Cutting Thin Si Wafers Using a Model 380 Ultrasonic Disc Cutter

1.0: Purpose

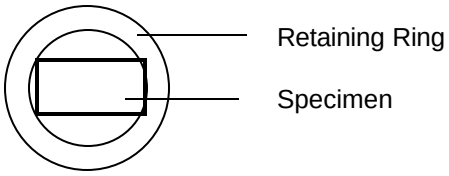
Cutting extremely thin and fragile Si wafers will be attempted using the Model 380 Ultrasonic Disc Cutter. The polished Si wafer is 3" in diameter and is only 0.0002" thick. These wafers are to be cut into small round discs on the order of 8mm in diameter using the Model 380. Several mounting systems and setups will be discussed and tested to see which method yields the best results. Each method is discussed in detail.

2.0: Experiments and Procedures

To first test the ability of the Model 380 to cut these wafers successfully, the standard method for mounting was attempted. All cuts were done using a 3 micron diamond suspension to help minimize chipping caused by the large abrasive particles. Four tests were conducted to see how well each mounting system performed in relation to the cutting of these samples.

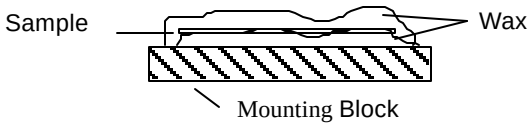
Standard Method

The first method used was the mounting of the wafers onto a standard stainless steel block. The sample was held into place using the round magnetic slurry retaining ring. These samples proved unsuccessful as they were not protected with any type of wax, causing severe stress at the tool / sample interface. Severe crumbling and cracking occurred during cutting.



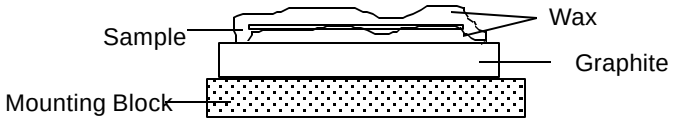
Wax Method

Another method attempted was using a low melting point wax to cushion and support the thin specimen during cutting. Using MWH 135 mounting wax, a thin barrier between the mounting block and the sample was created to provide the necessary support during cutting. A thin layer of wax was also applied to the surface to cushion the impact of the cutting tool on the surface. This method was also unsuccessful in producing damage free discs. A slight improvement was seen as compared to the standard method with the slurry retaining ring.



Graphite Method

Due to the lack of success with the other methods, another approach was taken. A graphite block was polished using SiC paper to produce a flat, smooth surface onto which the samples could be mounted onto. The specific aim of the graphite is to provide a flexible yet firm substrate onto which the sample could be mounted. This graphite plate should provide enough support for the sample to be cut without chipping or adverse effects seen in the previous cuts. The sample was then mounted using wax in a similar fashion as the Wax Method.



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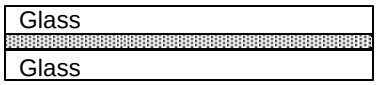
Although the graphite method showed a large improvement over the other methods used, it still was not done to satisfaction. The cuts made still exhibited a large amount of edge chipping and the mounting method proved to make handling the as cut specimens difficult without further damage.

Sandwich Method

The final tests done were to sandwich the sample between two glass plates to provide support and to make the sample "thicker". By stacking the sample it tricks the cutting tool into thinking the sample is a thick material, thus creating a higher quality cut edge. The glass makes handling the final cut specimen easy and prevents additional damage from occurring. The sample was mounted onto the glass plates using super glue and dissolved in acetone for further processing.



These samples proved to be very successful in cutting. Edge chipping, sample cracking, and specimen handling problems all were eliminated using the stacking method. The glass provided an easy means for positioning the sample during cutting as well as providing support during cutting and handling of the thin specimens. After investigation under a stereo microscope it was concluded that there were no visible chips on the edges and the cut looked uniform. This is an indication of a well cut specimen. In addition to the super glue, a wax layer can also be used as the adhesive. The wax is much faster to remove than the super glue which can be advantageous for certain applications.

3.0: Results and Conclusions

Based upon the tested methods and the results obtained, it is clear that the mounting method used for cutting thin specimens using the Model 380 is not a trivial task. In fact, the proper mounting methods can improve results, reduce material waste, and greatly affect the cutting efficiency of any material. The following table outlines the results obtained in this experiment:

Method	Comments
Standard (slurry ring)	Poor sample mounting; poor edge quality of cut; poor mechanical stability; severe cracking
Wax	Poor sample mounting; poor edge quality of cut; poor mechanical stability
Graphite	Fair sample mounting; fair edge quality of cut; poor mechanical stability
Glass stacking	Excellent sample mounting; excellent edge quality of cut; excellent mechanical stability

As illustrated in the table above, the glass stacking method proved to be the most successful method for cutting these thin silicon wafers. By combining the advantages of thick samples with the stability and support of the thin material, these fragile specimens can be cut with relative ease in a short period of time.

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