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Setting up and Using Digital Micrometer Controlled Lapping Fixtures

Purpose

Lapping and polishing fixtures are commonly used in materials preparation labs around the world. Lapping fixtures provide stability, precision, and uniform removal of material to ensure a high quality sample is produced. The use of lapping fixtures in both small scale sample production and wafer level device fabrication is common practice due to these inherent qualities. Crucial to the performance of these fixtures are the machining tolerances, construction and stability, and the initial setup processes of the fixture. This report outlines the methods used for setting up these types of instruments as well as initial removal accuracy.

Equipment Setup

The Model 147D Lapping and Polishing fixture was used to demonstrate the setup process. This process is the same for all of the lapping and polishing fixtures that utilize a digital indicator for measuring and monitoring the removal of material. A list of the fixtures falling under this category is given below:

MODEL #	SAMPLE Ø
147D, 147DE	2” (66 MM)
154D	2” (50 MM); LOW FORCE
155D	2” (50 MM)
157D	2” (50 MM); LOW FORCE

MODEL #	SAMPLE Ø
163	3” (75 MM)
164	4” (100 MM)
165	5” (125 MM)
166	6” (150 MM)
167	7” (175 MM)
168	8” (200 MM)

Table 1: Listing of the SBT Lapping and Polishing Fixtures utilizing a digital micrometer.

The Model 147D is used for a variety of lapping and polishing processes. It is a precision machined lapping fixture with several different components that perform some basic functions. A locking knob at the top of the fixture holds the mounting plates in place and provides a mounting location for additional loading weights. A mechanical micrometer is used to adjust the vertical height of the sample and mounting plate, advancing or retracting the sample to the plate surface. A digital micrometer indexes off the back of the mounting plate and changes based on the movements of the sample or mechanical micrometer in situ. A plunger assembly is used to maintain pressure against the piston assembly and helps to minimize any potential wobble in the fixture housing.

Figure 1: Image of the Model 147D with various parts of the fixture labeled.

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Zero Process

1. Planarize the mounting block to the carbide wear ring of the fixture using 120 grit SiC paper. Using a black marking pen draw an X on the mounting block face. When the marker has been ground away the mounting block is planarized.

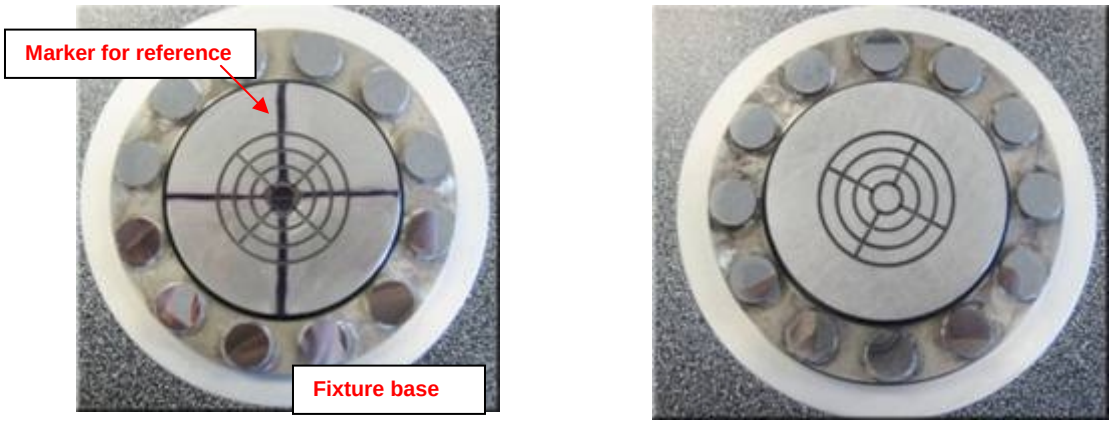

Figure 2: Illustration of the planarization process. A marker is used to create a reference mark to determine when the process is completed.

2. Add approximately 200 grams of weight to the top of the fixture. The weights will screw into the locking knob at the top of the fixture.
3. Adjust the tension of the plunger assembly to provide the maximum resistance that will allow the piston to slide freely. This is done as follows:
    a. Turn the plunger assembly clockwise to tighten down. Turn until no further rotation is possible.
    b. Rotate the threaded screw in the center of the plunger assembly about 3 turns to increase the tension on the piston assembly.
    c. Turn the plunger assembly counter-clockwise approximately 1 turn.
    d. Pull up on the locking knob to pull the piston assembly up. Release the locking knob and observe the sliding motion of the piston.
    e. If the piston does not slide down or the sliding motion is not smooth, turn the plunger assembly counter-clockwise until the piston moves smoothly.
4. Mount the sample using the vacuum chuck or low melting point mounting wax combined with the Model 110 Sample mounting fixture to create a uniform wax layer. Install the mounting plate to the bottom of the fixture.
5. Place the fixture onto a hard, flat surface, such as a granite leveling plate. Make sure the plate is free of contamination, particles, etc.
6. Turn on the digital micrometer by depressing the ON/OFF button.

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7. Turn the mechanical micrometer until there is a gap between the fixture housing and the bottom of the mechanical micrometer. This will allow the sample mounting plate to extend past the base of the fixture and will remove material.


8. Depress the ZERO button on the digital micrometer and establish the zero point of the sample/fixture assembly. This will be the point from which all measurements are taken.

9. Tilt the lapping fixture backward to raise the base of the lapping fixture above the leveling plate. This will allow the piston assembly of the lapping fixture to move if the zero point has not been established. Movement indicates that the mechanical micrometer stop has not set the zero point correctly and will be indicated by a change in the digital micrometer reading.


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10. Adjust the mechanical micrometer while the fixture is in the raised position until the digital micrometer again reads zero. This is the actual zero position of the sample/mounting plate assembly.

11. Lower the fixture once again so that the base of the fixture is flat on the granite leveling plate. Slide the fixture around by the base of the fixture on the plate to verify the digital micrometer reads zero. If the reading has changed, zero the digital indicator and repeat steps 9-11.

12. Once the zero position has been established, the fixture can now be setup to remove a specified amount of material. Tilt the fixture (as in Step 9) so the sample/mounting plate assembly is above the granite leveling plate. Rotate the mechanical micrometer counter-clockwise to advance the sample out (amount of material to be removed). Adjust this until the digital indicator reads the desired amount of removal.

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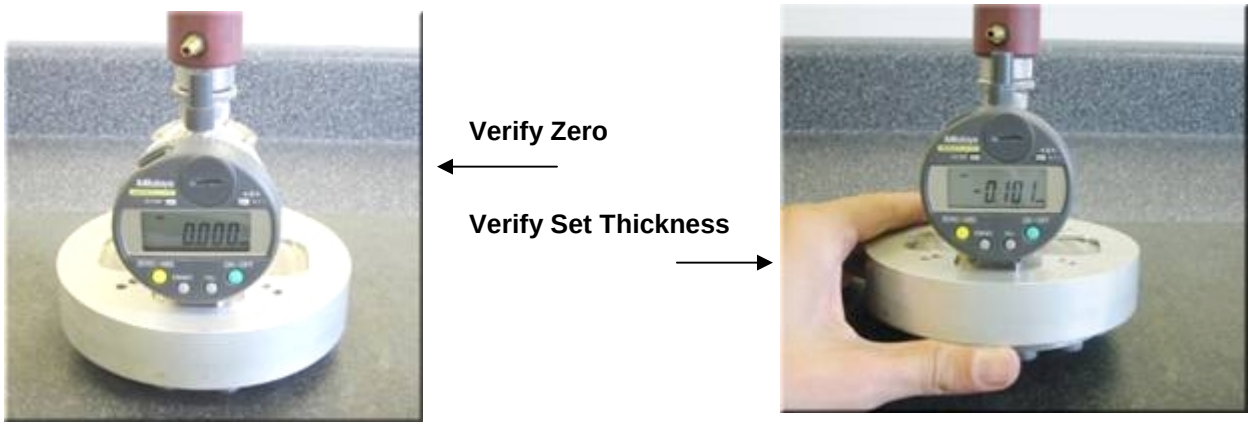
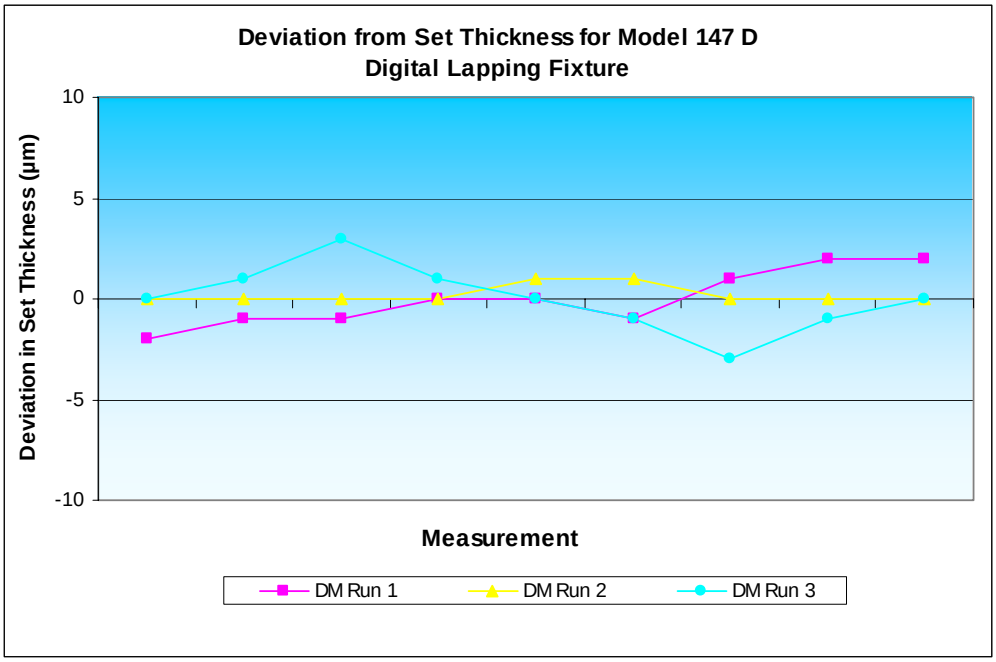
13. Lower the fixture so the sample and fixture base are flat on the leveling plate. Verify the zero position has not changed more than +/- 2µm. Tilt the fixture once again to verify the set thickness has not changed more than +/- 2µm.



14. The fixture has now been setup for removal of a specific amount of material.

Sample Processing

Once the lapping fixture has been properly setup, samples are ready for processing. For initial testing a small CdZnTe (cadmium zinc telluride) wafer of approximately 15mm^2 was mounted to the Model 147D for processing. The sample was then lapped on a copper composite lapping plate using 6 µm diamond suspension. Three different process runs were completed and the sample thickness was measured prior to and following lapping operations. The graph below shows the deviation of the measured sample thickness from the set thickness on the digital indicator of the lapping fixture.



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Conclusion

Using a digital indicator with the SBT line of lapping and polishing fixtures provides a good method to accurately control the sample thickness and the amount of material removed from a given specimen. When used properly, accurate control of the sample thickness can be achieved to within +/- 3µm from the target thickness. Using proper techniques for the setup of the fixture prior to lapping and polishing operations will ensure that accurate results are obtained.