Backside Mounting Procedures for Semiconductor Wafer Processing

Craig P. Orlando, Joel L. Goodrich and Ernest L. Gosselin

M/A-COM: Tyco Electronics, 43 South Avenue, Burlington, Massachusetts, USA
Phone: 781-564-3327, email: orlandoc@tycoelectronics.com © 2001 GaAs Mantech

ABSTRACT

Throughout the semiconductor industry there has been a procedure for backside wafer processing where a product wafer is mounted to a backing host. The standard procedure of backside mount and thin down is essential to produce a consistent and uniform overall wafer thickness. The final product, a semiconductor chip, is placed into a manufacturing package where thickness variations must be kept to a minimum, otherwise devices will not set properly into a package causing performance variations that would lead to poor electrical yields.

With this in mind, our focus has been to tighten the limits of the procedure during the backside wafer process. The backside process in the Semiconductor Technology Center in Burlington Massachusetts has two distinct mounting adhesive procedures for performing bulk removal of material. For the past two years, we have used an excellent temporary thermoplastic-mounting adhesive for backside wafer processing. This procedure combines a liquid adhesive and a unique backing host that makes the backside process visually superior and gives us the ability to automate various aspects of the remaining processes.

Additionally, there has been a need to use a second mounting adhesive for a number of products that have very specific process requirements. The end results for these products are that they need to be etched through to chip separation and not dismounted as wafers. When using the standard adhesive, the products that would be targeted to go for etch-through would always separate at every stage of the process after the thin down procedure had been performed. The separation of product wafer from the backing host creates massive device loss and lowers the overall yield for each wafer. These product types are very unique in that, they are being thinned to approximately two- (2) mils total wafer thickness. The product wafer is subjected to additional heated backside processing, while staying mounted to the backing host. These heated process steps would be the catalysts that would separate the product wafer from the backing host.

To avoid this separation problem, we are using the second mounting adhesive. It gives us the ability to structurally strengthen the bond between the product wafer and the backing host wafer during any heated operations. To remove the product wafer from the backing host, it is necessary to place the wafer into an environmentally friendly solution for dismounting. The evolution of these two procedures, using two mounting adhesives, will be discussed in detail below.

INTRODUCTION

In the past couple of years, backside wafer processing has been brought to new levels. Wafer uniformity issues and total thickness variation has made the process of bulk removal of backside material critical. The goal for backside processing has been to minimize total thickness variation or TTV. TTV is the total thickness variation across the wafer. Another goal has been to eliminate manual processes from the production floor.

Backside wafer processing begins with the application of a mounting adhesive. Reduction of TTV can be reached by limiting the variation of the mounting adhesive. Both goals, reduction of TTV and elimination of manual processes, can be achieved by converting to fully automated wafer handling equipment

The second step is the actual mounting process that places the product wafer with the mounting adhesive in direct contact with the backing host part. Once this part of the process has taken place the actual mechanical removal of excess material from the product wafer begins. This process is necessary in order for the final device to fit into a package. After the product wafer has been thinned down to a specific target thickness, the remainder of the backside process takes place. The preceding process steps after thin down will vary according to the product family type that is being produced.

Two Mounting Adhesives

After backside wafer thin down, some products will proceed to a backside metal process, while others will be dismounted. Because of these distinct differences, it has made it necessary to use two completely different mounting adhesives.

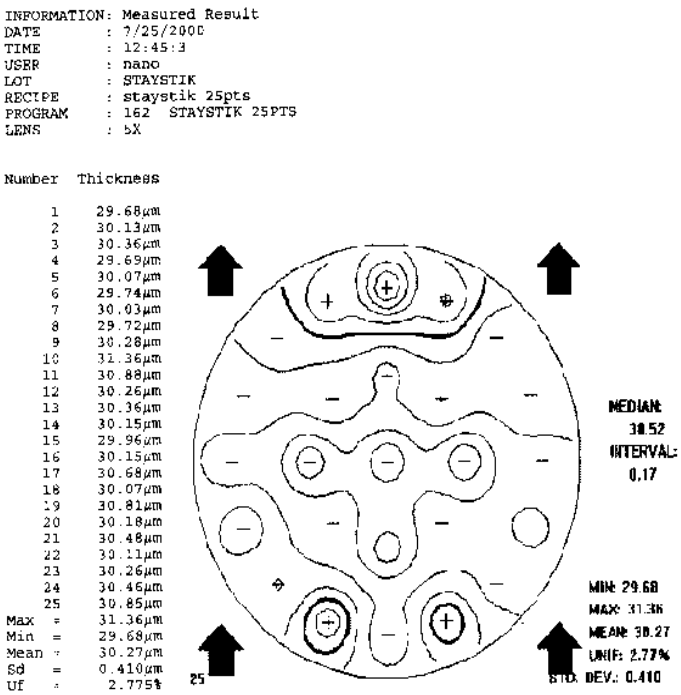
Staystik 336T

The first adhesive to be discussed is a temporary thermoplastic adhesive called Staystik 336T. Staystik is

manufactured by AlphaMetals, a division of Cookson America. Staystik is the standard mounting adhesive that is used in the wafer production fab. The standard layer that is used has an average thickness of thirty microns. Extensive work has been done to create a uniform layer (see Figure 1).

Figure 1.

Staystik 336T - 30 micron layer



Staystik – The Process

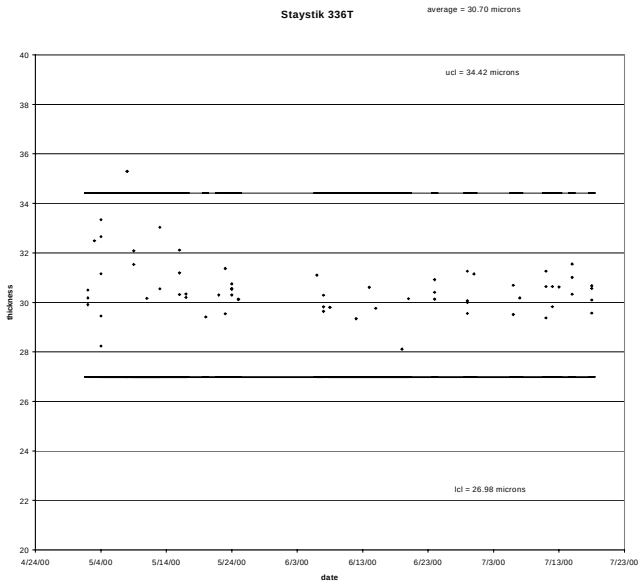
Staystik 336T has the ability to be dispensed like a photo resist layer. After dispensing the liquid, a spin coat is performed for full coverage. From spin coating, the product wafer is transferred to a hot plate for curing. A twenty-five-point measurement using a NanoMetrics 4150 Nanospec Measurement tool is performed after the curing cycle. This data is placed into an SPC chart (see Figure 2). Therefore, controlling the layer thickness and uniformity is a series of experiments altering the spin speeds and hot plate bakes.

A number of factors make Staystik a favorable mounting adhesive.

1. Once cured – Staystik will hold up to process temperatures in excess of one hundred degrees centigrade.
2. Workability – after mounting Staystik can be easily reworked.
3. Removal – place the mounted wafer and backing host on a hot plate set at greater than one hundred and fifty degrees centigrade.
4. Dissolving – Staystik readily dissolves in acetone and isopropanol.
5. Bond strength – mounted wafers will not debond during grinding or polishing operations.

The performance of Staystik as a mounting medium has greatly reduced thickness variation increasing the overall thickness yield through the backside process. This improvement in the yield has translated to more quality devices that meet package requirements.

Figure 2.



Durahold

Durahold is a solvent free, ultraviolet light curable, temporary adhesive made by Universal Photonics, Inc. Typically, this product is used in precision optics manufacturing. It does have certain qualities that fit our needs in the manufacturing of semiconductor wafers. This product will cure quickly at room temperature when exposed to ultraviolet light. The largest advantage is the ability of the bond, between the product wafer and the backing host, to strengthen when exposed to thermal factors such as: hot plates for bakes and heated plated baths.

One factor that must not be overlooked when using this product, is the fact that to remove or deblock the product, hot water is used. Therefore, after mounting any bath that is used can not have heated water, greater than eighty degrees centigrade, as a component. This type of disadvantage is actual a great plus; to have the ability to remove completed semiconductor devices with hot water, instead of solvents.

As stated previously, the Durahold mounting adhesive is used when the final product is a finished device that has been etched through to a device separation state.

Therefore, this product works well because a channel or via between the backing host and the product piece has been created. This path will allow the hot water to get between the adhesive and the product device and will create the start of the dismount process.

Durahold – The Process

Durahold is a liquid with a viscosity of 40,000 cP at twenty-five degrees centigrade. The application of the product is similar to a thick photo resist on a spinner. After the application, place the product wafer to the backing host part. Both parts are now placed under a UV light for curing. There will be no pressure placed on the product wafer during the mounting procedure. Curing time will depend on the light source intensity and the height of the light source from the parts.

The process of grind/polishing, and subsequence steps, can be performed according to the standard process specifications. However, special care must be taken when dealing with heated water solutions prior to the dismount procedure. The time to dismount the product from the backing host depends on the temperature of the heated water solution. For the particular product that has been selected for this procedure, the dismount process could take up to sixty minutes. Because the final product for this operation is a finished device, it is necessary to place the parts into an isopropanol rinse prior to drying.

SUMMARY

With these two mounting adhesives, the Semiconductor Technology Center in Burlington Massachusetts has the ability to address the variety of product types that are being requested. Aided by these two procedures, we have been able to remove bulk material and provide a consistent and uniform final wafer thickness. Also, by minimizing the TTV, there has been an increase in the final device yield translating into monetary savings.

REFERENCES

AlphaMetals Inc, Advanced Products Division, A Cookson America Company, Technical Bulletin on Staystik 336T Temporary Thermoplastic Adhesive, 1999.

Orlando, C., Goodrich, J., Sledziewski, J., Gosselin, E., " A Superior Mounting Procedure for Backside Wafer Processing in the Semiconductor Technology Center", M/A-COM Eleventh Annual Engineering Conference, October 1997.

AlphaMetals Inc., Material Safety Data Sheet on Staystik 336T, February 16, 1999.

Universal Photonics, Inc., Technical Data Sheet on Durahold, 1998.

Universal Photonics, Inc., Material Safety Data Sheet on Durahold, Part # KL19558-59, November 17,1998.

Orlando, C., "Semiconductor Wafer Mounting with a Solvent Free Adhesive", M/A-COM Fourteenth Annual Engineering Conference, October 2000.

Orlando, C., Goodrich, J., Gosselin, E., "Staystik Revisited – The Story of the Continuous Improvement of a Process", M/A-COM Fourteenth Annual Engineering Conference, October 2000.