the Snuffback time Linear Fit on Snuffback time is -32.29 ms near to setting.

5. CONCLUSION

The decrease in the value of Snuffback time (-) would result in an earlier end of the pressure pulse and an earlier deceleration of the writing pattern. Excessive Epoxy reduces while the dispenser is moving upward. Increase in value of Snuffback time (+) will result in the late end of pressure pulse and late deceleration on writing patterns. Glue tailing exists while the dispenser is moving upward.

DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Author has declared that no competing interests exist.
REFERENCES

5. Novin Yap, Caloy Hennosura, Freddie Pascual, Elimination of epoxy bridging in diebond process. ON Semiconductor Philippines Inc.
13. Rehman M. Khan. Problem solving and data analysis using minitab: A clear and easy guide to six sigma methodology.

© 2021 Capili; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/63863