

University of MN, Minnesota Nano Center

Standard Operating Procedure

Equipment Name: Rudolph ellipsometer
Badger Name: ellipsometer-r
Model: MS14C2C
Location: Bay1

Revision Number: 4
Revisionist: Paul Kimani
Date: 21 October 2013

1. Description

Ellipsometry is a non-destructive method of measuring the index of refraction and film thickness of a dielectric film on a reflecting substrate. It is a highly accurate and repeatable measurement. Ellipsometry involves illuminating the surface of a sample with monochromatic light having a known and controllable state of polarization and analyzing the polarization state of the reflected light. The wavelength of the laser is 632.8 nm. The laser size is 0.025 x 0.075 mm.

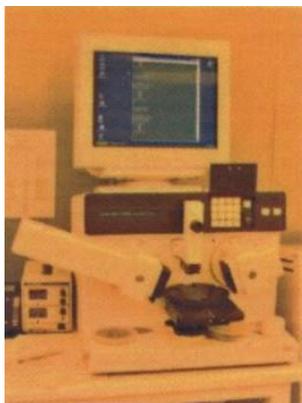


Figure 1

2. Safety

- a. Avoid eye contact with the laser to prevent eye damage.

3. Restrictions/Requirements

- a. Must be a qualified user
- b. Do not over tighten the three leveling knobs (jack screws) tighter than just a mild snug. You should not need to adjust the knobs more than a half turn.
- c. Do not turn the micrometers until they are maximized. The stage will collide with the Polarizer module or the Analyzer module.
- d. The compensator should remain in the DOWN position.

4. Required Facilities

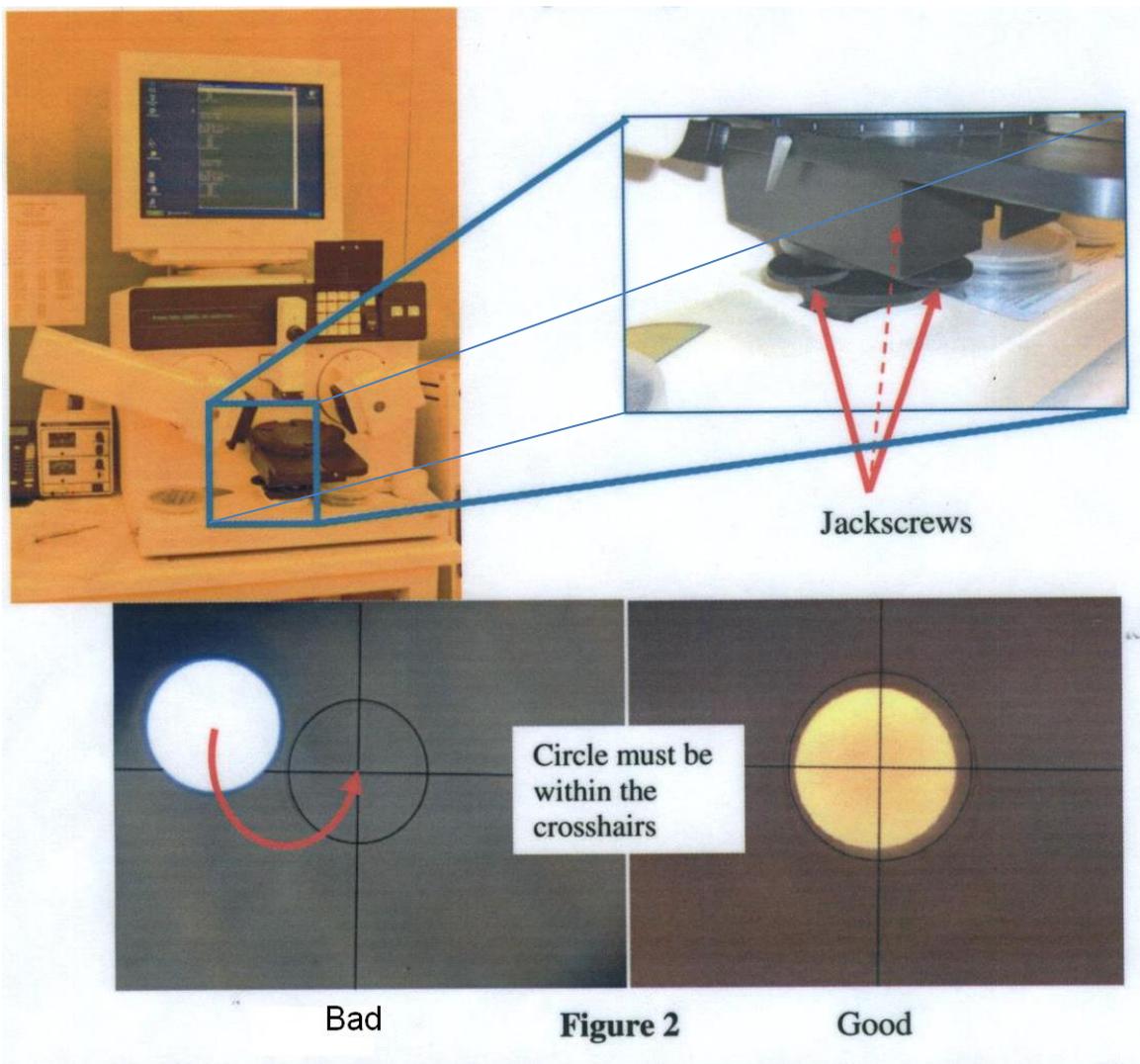
5. Definitions

- a. **TL** is Lower-layer film thickness of a multi layered film, **TU** is upper layer film thickness
- b. **NL** is lower-layer film refractive index of a multi layered film, **NU** is upper-layer refractive index
- c. **KL** is lower-layer film extinction index of a multi-layered film, **KU** is upper-layer film extinction index
- d. **NS** is substrate's refractive index, **KS** is substrate's extinction index

6. Setup

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- Place your wafer on the sample measuring stage.
- Adjust the sample tilt, orient the analyzer module and orient the polarizer. This is accomplished by viewing the area through the optics and rotating the left, right and front circular knobs until the white spot is centered within the prism (Figure 2). Do not over tighten the three leveling knobs (jackscrews) tighter than just a mild snug. You should not need to adjust the knobs more than a half turn.
- Move your wafer until the area you will be measuring is in view. If the laser light is visible, you can use it as an aid in positioning.
- You may need to double click the “Tera Term” Pro icon if the Rudolf screen is not shown on the monitor.



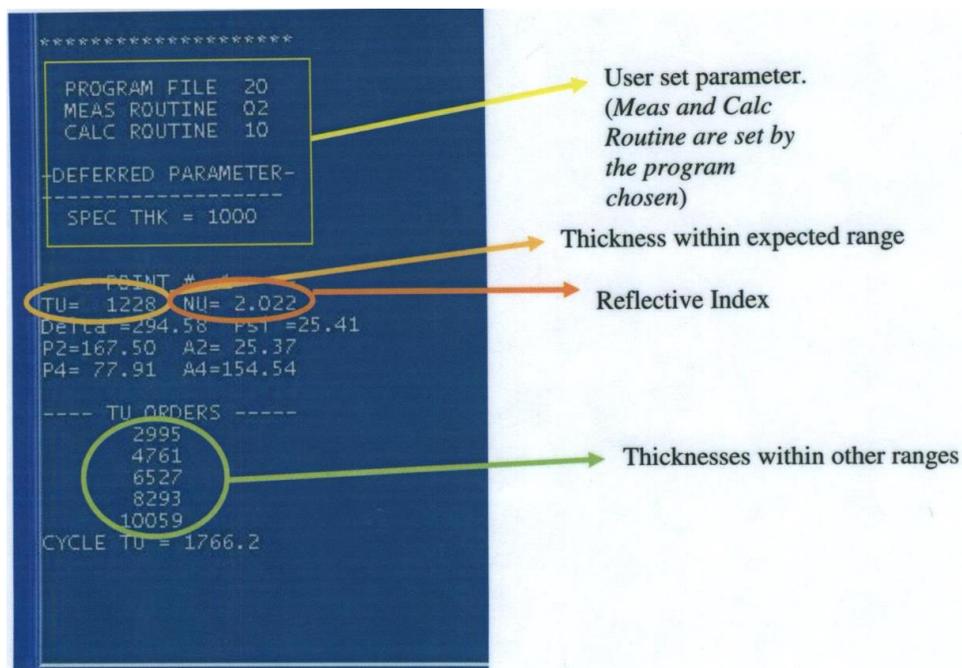
7. Operating Instructions

- After the wafer is aligned, measurements can begin. Press the **RUN** button. Select the program from the table below by pressing the program number and press **ENTER** button.

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PROGRAM	USER INPUT	OUTPUT	
Single layer	19	Sample I.D.	TU and NU
	20	Spec thickness	TU and NU
	21	Spec thickness, NU	TU
	22	Spec thickness	TU and NU
Double layer	32	Spec thickness upper layer, TL, NL	Spec thickness upper layer, TL
	33	Spec thickness, upper layer, TL, NL	Spec thickness upper layer, NL

- b. Answer the necessary questions.
- c. Once the system has all the needed items it will run the measurement program.
- d. Push the **CONT** button for further measurements if using the same program.
- e. The data listing may contain many lines of numbers. The important item is TU i.e. the thickness of the film being measured.
- f. All other **TU ORDERS** lists other orders of thickness that are also possible. Select the correct film thickness. Reconfirm the thickness by using the Nanospec.



8. Problems/Troubleshooting

- a. If the sample is not flat enough, it is necessary to adjust the gain while taking the measurements over the samples surface.