International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Diamond Saw Blade with Enhanced Dual Concentration

Bryan Christian S. Bacquian
New Product Development and Introduction, Back-End Manufacturing & Technology, STMicroelectronics, Inc.
Calamba City, Laguna, Philippines 4027

Abstract *— Mechanical Dicing is the most common die separation process, which introduces several challenges on the emerging semiconductor package assembly. Diamond blades are typically designed to have different concentration to address different requirements of the die surface and backside. The process solution introduced was the integration of both low and high concentration to address the weakness of step cut in terms of quality and manufacturing performance.*

Keywords— *Mechanical Dicing; Step Cut; Wafer; semiconductor package; process solutions.*

I. Introduction

Mechanical Dicing are the most common die separation process used in the semiconductor packaging assemblies. Typical tooling used for mechanical dicing is diamond blades. A Diamond Blade is a saw blade, which has diamonds fixed on its edge for cutting hard or abrasive materials. Blades have different characteristics like kerf width, the thickness of the blade cut, concentration, the number of diamonds present on a certain area and exposure, the effective length of the blade wherein cutting obtained. The current advanced mechanical dicing method for wafer with thick metal and narrower saw street is step cut, which will balance the topside chipping and backside chipping by different blades [1]. As shown on Figure 1 [2], Z1, which grooves the silicon, wafer from the top to initially separate the dies with each other. Z1 blade is responsible for the quality of top side and the electrical reliability of the dies. Z2, which is typically the narrower blade, is responsible for the full separation of the dies and also the silicon chip out wherein it typically concerns about the electrical connectivity of the die on the semiconductor package carrier, either lead frame or substrate.

The emerging semiconductor wafer technology is very sensitive to any movement present during mechanical dicing. Low K, is observed to have very sensitive metallization that fails with large mechanical vibration. In order to address the problem of Low K, blades were modified to minimize these stresses. The critical blade characteristics involved was diamond concentration, which play a major role on cutting quality. According to Wang et.al [3], it is found that the higher concentration of the diamond can extend blade life and reduce die backside chipping. The lower concentration of the diamond can reduce topside chipping.

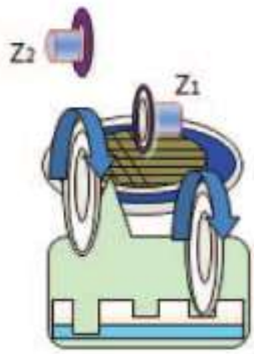

Fig. 1. Wafer Sawing Process with Step Cut [2]

In addition, Mechanical step cut is also critical when the step is not present. According to several studies performed, Z1 and Z2 accuracy plays a role on ensuring that the backside chipping will not be present on the top side. As shown on Figure 2, no step cut found, wherein increases the risk of electrical failure to possible topside chipping and even die crack. Step cut also shows some problems in terms of process manufacturing such as wafer Sawing Equipment Utilization and Wafers per hour due to two separate blades used during die separation process.

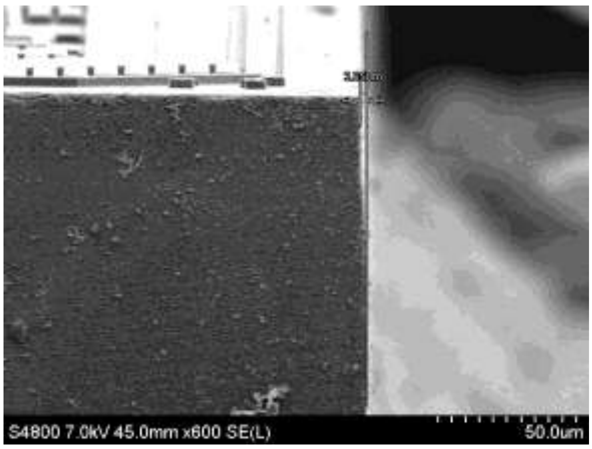

Fig. 2. No Step Cut

The paper will discuss the solution to the typical Diamond Saw Blades that are in the form of Single Bond Material with one type of concentration.

II. PROCESS SOLUTION

In order to improve the step cut efficiency. The team has offered the idea of blade comprising of two different bonded material. Dual concentration blades were designed to have different concentration to address both top side and backside chipping requirement of Low –K mechanical dicing. The Higher concentration area are placed on the outer part to cater the cutting of the top side of the die and minimize vibration of large diamond present from the inner side of the blade. Lower Concentration area was placed in the inner part of the blade to cater the full separation of the silicon area.

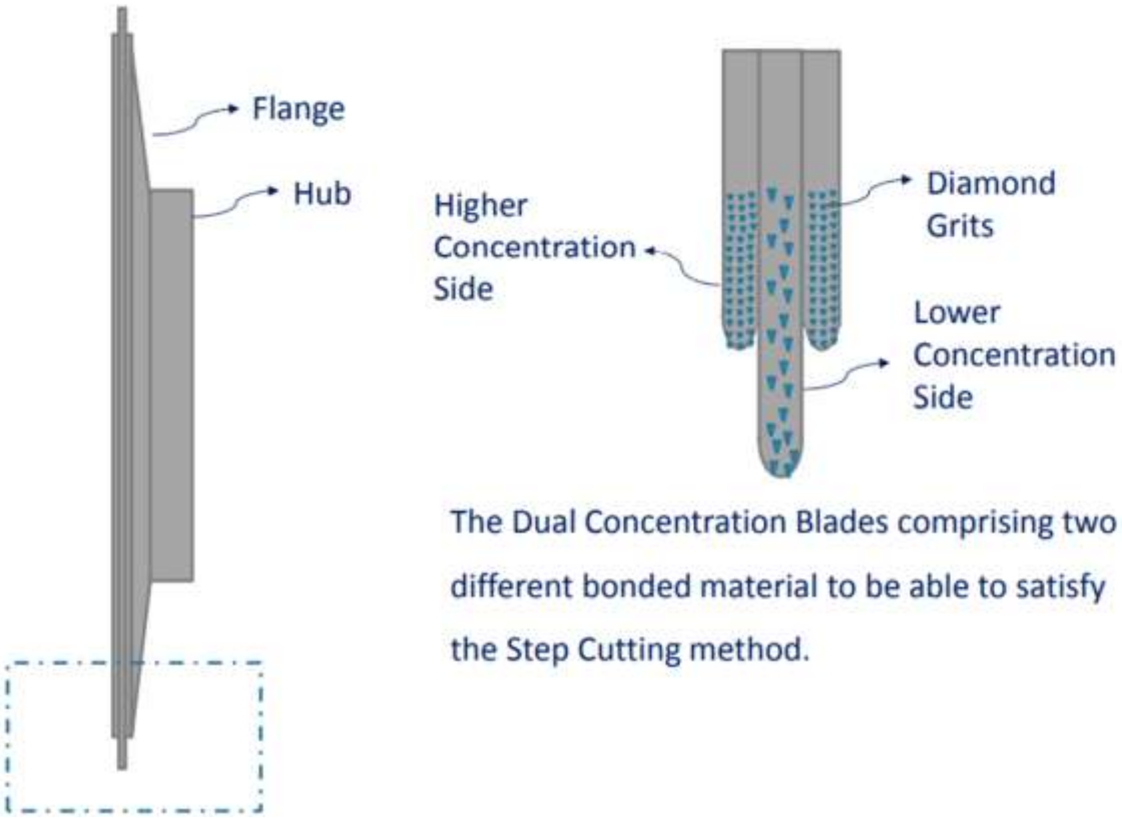

Fig. 3. a. Analysis of Variance on two cDAF type b. Cohesive Adhesion on Paddle

III. CONCLUSION

The material improvement of blades will offer advantages on the mechanical dicing process. One is the improved Cutting Quality of Step Cut Method with integrated low and high concentration areas, which is by effective cutting since the silicon, cut through using one mechanical interference. Next is the no offset second Step Cutting, which ensures the reliability of the wafer top side by eliminating the risk of backside, chipping propagation. Lastly was OEE/WPH Improvement, since Single Blade is used for two spindle systems, Dual Cut Method could replace Step Cut Method and Minimize Downtime for the Blade replacement and blade dressing since Single Blade is used

REFERENCES

[1] Liu, H., Wei, J., Wang, J., Xu, S., Investigation of Single Cut Process in Mechanical Dicing for Thick Metal Wafer, 2016 17th International Conference on Electronic Packaging Technology
[2] Kong, X., Wang, X., Wu, C. Diamond sawing process of 12 inch low-K silicon wafer applied in smart card, 2014 15th International Conference on Electronic Packaging Technology
[3] Duan Y., Lilei, Y., Cui, H., Liu, J. 300-mm Low-k Wafer Dicing Saw Development, IEEE Transactions on Electronics Packaging Manufacturing, Vol. 30, No. 4, October 2007

Bryan Christian S. Bacquian "Diamond Saw Blade with Enhanced Dual Concentration," *International Research Journal of Advanced Engineering and Science*, Volume 4, Issue 3, pp. 567-568, 2019.