

Innovative Approach Controlling the Epoxy Fillet Height for Thinner Die

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I. OVERVIEW

There is a clear trend in the semiconductor packaging industry towards the use of thinner die, and reduced size packages, driven mainly by higher functionality of hand-held and portable devices. This trend causes some challenges to the use of traditional die attach paste adhesives, as the paste spreads to form a fillet, and also risks the adhesive flowing into the top of the die. At the same time, demands for electrical and thermal performance together with reliability are increasing. What’s more, manufacturing yield continues to be crucial to control costs. Also semiconductor packaging apparatus for preventing cracking and delamination in a packaged semiconductor chip by controlling the die attach fillet height.

Controlling the epoxy fillet height was not easy in Die Attach process specially for the thinner die thickness. This paper summarizes most recent learning's pertaining to the thin die bonding process, on how to achieve and control the fillet height during Die Attach as showed in figure 1.

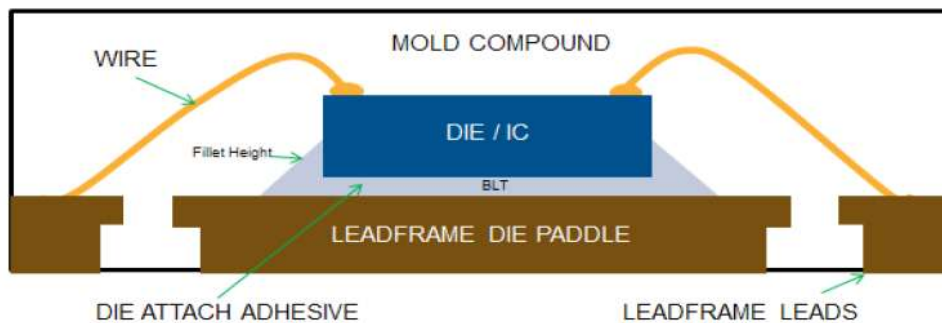


Fig. 1. Cross-section drawing of a QFN package

Die attach fillet is an excess die attach adhesive climbing on the edge of the die during die attach process. The basic purpose of this die attach fillet is to anchor or provide mechanical strength along the die edges. Fillet height is being measured in percentage of the epoxy glue height relative to the die thickness as illustrated in Figure 2.

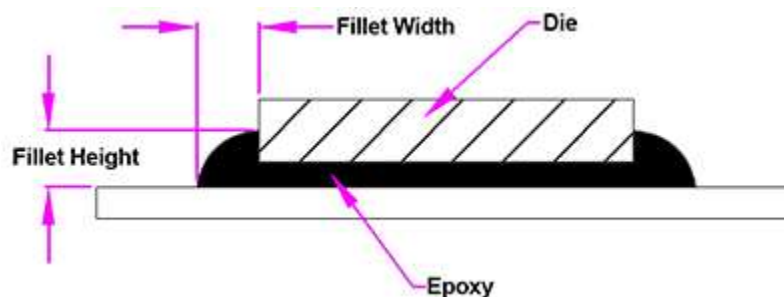


Fig. 2. Fillet Height illustration

II. PROBLEM IDENTIFICATION

Picking and bonding thin die, presents new challenges to the die bonder industry. The problems in achieving and controlling the epoxy fillet height for thin die and also risks the adhesive flowing into the top of the die as showed in figure 3. Common criteria or requirement for Good Fillet Height is less than 75% of Die thickness as showed in figure 4.

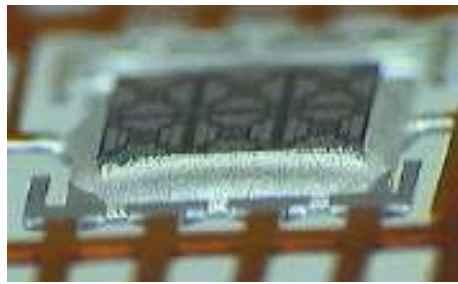


Fig. 3. Excessive epoxy fillet height



Fig. 4. Good epoxy fillet height

III. ASSEMBLY PROCESS IMPROVEMENT

One of the solution is to explore the effectivity of Wafer sawing cutting method. Wafer sawing is a cutting process which separate dies from a piece of wafer. The sawing process can be done by mechanical or laser process. The area that has been cut away during sawing process is called sawing street. Common cutting method is Single Cut; the work piece is severed by a single full cut in only one process step. It is performed by single or dual spindle dicing saws to reduce the process time.

The Step Cut is performed by dual spindle dicing saws. Each spindle is equipped with a different dicing blade. This process is a solution to many problems currently faced (e.g. backside chipping) and can be integral in achieving an acceptable process for many different applications and wafer singulation as illustrated in figure 5.

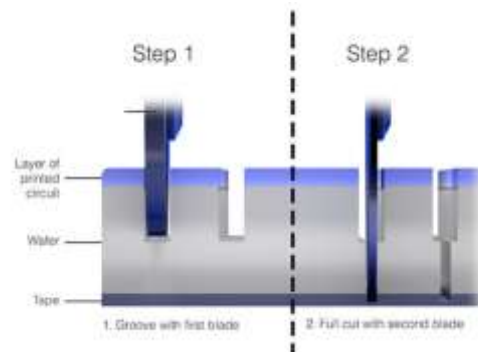


Fig. 5. Wafer Sawing Step Cut

We want to explore Step cut ratio on thin dice at wafer sawing station, if can help to control the epoxy to achieve the required fillet height 25~75% of die thickness. As a result, using Saw Step Cut Ration 60/40 showed fillet height (25%-75%) after DA Cure is more achievable as shown in figure 6. The cutting saw line will serve as stopper to control epoxy flowing on the die side wall onto the die top.

At Die Attach process we want to explore other epoxy dispense pattern to resolve fillet height and insufficient epoxy. Dispensing pattern is very important during the die attach process. The key difficulty is that the square shape of the die is not easy for full filling. There are three criterions to judge a proper dispensing pattern: (1) Fillet Height; (2) little or no contamination on die top; (3) epoxy coverage after Die attach cure.

In experiment, Cross dispensing pattern and Asterisk dispensing pattern was observed heavy wavy fillet coverage, as shown in figure 7. In the simulation, the results shown; Double Cross epoxy dispensing pattern will result to control fillet high and full epoxy coverage.

Step cut ratio:

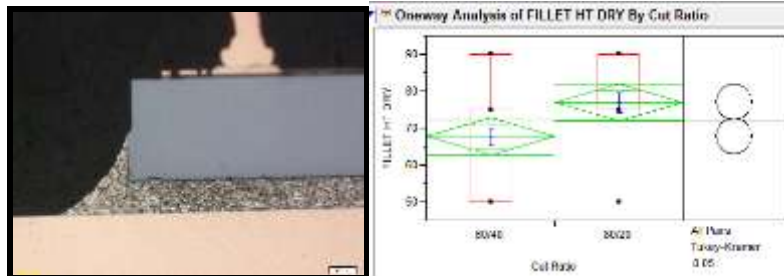
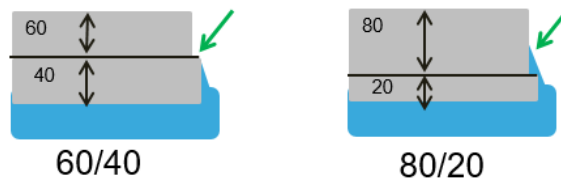


Fig. 6. Wafer Sawing Step Cut Ratio analysis using 2 sample T-test


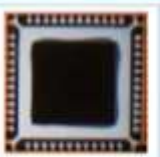
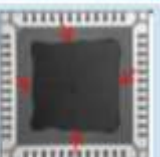


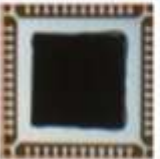
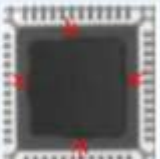


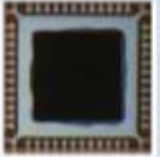


Dispense Pattern	Dispense Pattern Optical	Epoxy Coverage Optical	X-ray image After Cure	Epoxy Fillet Height	Result
Cross					Failed
Asterisk					Failed
Double Cross					Passed

Fig. 7. Evaluation on different Epoxy Dispense pattern

Recommendations are made on how to achieve and control the fillet height during Die Attach. Using Saw Step Cut Ration 60/40 and Double Cross epoxy dispensing pattern offer solutions to control the epoxy fillet height challenge faced by semiconductor packaging specialists. These materials provide controlled bond line thickness, minimal die tilt and controlled epoxy flow. These features allow reduced package size and enhanced reliability.