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Comparing Wax Layer Thickness after Mounting

Introduction

Mounting of samples using adhesive mounting wax is a common technique used in the preparation of materials, especially during lapping and polishing operations. As with any mounting technique it is extremely important to keep the adhesive layer uniform and to a minimum possible thickness. This report shows the variation in specimen thickness after mounting with different types of adhesive wax. Evaluation of the best type of wax to use from a uniformity standpoint will be discussed.

Procedure

There are many methods available for mounting samples prior to processing. The most common technique implemented in preparation of materials today is perhaps the use of mounting wax for temporary mounting of samples. Adhesive wax is advantageous in that it can be used several times over without the need to replace it, the wax is a temporary mounting technique that allows removal of the sample, and most waxes are soluble in some type of organic solvent or cleaning agent. A wide number of mounting waxes are available for use in sample mounting, and the selection of these waxes is dependent upon the requirements of the sample. Temperature threshold, chemical sensitivity, and material composition are all factors that need to be considered when selecting a particular mounting wax for sample preparation. Below a basic table outlining some common mounting waxes and their basic properties is given.

WAX TYPE	MELTING POINT (°C)	STRENGTH	HARDNESS	SOLUBILITY
MWH 135	135	High	Very Hard	Acetone
MWH 080	80	High	Hard	Ethanol, acetone
MWM 070	70	Moderate	Moderate	Warm soapy water
MWS 052	52	Moderate	Soft	Perchloroethylene

Table 1: Properties of various mounting waxes available from SBT.

Sample mounting for lapping and polishing operations can be accomplished using a variety of mounting techniques. Typically a sample mounting block of some type (stainless steel, ceramic, glass) is heated on a hot plate at a particular temperature dependent upon the melting point of the adhesive wax, after which a small amount of wax is applied to the mounting surface. The wax is allowed to heat to a liquid flow point, after which the sample of interest is placed onto the mounting block and immersed into the wax. Excessive wax can lead to poor results and therefore should be avoided. Samples are then clamped together using some type of clamping device, typically a spring loaded clamp such as the Model 110 Sample Mounting Fixture. The entire clamped assembly is then placed onto a heat sink and the sample/sample mounting block assembly is allowed to cool to room temperature.

Sample Mounting

A silicon wafer sample was used as a control sample to help determine wax layer uniformity. The wafer sample, approximately 20mm x 18mm x 0.730mm in thickness was measured prior to each mounting process. Measurements were taken along 16 different points and tabulated to determine the variation in sample height prior to mounting with wax. The tabulation of these measurements is given with the wax mounting data. Figure 1 shows the technique used for measuring the silicon wafer sample prior to and following wax mounting.

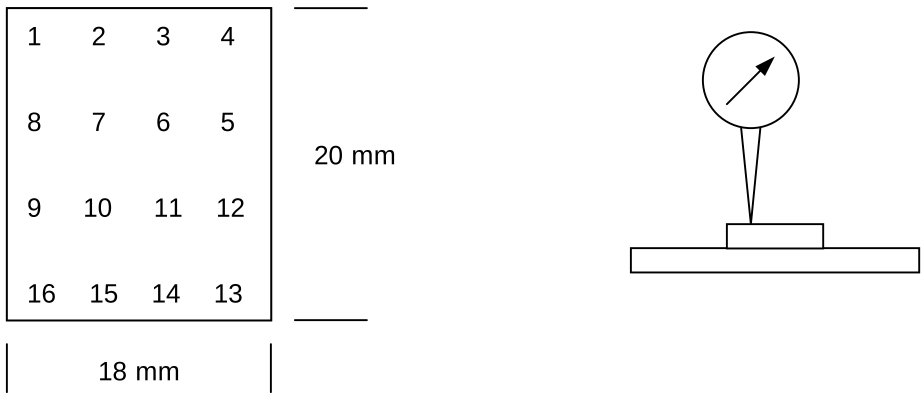

Figure 1: Schematic illustration of the technique used for measuring thickness of the silicon wafer both before and after wax mounting. At left is an illustration of the silicon sample and the measurement points. At right is a basic illustration of the depth gauge arrangement used for measuring thickness.

MWS052 Wax

This wax is characterized as a very soft mounting material with a low melting point of approximately 52° Celsius. Although this is the listed melting point, the actual flow point of the mounting wax appears to be slightly above this threshold and was found to be closer to 65° Celsius. A glass mounting plate was heated on a hot plate set at 65° Celsius and allowed to heat for approximately 5 minutes. Following this heating process, a small amount of wax (approximately 2 grams) was applied to the glass plate and allowed to melt completely. The silicon wafer sample was placed onto the wax and pressed down using tweezers. The glass plate/sample assembly was then placed into the Model 110 Sample Mounting Fixture and clamped together, placed onto a Model 125 Cooling Tray, and allowed to cool to room temperature. Total cycle time was approximately 7 minutes. Following mounting the sample and glass plate were cleaned using solvents to remove excess mounting wax prior to measurement on the depth gauge.

MWM070 Wax

This wax is characterized as a moderate hardness mounting material with a low melting point of approximately 70° Celsius. Although this is the listed melting point, the actual flow point of the mounting wax appears to be slightly above this threshold and was found to be closer to 80° Celsius. A glass mounting plate was heated on a hot plate set at 85° Celsius and allowed to heat for approximately 5 minutes. Following this heating process, a small amount of wax (approximately 2 grams) was applied to the glass plate and allowed to melt completely. The silicon wafer sample was placed onto the wax and pressed down using tweezers. The glass plate/sample assembly was then placed into the Model 110 Sample Mounting Fixture and clamped together, placed onto a Model 125 Cooling Tray, and allowed to cool to room temperature. Total cycle time was approximately 7 minutes. Following mounting the sample and glass plate were cleaned using solvents to remove excess mounting wax prior to measurement on the depth gauge.

MWH080 Wax

This wax is characterized as a hard mounting material with a melting point of approximately 80° Celsius. Although this is the listed melting point, the actual flow point of the mounting wax appears to be slightly above this threshold and was found to be closer to 90° Celsius. A glass mounting plate was heated on a hot plate set at 90° Celsius and allowed to heat for approximately 5 minutes. Following this heating process, a small amount of

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wax (approximately 2 grams) was applied to the glass plate and allowed to melt completely. The silicon wafer sample was placed onto the wax and pressed down using tweezers. The glass plate/sample assembly was then placed into the Model 110 Sample Mounting Fixture and clamped together, placed onto a Model 125 Cooling Tray, and allowed to cool to room temperature. Total cycle time was approximately 7 minutes. Following mounting the sample and glass plate were cleaned using solvents to remove excess mounting wax prior to measurement on the depth gauge.

MWH135 Wax

This wax is characterized as a very hard mounting material with a melting point of approximately 135° Celsius. The actual flow point of the mounting wax appears to be about the same as the listed melting point of the wax. A glass mounting plate was heated on a hot plate set at 127° Celsius and allowed to heat for approximately 5 minutes. Following this heating process, a small amount of wax (approximately 2 grams) was applied to the glass plate and allowed to melt completely. The silicon wafer sample was placed onto the wax and pressed down using tweezers. The glass plate/sample assembly was then placed into the Model 110 Sample Mounting Fixture and clamped together, placed onto a Model 125 Cooling Tray, and allowed to cool to room temperature. Total cycle time was approximately 7 minutes. Following mounting the sample and glass plate were cleaned using solvents to remove excess mounting wax prior to measurement on the depth gauge.

Results

Following measuring of each mounted sample the results were plotted on graphs to illustrate the differences in wax uniformity following mounting. Waxes that exhibited the highest amount of variation were the MWS052 and the MWH080 mounting waxes. The MWS052 mounting wax exhibited a thickness variation of 30 µm from the lowest to highest value. From the graph it is clear that the sample height is not uniform, a direct result from the wax layer under the sample being uneven. Similarly, the MWH080 mounting wax displayed similar behavior following mounting. A total variation of 25 µm was observed with the mounted sample, clearly showing uneven wax layer under the sample. These two graphs are given below.

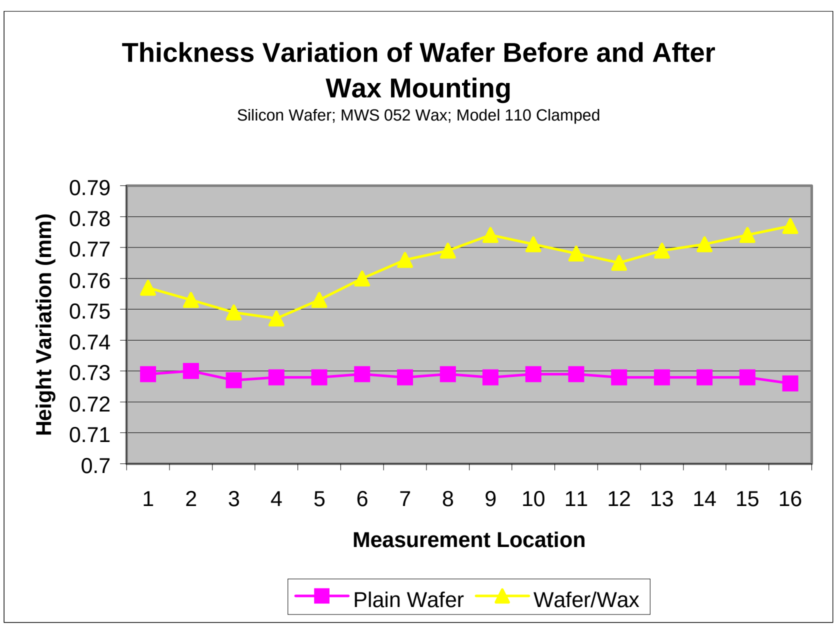

Figure 2: Chart illustrating thickness variation of silicon sample mounted with MWS052 wax.

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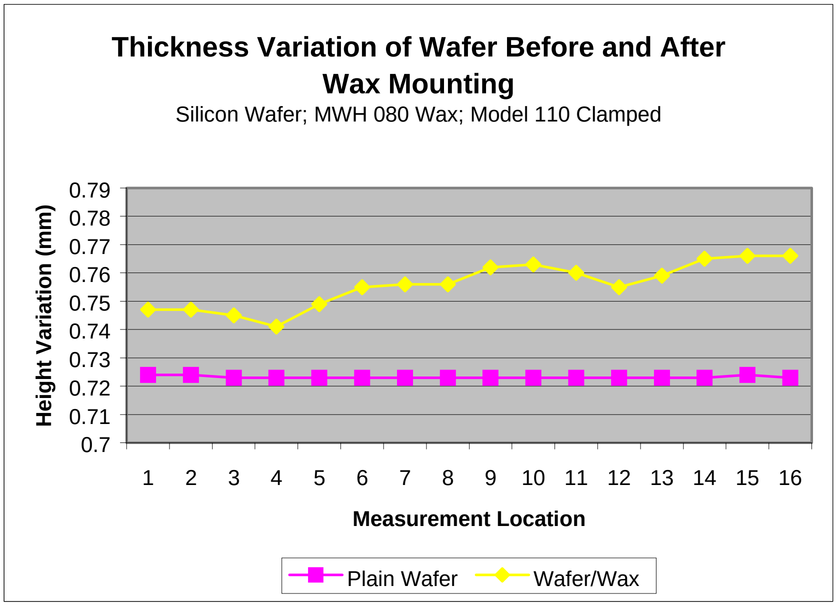

Figure 3: Chart illustrating thickness variation of silicon sample mounted with MWH080 w

Conversely, the MWM070 and MWH135 mounting waxes displayed excellent uniformity following mounting. The MWM070 wax showed thickness variation of 4 µm after wax mounting, and displays no inconsistent thickness variation. Results obtained from MWH135 mounting procedures were virtually identical with a thickness variation of only 4 µm from the original thickness.

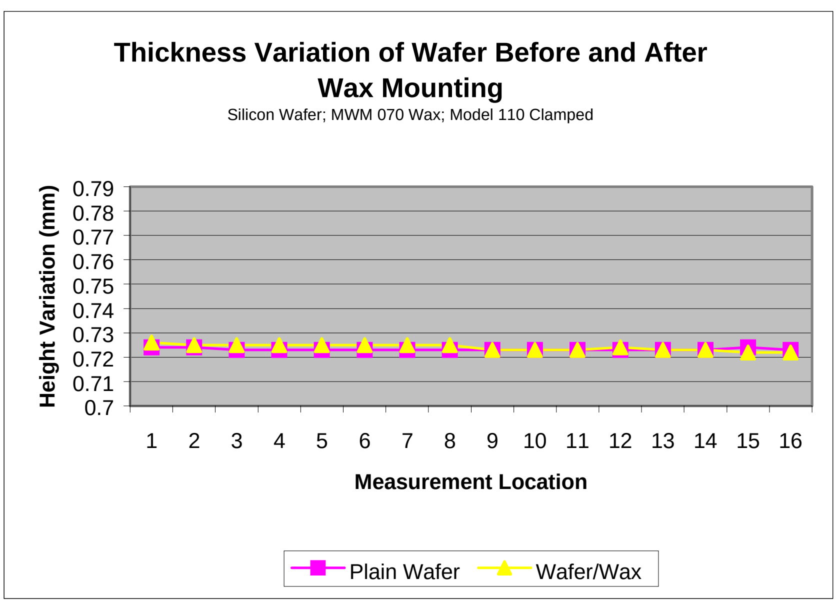

Figure 4: Chart illustrating the thickness variation of silicon sample mounted with MWM070 wax.

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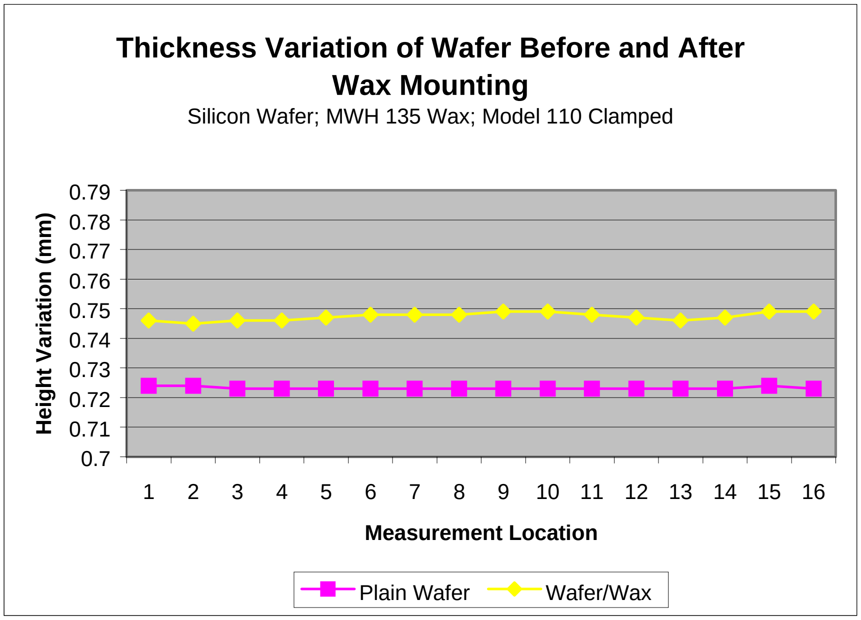

Figure 5: Chart illustrating the thickness variation of silicon sample mounted with MWH135 wax.

Conclusion

It is clear that the wax layer between the mounted sample can have a profound affect on the final outcome of lapped and polished samples. Depending upon the critical nature of the sample and how precise the sample thickness must be will dictate how careful a user must be when mounting samples prior to processing. The proper selection of mounting wax, hot plate temperature, and clamping techniques will help ensure that a uniform, consistent wax layer is obtained. Measuring the sample thickness following wax mounting is key to understanding how well the sample has been mounted and to eliminate possible errors in lapping.