SOP: General Operation of the Filmetrics F40 Thin-Film Analyzer

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General Information

The Filmetrics F40 Thin-Film Analyzer is a tabletop tool capable of quick and accurate measurement of thickness and optical constants (n and k) of transparent thin films. This system is equipped with a visible to NIR light source suitable for the measurement of films thicknesses in the range of 20 nm – 150 µm.[2] Sampling spot size is approximately 20 microns[3]. Thin films typically measured includes oxides, nitrides, resists, polysilicon, and other optical coatings. Not suitable for use with very rough or opaque films.

[1] SOP adapted from Operation Manual for the F40 Reversion 8.12.4.0 ©2019

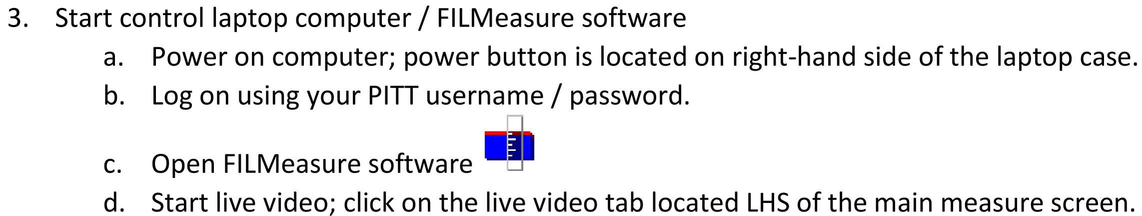
[2] Usable thickness range is material dependent.

[3] Optical configuration includes a 15x reflective objective and 300 µm circular aperture

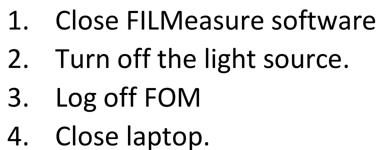
Start Up / Powering Up the System

1. Via FOM, logon on to start your session.
2. Turn on the light source; source is switched using the green button located on lower left-hand side of the F40 integrated spectrometer / source

Light source should stabilize within 10 minutes of power on.

3. Start control laptop computer / FILMeasure software
   a. Power on computer; power button is located on right-hand side of the laptop case.
   b. Log on using your PITT username / password.
   c. Open FILMeasure software 
   d. Start live video; click on the live video tab located LHS of the main measure screen.

Shut Down / Powering Down the System

1. Close FILMeasure software 
2. Turn off the light source.
3. Log off FOM
4. Close laptop.

General Operation

Prior to collecting data, configure a recipe / fitting method and complete the baseline measurement procedure.

Recipe Setup / Fitting method.

1. Select a preconfigured recipe; preexisting recipes may be selected using the drop-down control located above the “Edit Recipe” button.
2. If suitable recipe does not exist; configure a new recipe using the “Edit Recipe” window (See Editing Film Recipes)

Do not over-write recipes in the recipe root folder.

Baseline Measurement Procedure

During baseline procedure three measurements are collected. First the sample reflectance is measured, then reflectance of a standard material (usually a clean Si substrate) is measured, before finally the dark / background signal is collected.

1. Start Live video, (see Start Up / Powering Up the System step 2.d)
2. Place sample on stage, focus sample surface using the Z-micrometer drive and align region of interest under the sampling aperture.
3. Click the “Baseline” button and collect sample reflectance using the “Acquire sample” button.
4. Position reflectance standard, adjust focus as necessary and collect standard reflectance using the “Acquire reference” button.

   It is possible to use Si wafer as the reflectance standard for measurements of a sample with a wide variety of substrates (GaAs, InP, glass, plastic ,etc.)

5. Collect dark / background signal. Position the stage aperture or 45° reference sample under the objective's focus and collect background using the "Acquire background" button.

The center of X-Y stage contains an aperture convenient for collecting dark signal. To align this aperture, set the X / Y stage micrometer drives to 20 mm and visually verify that the measurement spot is centered in the stage aperture.

It is recommended to periodically re-baseline the system to account for any changes instrument condition (for example source intensity drift or movement of fiber optic patch cables)

Sample Measurement

1. Load sample, place region-of-interest under the sampling aperture and adjust sample surface as required.
2. Collect sample reflectance, click the "Measure" button.
3. Evaluate the measured reflectance signal (blue curve), the modelled data (red curve) and the goodness-of fit [GOF]

For well fit data, the wavelengths of the peaks and valleys of the reflectance signal and model curves should strongly correlate. The amplitude of the peaks and valleys may display significant differences.

GOF between above 0.8 are typical for well modeled systems. If GOF is lower than 0.8 consider modifying recipe and / or fitting procedure.

4. Evaluate additional regions of interest by repeating (Sample Measurement steps 1-3)

Basic Data Analysis

1. Sample statistics: When multiple regions have been measured, it is possible to use the "History" tab to display and evaluate statistics of a multi-site data.
2. Numerous options for exporting data and screen view are available via the "File" menu commands.

Editing Film Recipes

Film recipes are used to define film structure, measurement units, fit initial conditions / constraints, and analysis options. Each recipe is composed of 1 or more film layers and 1 substrate materials.

- Film Stack tab: (See Figure 2)
    - Layers can be inserted, changed, or deleted using the "Film Stack" tab of the Edit Recipe window. Layer material can be set using the "Composition" drop-down controls.
    - "Measure" check boxes on this tab are used to designate fitted parameters. (See orange circle in Figure 2)
    - Layer analysis method (Grid, FFT or None) is selected from the "Refine" via drop-down control.

Do’s and Do-Not’s

Do’s

- Allow at least 10 minutes for light source to stabilize after power on. Very thin film, < 250 nm, may require longer warm up times.

Do Not’s

- Rapidly power cycle the light source.
- Do not crash the objective lens into sample surface

Resources

- Manufacturer resources
  - Refractive Index Database – Table of Refractive Index Values for Thin Film Thickness Measurement (filmetrics.com)
  - Spectral Reflectance Calculator for Thin-Film Stacks (filmetrics.com)
  - Thin Film Thickness Measurement Videos (filmetrics.com)
  - Filmetrics Operation Manual for the F40

Figures

F40 Thin-Film Analyzer Anatomy & Accessories.

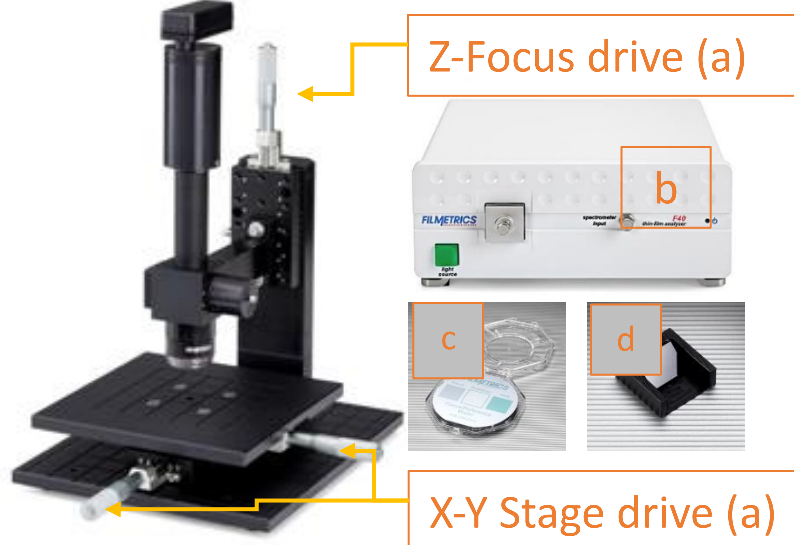


Figure 1

a) Microscope optics platform. Includes calibrated color camera and 40 mm of X/Y/Focus travel
b) Integrated spectrometer / light source
c) TS-Focus – SiO2-4-10000 Focus / Thickness standard, 10000 Å thickness standard
d) BK7 45° Reflectance Standard

Edit Recipe / Film Stack

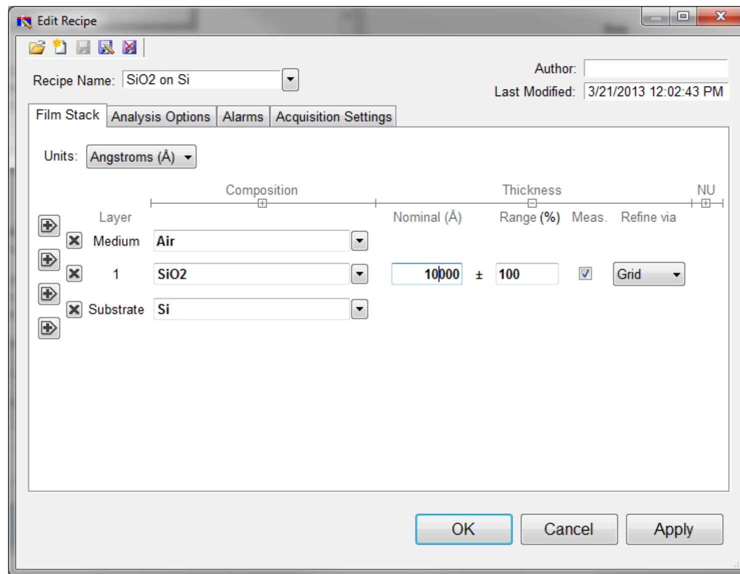


Figure 2

Revision History

Date	Originator	Description	Version
April 2022	Daniel Lamont	Initial SOP Release	0.XXX