Improvements in Thin Wafer Handling - Equipment and Material Impacts

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Abstract:

The advancements in thin wafer handling for thermal slide debonding are multifaceted. The improvements in both the equipment capabilities and the materials for thermal slide debonding are the key topics of this paper. The main points presented include a) the effect of the material on stress experienced by the thinned wafer during debonding and after debonding before tape mount, b) the capability of the slide debonder to debond different size configurations such as a 4-inch device wafer on a 6-inch carrier for better support through upstream processes, and c) the ability to remove the thinned device from the thermal slide debonder and proceed to tape mount without the thinned wafer ever being unsupported. These improvements allow for thinner and more fragile devices to be debonded with less stress and more support through the entire process.

INTRODUCTION

Compound semiconductor companies have been performing wafer thinning as a means of heat dissipation for over 20 years. GaAs wafer sizes started as wafer pieces and now are 150 mm in size and are run at relatively high volume in the world's leading fabs. III-V semiconductor substrates are becoming a larger part of the product mix for making chips. As this trend continues, the ability to support these more fragile substrates or thinned substrates with high topography throughout the entire backside process from initial thinning all the way through to tape mounting and cleaning becomes more important. To make this capability possible, new materials and equipment must be designed to enable lower stress on the device throughout the process. Even though more support is needed, it cannot be obtained at the cost of throughput.

The new materials will be benchmarked against industry standards. The new tool designs will be implemented to show a total solution for better processing.

BACKGROUND

Brewer Science and TriQuint Semiconductor have been working together to implement the technology breakthrough that allows for a more stable low-cost-of-ownership process.

Last year TriQuint presented the improved uniformity in final device thickness by using a single coat process of WaferBOND® HT-10.10 material to achieve a 100-µm coat over 80-µm topography. Since then, Brewer Science and TriQuint have worked together to identify opportunities for further improvements to and optimization of the entire process. Brewer Science has worked on a new material solution to reduce the bowing and decrease the stress during the slide debonding process. Brewer Science has also developed a thin wafer handling tool (TWHT) that allows for more support after the thinned device is debonded. These solutions, both material and equipment, have been inserted into TriQuint's production process.

EXPERIMENTAL

Materials: WaferBOND® HT-10.10 material, Brewer Science experimental bonding material
Tools: Cee® 1300CSX slide debonder, 4-inch TWHT, 6-inch TWHT, SVG8800 coater/developer, ATI MWMS-677 tool, C&D film frame cleaner, Ultron UH115 film frame mounter

RESULTS

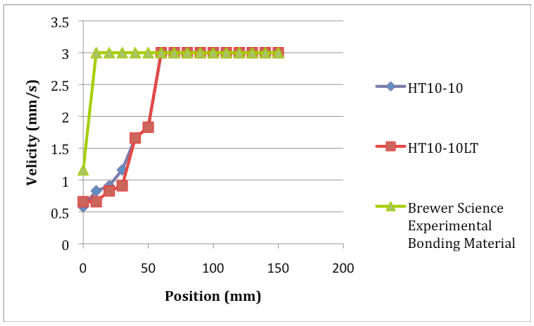

FIGURE 1. GRAPH OF VELOCITY (MM/S) VERSUS POSTION (MM) OF THE 150-MM WAFER DURING THE DEBONDING PROCESS

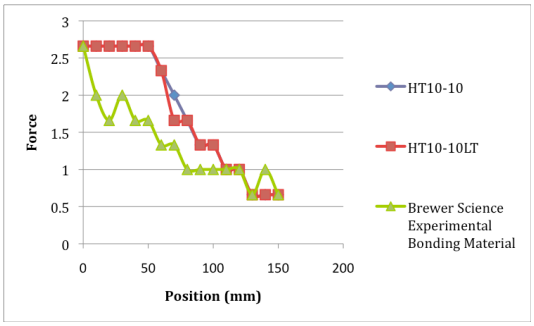

FIGURE 2. GRAPH OF THE FORCE (LB) VERSUS POSTION (MM) OF THE 150-MM WAFER DURING THE DEBONDING PROCESS

In Figures 1 and 2, the graphs show that the Brewer Science experimental bonding material requires a lower initial force during the start of the slide debonding process while having a higher velocity compared to WaferBOND® HT-10.10 material. This performance creates less stress while maintaining throughput during the debonding process. If stress on the wafer is not an issue but temperature is, this material can be debonded at a lower temperature without increasing stress above what is typically seen with the WaferBOND® HT-10.10 material. (Graph to come.) Even though the experimental material allows for lower-temperature processing during the debonding process, it is still as thermally stable as WaferBOND® HT-10.10 material with a Td of 254°C in air.

CONCLUSIONS

As discussed in the results, the platen design and software employed by the Cee® 1300CSX debonder allow various sizes of device wafers and carriers to be thermally debonded. The new Brewer Science experimental bonding material allows for lower stress during debonding, and the TWHT allows for support of the thinned device after debonding as it is transferred to tape mounting and cleaning without having to be removed from a Gel-Pak carrier. These three things in combination allow for a more stable, fully supported process from start to finish.

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ACRONYMS

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REFERENCES

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