



Effect of Backgrinding Tape Lamination on Die Alignment

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Authors' contributions

This work was carried out in collaboration between both the authors. Both authors read, reviewed, and approved the final manuscript.

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ABSTRACT

The continuing growth and development on semiconductor package miniaturization have become a particular interest and focus semiconductor industry. The importance of thinner packages also demands a thinner vertical structure of the integrated circuit (IC) design with silicon die or the wafer playing essential role in package thinning. As the wafer goes thinner, problems may occur in the wafer preparation or pre-assembly. With the introduction of new wafer preparation technologies such as dicing before grinding and laser die attach film (DAF) cut, technical challenges were inevitable. The paper focused on the effect of backgrinding tape lamination on die alignment. Tensionless lamination helped eliminate the horizontal pressure applied into the tape thus mitigating the die mis-alignment problem. For future works, the configuration could be applied on wafers with similar technology and/or application.

Keywords: Lamination; backgrinding; wafer thinning; die alignment.

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1. INTRODUCTION

Every new technology developed and introduced in the manufacturing plant brings along many challenges that would affect the assembly yield. The development of thinner die configuration has evolved from the conventional wafer preparation process into an advanced dicing before grinding process. Traditional pre-assembly or wafer preparation process shown in Fig. 1 involves wafer taping, backgrinding, until wafer mechanical sawing. Worthy to note that manufacturing assembly process flow differs with the product and its technology [1-4]. With the continuing technology trends and state-of-the-art platforms, challenges in semiconductor assembly manufacturing are inevitable [5-7]. The paper focused on the effect on die alignment with different types of backgrinding tape lamination.

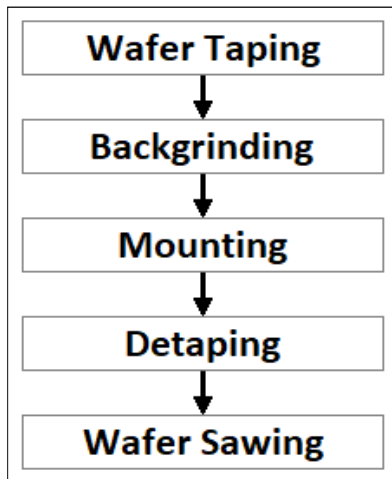


Fig. 1. Pre-assembly conventional process flow

2. LITERATURE REVIEW AND PROBLEM IDENTIFICATION

Dicing before grinding was introduced to attain the required thin wafer thickness without

compromising the die strength. The process is focused on the removal of backside chipping which might cause breakage on the silicon area of the die, consequently improving the silicon die's quality [8]. Nevertheless, the process is not enough to support the increasing demand for thinner packages. The addition of the die attach film (DAF) material attached underneath the pre-sawn grinded wafer brought another challenge for a breakthrough process development which is the laser DAF cut. Laser (light amplification by stimulated emission or radiation) DAF cut is focused on the successive singulation of the DAF material underneath the pre-sawn wafer using low power lasers. With this, the introduction of dicing before grinding with laser DAF cut would enable the integration of the wafer thinning process and the use of DAF without compromising the quality requirement of thinner dice [8]. Fig. 2 shows the wafer preparation process flow including the laser DAF cut.

One advantage of laser DAF cut is the ability not to subject the silicon wafer and DAF to any mechanical stress thus removing the possibility of chippings or burrs. The laser will pass through the die opening (kerf width) without hitting the silicon side wall thus eliminating mechanical stress. On the other hand, an inherent problem encountered at the advanced pre-assembly process is the die mis-alignment or kerf shifting as illustrated in Fig. 3. Kerf shifting refers to the movement of dice induced after wafer backgrinding and mounting process. The higher the tension being applied to the wafer, the higher disturbance into the singulated dice would happen. This in turn result to the die movement or mis-alignment. The control of tension during the dicing before grinding process should be carefully employed. Along with the tension applied during backgrinding tape lamination, stress added during succeeding processes increases concern for die shifting issues.

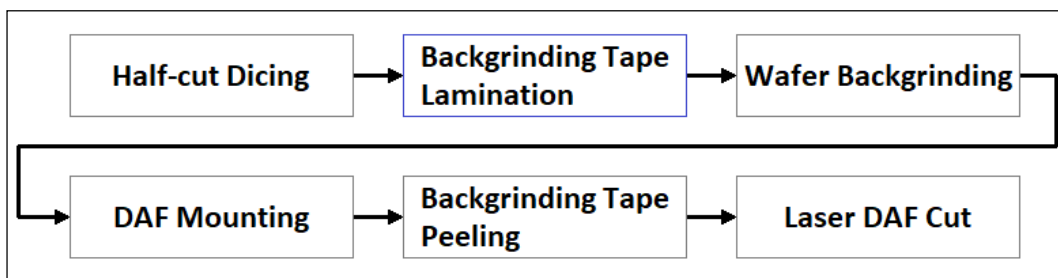


Fig. 2. Advanced pre-assembly process flow

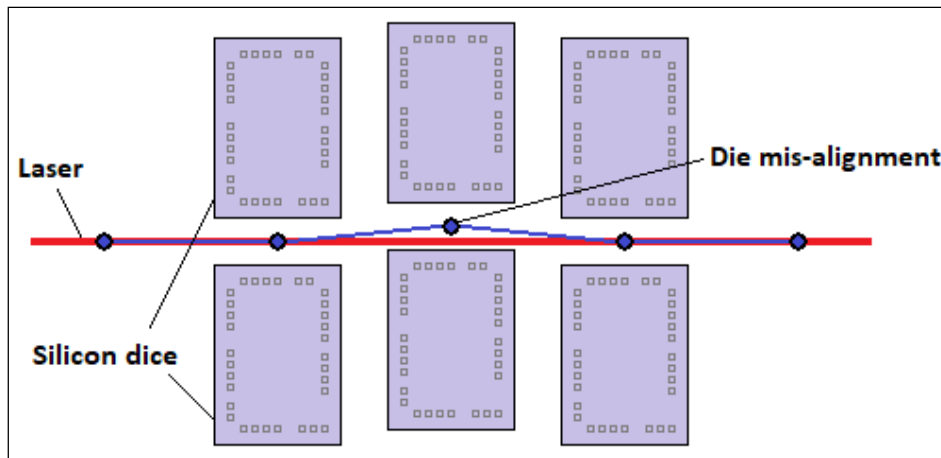


Fig. 3. Die mis-alignment manifestation

3. EXPERIMENTATION

Silicon wafer with DAF was used as carrier for the evaluation as represented in Fig. 4. Wafers were processed using the dicing before grinding process with 50 microns specified final thickness and a required final die size.

The evaluation done to understand and solve the large die mis-alignment issue is categorized into backgrinding tape lamination tension effect validation using tension and tensionless lamination process. To check the robustness of the wafer during backgrinding with different

backgrinding tape lamination condition, one tape was used throughout the experiment. The effect would be distinguished using different conditions, with tension and tensionless lamination. Tension lamination refers to the standard backgrinding tape lamination process wherein pressure is applied horizontally and vertically with respect to wafer surface. Conversely, tensionless lamination refers to the process wherein backgrinding tapes are applied without any tension or pressure. The experiment results were then assessed based on the large die mis-alignment.

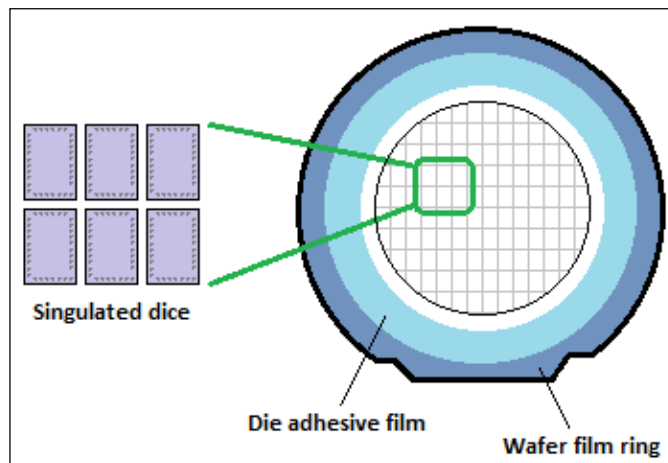


Fig. 4. Wafer representation

Table 1. Evaluation on backgrinding tape lamination

Type of lamination	Die mis-alignment	Remarks
With tension	Manifested	Fail
Tensionless	No manifestation	Pass

4. RESULTS AND DISCUSSION

The experiment results were analyzed on the different evaluation trials. Table 1 shows that tensionless lamination helped eliminate the horizontal pressure applied onto the tape thus mitigating the die mis-alignment issue.

With the die mis-alignment problem addressed during backgrinding tape lamination, other wafer defect particularly edge cutting was also eliminated.

5. CONCLUSION AND RECOMMENDATIONS

Tension control is the critical characteristics on handling thin wafers processed using dicing before grinding process. Tensionless backgrinding tape lamination is vital for die alignment control which helped eliminate the horizontal pressure applied on the tape, hence preventing the die mis-alignment problem.

Future studies could include some failure cases to validate the application on wafers. Discussions in [9-11] are helpful in mitigating defects related to wafer preparation. In-depth evaluation on different tapes and sizes, as well as tension control mechanism and applied pressure could be explored. For future works, tensionless type of lamination could be applied on wafers with similar die technology.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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