Appendix D: The Sloan Dektak

The Surface Profile Measuring System

I. Introduction

In this laboratory we will use the Sloan Dektak for the measurement of surface elevation differences or step heights. It actually consists of three separate pieces of equipment. The main unit, a fast leveling module (FLM), and a chart recorder. The main unit is very delicate and the manufacturer claims it can be used to determine differences as small as 25Å and as large as 1,000,000Å (0.1 mm). The calibration of the instrument is checked periodically and its accuracy is generally not better than ±50Å but it might depend on how it was treated by the last user. Be careful not to bump the instrument or the table upon which it rests while it is in use.

Your sample, whose thickness is to be determined, rests on the stage beneath the sensing head. The stage can be adjusted manually to level the surface of the sample (see below). The sensing head contains a diamond stylus with a tracking force of about 50 milligrams. This is not a small force for soft metals and it is possible that the stylus may scratch your sample as it moves across the surface. It is highly recommended that you complete all your required electrical measurements before attempting to measure the film thickness. The measurement is made by slowly moving the stylus over your sample, starting on that part of the glass slide which is clean, continuing over the sample, and back to a clean part of the glass slide. The direction of the sweep is normally from front to back of the instrument. The chart recorder will show a square wave like pattern whose height is directly related to the film thickness.

Three profile scanning speeds of 0.01, 0.1 and 1 cm/min may be selected from the front panel. In addition, a manual over-ride thumb wheel provides both a variable forward and reverse scan speed and can be used for more rapid stage movements. The sensing head is equipped with a 40 power microscope with direct illumination for observation of the sample.

Before attempting to use this instrument, you should talk to the instructor, TA, Tom Baldwin or Alan Monroe. They will check you out on the equipment.

II. Proceedure

Again, before using this thickness measurement system you should have completed all the electrical measurements required in experiment X. If you are not careful, it will be possible to damage your sample. This is a relatively new instrument and we do not have enough experience with it to know all the things, which can go wrong when students attempt a measurement.

1. Make sure all three components of the measurement system are connected as shown in Figure D-1. The chart recorder should be initially set to the follow conditions:
    - Power off
    - Pen Lift Lever up
    - Chart Speed at position #2
    - Filter at position #1

2. The main Dektak unit should be set to the following conditions:
    - Vertical stage all the way up
    - Range =10kÅ
    - Speed cm/min OFF
    - Manual speed thumb wheel set with the notch in the center position
    - Fine zero thumb wheel set with the notch in the center position
    - Rear limit switch should be set to 0.0 cm (push in and slide)
    - Front limit switch should be initially set to 0.5 cm.

3. Turn on the power for all three units. The Sloan FLM limit switch should be depressed and initially select the 10 kÅ/DIV scale (two red lights are now on). Push the baseline button and the chart recorder should move to the center of the page. You can change the baseline position by holding down the baseline button while rotating the thumb wheel on the FLM.

4. Place your glass slide (film side up) on the Dektak stage and approximately center it under the sensing head stylus. There are three thumb wheels on the stage. The top one is used to rotate the stage. The thumb wheel on the left is used to make fine adjustments in the x-position. <u>The bottom thumb wheel is used for leveling the stage (needed below).</u>

5. Lower the sensing head containing the stylus until the stylus almost touches the glass slide. Slowly continue lowering the stylus while watching <u>the head position meter on the FLM unit</u>. Initially the meter should read 10 (high) but as you lower the stylus it will start to move down. Continue lowering the stylus until the meter is at mid scale (5). Push the "base line" button on the FLM unit and the chart recorder should move to the center of the page. **<u>NEVER MOVE THE SLIDE BY HAND WHEN STYLUS IS DOWN!</u>**

6. Push the 1 cm/min scanning speed button on the main Detak unit and make sure the stylus is moving near the part of the sample that you wish to scan. You my view the region over which the sample is being scanned by looking through the microscope. Turn on the microscope lamp for better viewing. You can rotate the sample so that the part of the sample you want to scan is perpendicular to the scan direction by turning the top most thumb wheel on the stage. You can also make fine X position adjustments by turning the left thumb wheel on the stage. If you find that you need to make a Y position adjustment, raise the stage so that the stylus is well above the glass slide before attempting to move the sample by hand. Repeat step 4 to get the stylus back in the measurement position. You may change the sweep length by adjusting the front stage stop limit switch (push in and slide the bar in the direction desired). It is recommended that before changing the stop limit switch your turn the sweep off and press the retrace button of the FLM. When the stage pointer hits the stop limit switch, the unit will automatically reset the sweep position back to the starting position and start a retrace. At any time during the sweep you can initiate a retrace by depressing the "retrace" button on the FLM.

7. Now you should be ready to level the sample. Depress the "base line" button on the FLM again and start your scan at 1 cm/min. Watch the pen on the chart recorder (see Fig. D-2). If it moves up during your sweep rotate the leveling thumb wheel (bottom thumb wheel on stage) CCW or if the pen moves down rotate the thumb wheel CW. Continue doing this until the chart recorder pen hardly moves during the full sweep of the stage. Note: as the leveling is changed, the head position meter changes. You will need to adjust the stage height to bring the "head position meter" back to mid scale (see instruction 4). Next, depress the 2 kÅ/div scale button on the FLM and repeat the leveling procedure. Continue leveling procedure until the chart recorder pen is approximately flat on the 500 Å/div scale of the FLM. This will most likely be the scale at which your final measurements are done: **1 cm of pen deflection = 500 Å variation of stylus height.** You may try to increase the precision of your measurement by working on the 200 Å/div scale but it becomes increasingly more difficult to obtain a level trace as the sensitivity increases. Also, the larger the scanning distance, the harder it is to obtain a level trace over the whole scan.

8. You are ready to make the final determination of your film thickness. It is initially recommended that you sweep over one of the narrow lines connecting your sample to the area where the copper pins of the sample holder make electrical contact. Bring the chart recorder pen down to the paper and start the chart at the slowest speed. Set the main Dektak scan speed to 0.1 cm/min. Change the scan

9. After you are finished, keep the chart recording and paste it in your notebook after you have analyzed it. Raise the stylus and remove your sample. Turn everything off and cover the equipment.