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Applications Laboratory Report
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Lapping and Polishing II-VI Semiconductors

Purpose

Semiconductor materials are used in broad range of applications present in today's marketplace. Virtually everything in our world today utilizes some form of semiconductor materials, whether it be in hand-held PDA's to the computers at our fingertips each day.

Of particular importance are II-VI semiconductor materials that are currently being used in radiation monitoring devices and other similar applications. Processing these soft, brittle materials using mechanical polishing methods can be problematic. This paper outlines a process for preparing such materials.

Materials and Methods

Samples of CdTe wafers were obtained for polishing to be carried out mechanically. Each sample was approximately 1mm in thickness prior to lapping and polishing processes. Wafer lapping is typically carried out using a precision lapping machine coupled with a lapping and polishing fixture that is used for controlling specimen thickness and maintaining planarity during processing. Factors affecting the lapping process are the lapping plate material, hardness of the specimen being lapped, load applied during lapping, abrasive particle size and hardness, lapping wheel speed, specimen rotation, and the flatness requirement.

Lapping and polishing was carried out using the Model 920 Lapping and Polishing Machine equipped with a Model 92002 Workstation. The wafers were held in place using the Model 147 Lapping and Polishing Fixture equipped with a Model 15001 Vacuum Accessory for holding the specimen by vacuum. A typical arrangement is shown in Figure 1 below.

Figure 1: Illustration of the lapping and polishing setup used for processing. The Model 920 Lapping and Polishing Machine is shown with the Model 92002 Workstation and the Model 147D Lapping and Polishing Fixture. The system uses an 8" diameter lapping wheel combined with abrasive suspension or polishing cloth to produce a lapped, smooth surface.

Lapping and Polishing Methods

Many techniques exist for producing polished samples from an as-cut wafer. This report used a system of mounting samples to a glass mounting plate, ¼" thick x 2" diameter. The glass plate was placed onto a hot plate and heated to 70° Celsius. Small amounts of wax (MWS052) were sliced into thin sheets and placed onto the glass plate. The wafers were then placed onto the plate and pressed down for uniformity with a Model 110 Sample Mounting Fixture. The assembly was allowed to cool for 30 minutes prior to lapping.

This particular wax was used along with a glass mounting plate arrangement to prevent cracking and wafer damage during thermal cycling. If the mounting wax used has a high melting point, or the mounting surface and specimen has a large difference in thermal expansion coefficient, specimen cracking will occur. Glass was used to match the coefficients as closely as possible, and the low temperature curing wax helps ensure a minimum amount of thermal cycling.

Following mounting of the wafers they were inserted into the Model 147D and held in place using a GAST mechanical vacuum pump. A two step lapping and polishing process is used to produce the desired surface finish of the wafers and is discussed below.

Lapping

Lapping of the wafers to a specific dimension was first carried out to produce wafers that are 300µm in thickness and to remove some of the sawing roughness induced during the cutting process. Lapping was carried out using a copper composite lapping plate with 3µm diamond suspension. Suspension was applied to the lapping plate surface using a spray bottle, and 5 sprays per 5 minutes were used as the application rate. Lapping was done under the following conditions using the Model 920 Lapping and Polishing Machine, Model 147D Lapping and Polishing Fixture, and Model 92002 Workstation:

LAP SPEED:	1 on dial (75 RPM)
ARM SPEED:	8 on dial (20 RPM)
PLATE:	LP 920 A with copper composite plate attached
ABRASIVE:	3 µm diamond suspension (DS030-16)
FEED RATE:	5 sprays / 5 minutes
LOAD:	850 grams
POLISHING TIME:	5 minutes

Polishing

The polishing process was used to produce the final surface finish of the material. Polishing was carried out using 1 µm diamond suspension on Nylon polishing cloth attached to a Cast Fe lapping plate. The following parameters were used:

LAP SPEED:	1 on dial (75 RPM)
ARM SPEED:	10 on dial (20 RPM)
PLATE:	LP 920 M with Nylon cloth attached
ABRASIVE:	1 µm diamond suspension (DS010-16)
FEED RATE:	5 sprays / 5 minutes
LOAD:	850 grams
POLISHING TIME:	12 minutes

Results

Cadmium Telluride is traditionally a very difficult material to prepare, especially to lap and polish with very little mechanical damage at all. Once the material is in wafer form, lapping and polishing is performed until it is free of surface defects, scratches, and is uniform in thickness and polish quality. Often times chemical polishing is used for producing smooth wafer surfaces but is difficult to control.

Using the composite plate process it is relatively straight forward to obtain a smooth surface with very little defects. Although some small scratches still remain, further processing will improve the results and eliminate any associated defects with the samples. The final thickness of the wafers was approximately 300 µm (+/- 10 µm) which was within the acceptable limits of thickness variation. The flatness on this sample was found to be < 0.2 lightbands (0.0000023" or 59 nm).

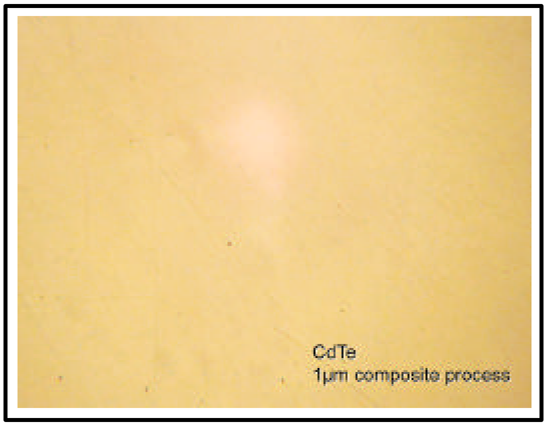

Figure 2: Optical micrograph showing the surface finish of the CdTe sample following lapping and polishing with the composite process. This polishing process resulted from < 20 minutes of process time.

Conclusion

Processing these II-VI semiconductor materials can easily be done using the process described above. Traditional polishing methods generally require a large amount of operator skill and typically are difficult to duplicate. However, using the SBT line of polishing equipment combined with the correct lapping and polishing materials, lapping and polishing these difficult materials can be much easier to achieve.