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## Filmetrics-Standard Operating Procedure

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**Badger Name:** K1 Film Thickness Filmetrics

**Revision:** 3

**Model:** F50-EXR

**Revisionist:** Laura Parmeter

**Location:** Keller-Bay 1

**Date:** 3/6/2020

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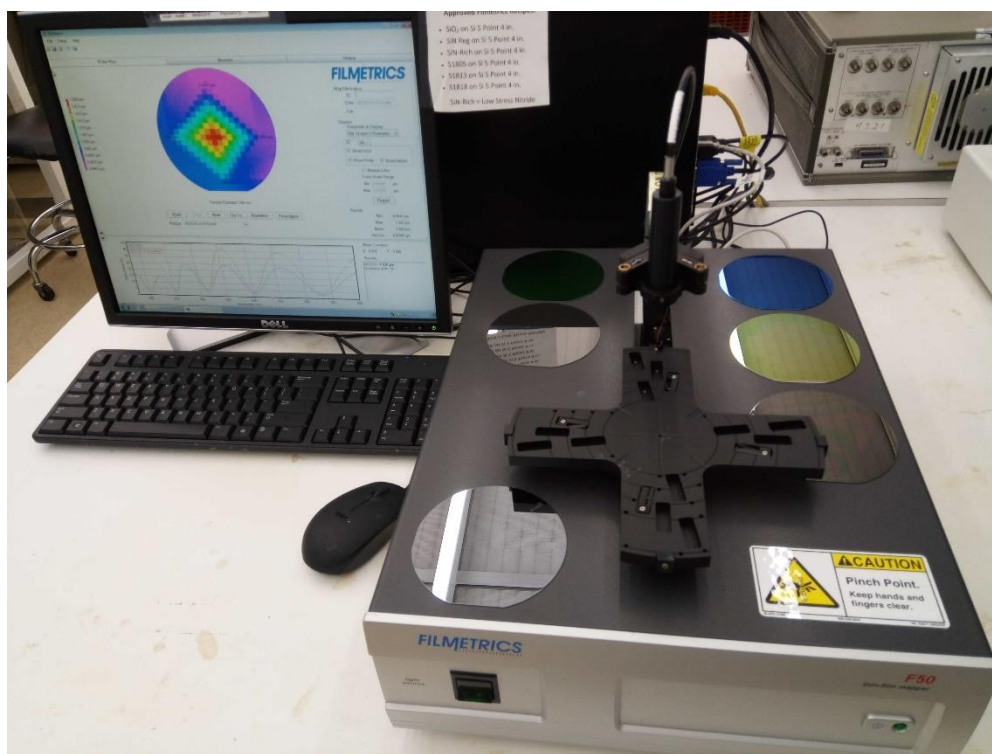
## Filmetrics-Standard Operating Procedure

### 1. Scope

**1.1.** This document provides detailed instructions on how to properly operate the Filmetrics.

### 2. Tool description

**2.1.** The Filmetrics is a thin film measuring system that can measure normal semiconductor films. Transparent films are easiest to measure but it can also be used on thin opaque layers. You should know the expected film thickness within 1000 Ang for the best accuracy. The light source reflection is measured by a fiber optic cable. The wavelength range is from 380nm to 1700nm. Most recipes are for Si substrates, but other substrates can be used such as GaSa, InP, Glass, and more.



**Figure 1** The Filmetrics, model F50-EXR, is located in Keller Hall, Bay 1.

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### 3. Safety

- 3.1. **Keep your hands clear** of the wafer stage, it moves very fast.
- 3.2. Do **NOT** move or adjust anything on the system. If this is done, the damage to the machine could be irreversible.
- 3.3. Do **not** move or adjust the fiber optical cable above the wafer stage.

### 4. Restrictions

- 4.1. Only films that can be measured optically.

### 5. Tools and Equipment

- 5.1. Filmetrics stage and optics
- 5.2. PC
- 5.3. Bare silicon wafer for baseline

### 6. Procedure

#### 6.1. Setup/Baseline

- 6.1.1. The Filmetrics is **not** interlocked with Badger, so you do not need to enable it before use.
- 6.1.2. If the computer is off or the system needs to be restarted, **turn it on** by the main power button. *\*Username and Password are both the same, "measure" and "measure".*
- 6.1.3. Turn on the **lamp** power switch to the unit, located on front of the main unit (see Figure 2). The switch will turn green when it's on.

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**Figure 2** Lamp power switch

- 6.1.4.** Wait a minimum of **5 minutes** for the lamp to warm up. For more precise measurements wait an additional 10 minutes (15 minutes total).
- 6.1.5.** If the software is not running, start it by double clicking the **Filmapper Icon** on the desktop. *\*Again, the Username and Password are both the same, “measure” and “measure” (see Figure 3).*

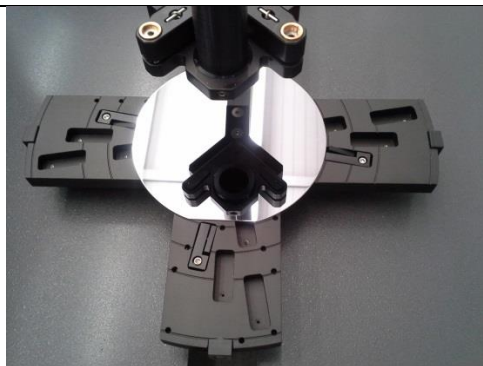


**Figure 3** Log in screen.

- 6.1.6.** Place a bare Si wafer on the center stage (see Figure 4). **Never move or rotate the wafer stage.** *\*For your convenience, a bare Si wafer is located on or near the tool.*

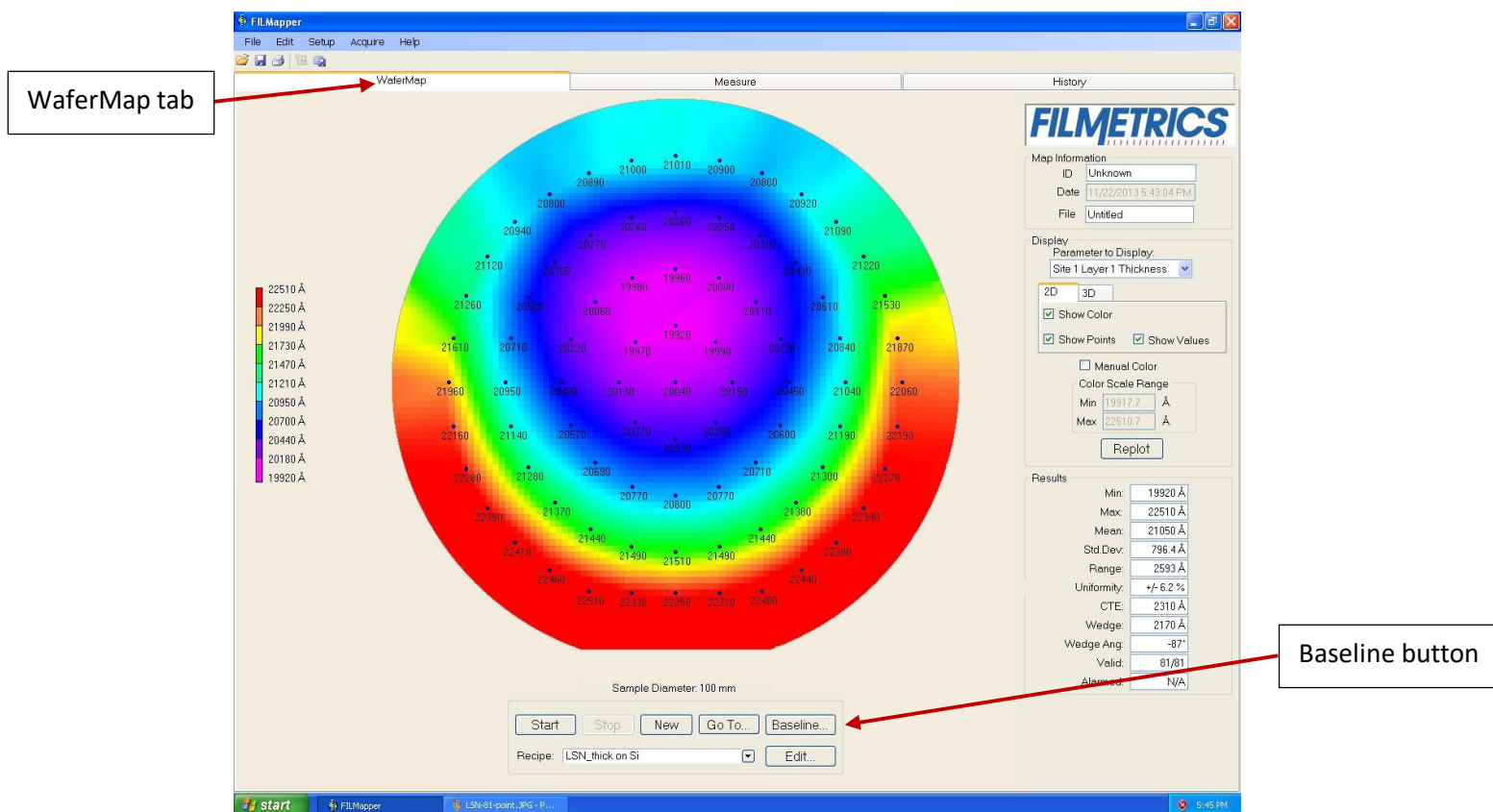
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**Figure 4** A bare Si wafer on the stage for baseline measurement.

**6.1.7.** Take a **baseline measurement** by clicking the “Baseline...” button under the WaferMap tab (see Figure 5).



**Figure 5** WaferMap tab displaying thickness values with statistics lower right.

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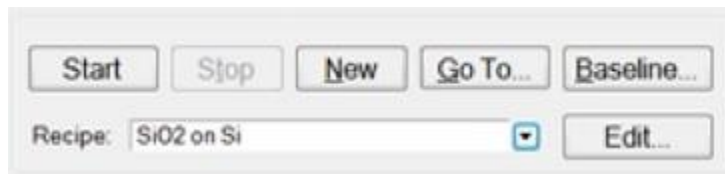
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**6.1.7.1.** Two prompts will pop up before baseline measurement is taken. For the first prompt select **“Take Sample Reflectance”**, for the second prompt select **“Take reflectance standard.”** **NOTE:** The stage will move fast –keep hands away while it measures the wafer. The baseline takes about 10 seconds. At the end of the measurement the stage does a quick calibration, **WAIT** for the baseline prompt box to disappear before removing the bare Si wafer. If you try to remove the wafer too soon you could damage the stage.

### 6.2. Measurement

**6.2.1.** After the baseline has been measured, select your desired **recipe** from the dropdown menu (see Figure 6). *\*Contact MNC staff if you can't find a recipe that will work for your substrate.*



**Figure 6** Select recipe from the dropdown menu (the arrow pointing down)

**6.2.2.** Load your **substrate** to be measured.

**6.2.2.1.** Make sure your **4 inch wafer** is within the tabs on the stage.

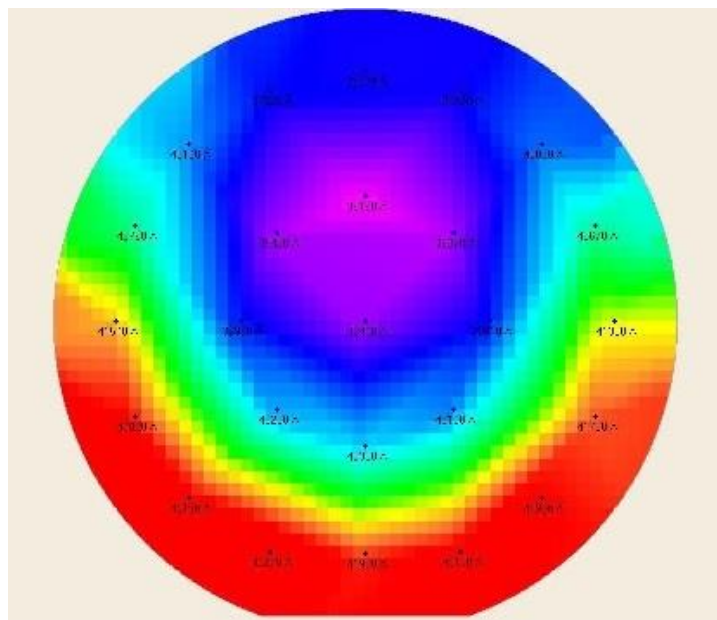
**6.2.2.2.** Small **pieces** can be used by placing them in the center of the stage area and selecting a single measuring point recipe.

**6.2.3.** Click the **“Start”** button to take your measurement.

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**6.2.4.** Film thickness values will appear on a **wafer map** (see Figure 7). The number of points measured is set by which recipe is selected. *\*Click “Replot” button if the display does not update.*



**Figure 7** The system can measure and graph thickness with color, it can also subtract layers between process steps, as measuring etch rates. The  $n$  and  $k$  values can be found and displayed for certain films.

**6.2.5.** After the measurement is done check the graph and the lower right box for measurement **results** and **Goodness of fit** (see Figure 8). **NOTE:** The closer this value is to 1.0 the better the measurement was compared to expected film characteristics.

Measurement Results
SiO <sub>2</sub> = 6298 Å
$n(632.8\text{ nm})=1.7860$
Goodness of fit = 0.9927

**Figure 8** Measurement Results showing Goodness of fit.

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**6.2.6. Record** the data or save the wafer map as an image (.png, .jpg, .bmp format) by

selecting “Save Wafer Map” under File. *\*The computer is not hooked up to the*

*network so you will need to use a USB drive to retrieve your files.*

### 6.3. Additional Capabilities

**6.3.1.** More information and data can be found from the **history tab**.

**6.3.2. Other substrates** can be used- you must first do a baseline for that substrate.

Contact staff if you have questions or need a recipe reviewed.

**6.3.3.** The system software allows the difference between two maps to be compared

(see Figure 9). For example, comparing the film thickness measurements before

and after etching can give you an **etch rate**. After entering in the amount of time

etched, one map is subtracted from another and a resulting map shows the etch

rate.

**6.3.3.1.** Take a pre-measurement of your substrate and save the wafer map.

**6.3.3.2.** Either deposit a film or etch your substrate.

**6.3.3.3.** Take a post-measurement of your substrate and save the wafer map.

**6.3.3.4.** Under File select “Open Difference Map...” Load both your pre and post

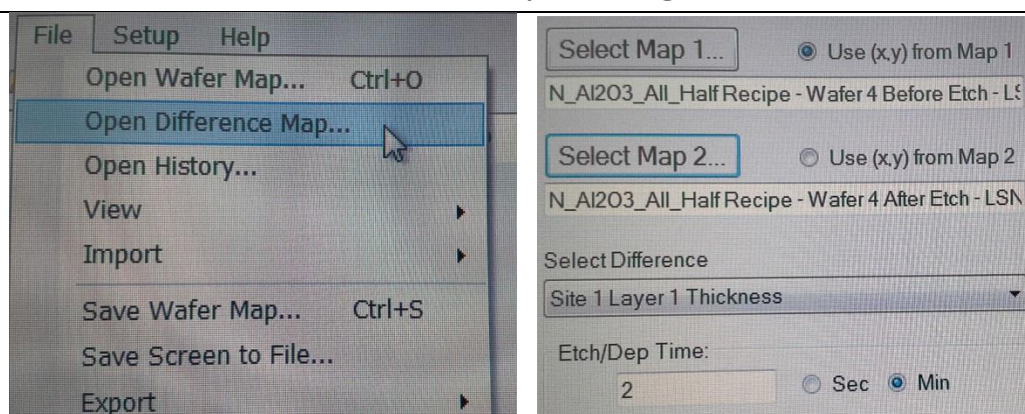
measurement wafer maps. Enter in the etch or deposition time. Click the

“Display Difference Map” button at bottom. Save image if needed.



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*Figure 9 Difference map options.*

### 7. Problems/Troubleshooting

- 7.1. If there seems to be a problem with the software not seeing the system, you can exit the Filmetrics software and try restarting it. If this does not solve the problem, do a normal shutdown/restart of the computer. Select user account **measure**, password is "measure". Then click on the Filmetrics icon. If problem still occurs, contact staff or log system down on Badger.
- 7.2. If the computer has a problem communicating with the unit, the main power switch to the Filmetrics unit should be switched off for ~10 seconds and then back on. The switch is located on back of the main unit.

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### 8. Specifications

Wavelength Range:	380-1700 nm
Thickness Measurement Range*	150 Ang – 250 um
Thickness Req'd to Measure n and k	1000 Ang
Accuracy*	The greater of 0.4% or 20 Ang
Precision (1)	1 Ang
Stability (2)	0.7 Ang
Spot Size	Standard 1.5 mm
Light Source	Tungsten-Halogen

\* Material dependent.S

(1)  $1\sigma$  of 100 measurements of 500 nm SiO-on-Si. Average of  $1\sigma$  over 20 successive days.

(2)  $2\sigma$  of daily average of 100 measurements of 500 nm SiO -on-Si over 20 successive days

**Figure 10** Performance specifications of the F50-EXR system listed from the manufacturer.