Arizona State University NanoFab

FILMETRICS F40 STANDARD OPERATING PROCEDURE

Rev D

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1.0 Purpose / Scope

1.1 The Filmetrics F40 uses spectroscopic reflectometry to measure and analyze single layer or multilayer film stacks. The detector is mounted on an optical microscope, so known, selected areas on patterned wafers can be evaluated following deposition or etch steps. The F40 is a valuable technique to monitor a sequence of process steps. This SOP provides the procedures to set-up and calibrate the F40 system and then measure the thickness or thicknesses of a film or multiple films on known substrates. The tool is limited to Visible light from 400nm to 850nm wavelengths.

2.0 Reference Documents

2.1 Filmetrics F40 manual from Filmetrics.com.

3.0 Equipment/Supplies/Material

3.1 Zeiss Microscope and microscope light source.

3.2 Computer with AmScope and FILMeasure software.

3.3 Clean silicon reference wafer.

3.4 Tweezers to handle wafers.

4.0 Safety

4.1 Follow all safety procedures outlined in the NanoFab Handbook

4.2 Do not attempt to repair the tool under any circumstances. Submit a service request and contact ASU NanoFab staff.

5.0 Setup Procedures

5.1 The Zeiss microscope has four objectives for viewing: 4x, 16x, 40x & 80x. Please insure you match the objective to the objective selected on the Filmetrics software.

5.2 Open the Filmetrics software by clicking on the FILMeasure icon on the desktop.

5.3 Turn ON Microscope lamp power B setting on voltage meter between 4-7v. Ensure light has been On and stabilized for 5 minutes before calibrating the baseline.

5.3.1 Ensure the meter display toggle is selected to B.

5.3.2 Lower A microscope light will not be used for measurements.

5.4 The Zeiss light intensity aperture on the right side of scope should be set to 8 (max setting).

6.0 Baseline Calibration

6.1 Select the appropriate microscope objective, either 4X or 16x lens.

6.2 Select Baseline button and follow the prompts.

6.2.1 Step 1 of 3: Take Sample Reflectance.

6.2.1.1 Load your actual sample to be measured.

6.2.1.2 Ensure Reflectance standard matches your substrate material (silicon).

6.2.1.3 Rt lever Aperture light knob ← (Light in eye lens).

6.2.1.4 Focus wafer.

6.2.1.5 Rt lever aperture knob to allow measurement → (No light in eye lens).

6.2.1.6 Depress Take Reflectance Standard button.

6.2.2 Step 2 of 3: Take Reflectance Standard.

6.2.2.1 Load your bare silicon reference substrate.

6.2.2.2 Ensure Reflectance standard matches your substrate material (silicon).

6.2.2.3 Rt lever Aperture light knob ← (Light in eye lens).

6.2.2.4 Focus wafer.

6.2.2.5 Rt lever aperture knob to allow measurement → (No light in eye lens).

6.2.2.6 Depress Take Reflectance Standard button.

6.2.2.7 If you receive a Spectrometer peak intensity is xxx% of previous error, select OK. Select Next on the Step 2 of 3 window.

6.2.3 Step 3 of 3: Take Background.

6.2.3.1 Place Rt lever Aperture light knob ← (Light in eye lens).

6.2.3.2 Depress Take Background button.

6.2.3.3 Finish. Depress Finish to complete Baseline.

7.0 Sample Measurement

7.1 Load your sample to be measured on the stage.

7.1.1.1 Ensure Reflectance standard matches your substrate material (silicon).

7.1.1.2 Rt lever Aperture light knob ← (Light in eye Lens).

7.1.1.3 Focus wafer.

7.1.1.4 Rt lever aperture knob to allow measurement → (No light in eye lens).

7.2 Ensure the Objective on the Filmetrics program matches the microscope objective.

7.3 Select the User Recipe you intend to use to model your measurement.

7.4 Select Edit Structure button to view Structure selection.

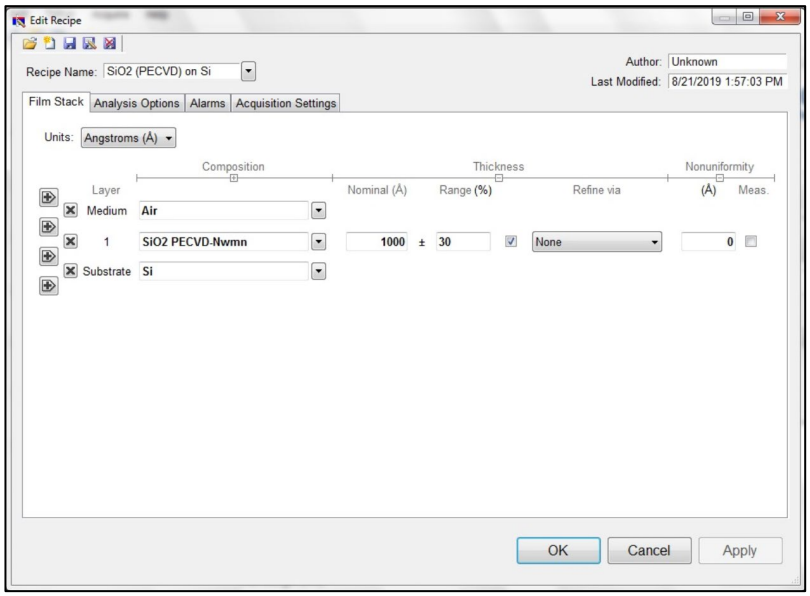
7.5 Edit Structure Film Stack Tab.

7.5.1 Ensure the intended material layers on the recipe are correct or require updating.

7.5.2 Enter an approximate film thickness if known.

7.5.3 Checking the Fit boxes ensures the parameters is considered for the fitting of the data.

7.5.4 Select or deselect Fit boxes or options ultimately to improve the Goodness of Fit (GOF) value.



7.6 Edit Structure Analysis Options Tab.

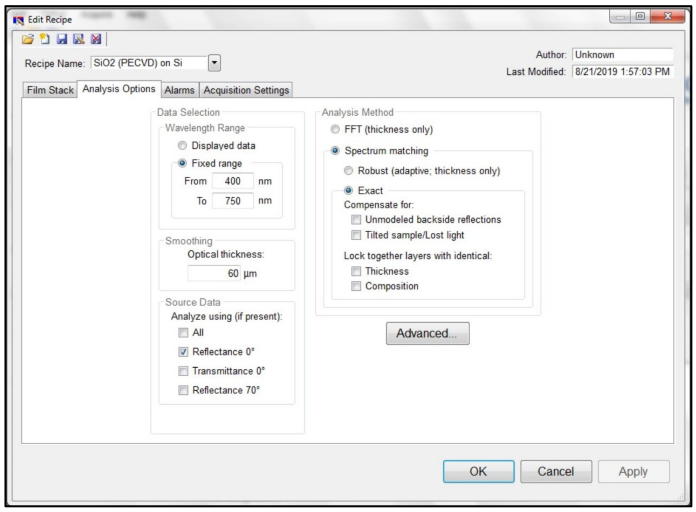
7.6.1 The Grid method searches the entire allowed thickness range to find best initial thickness.

7.6.2 The Fourier search for thickness analyzes the oscillations present in the spectrum and determines the film thickness.

7.6.3 Measurement Type will remain Reflection 0°.

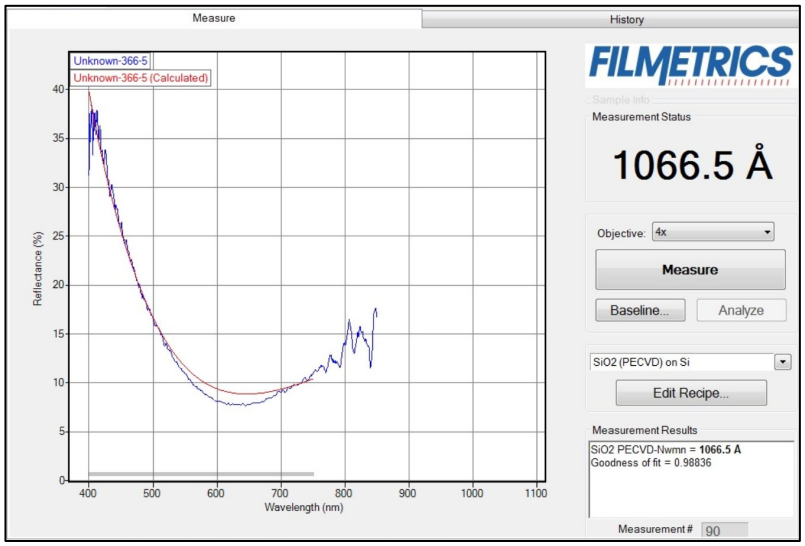
7.6.4 Analyzed Data: The wavelengths of the spectrum used for measurements are 400-850nm with Displayed Data Selection. They can be set to another value within the range using Fixed Range.

7.6.5 Smoothing/ Optical Thickness: This performs wavelength averaging on the measured spectra. Default value is 60µm. Decreasing this value could improve signal to noise levels.



7.7 Depress the Measure button to display reflectance and evaluate the thickness values and GOF parameters.

7.8 The displayed spectrum displays the measured data (Blue) and calculated model (Red) reflections. The measured data and the calculated will be close if the selected recipe matches the film.



7.9 Recommendations for improved accuracy.

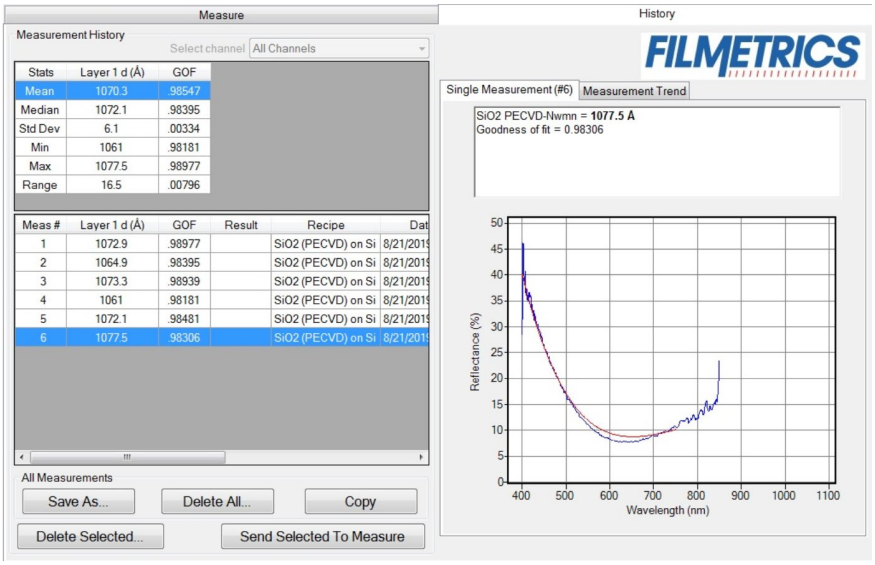
7.9.1 Restricting the wavelength can be helpful if n and k are not accurate over the whole wavelength range.

7.9.2 Slight amounts of surface or interface roughness may be present that will decrease the accuracy of the measurements.

8.0 Measurement Statistics

8.1 One the Filmetrics main display page, select the History Tab at the top right of the page.

8.2 The Measurement History table will compile measured data from a sample to include Median, Std Dev, Min, Max and Range. You may clear and save the data.



9.0 Revision History

Effective Date	Originator	DESCRIPTION OF REVISION	Issue
05/05/09	N/A	Initial Release	A
07/13/07	Paul Boland	Update	B
04/01/15	Wayne Paulson	Update instructions & convert to SOP format	C
09/03/19	Jaime Quintero	Checklist format	D