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Nanospec / AFT Film Thickness Measurement System

Capabilities and Requirements

Measures film thicknesses ranging from 100 Å to 50 µm. Wafers sized 3" – 6" can be used. The following film types are measurable using the machine's visible light:

Oxide on Silicon	Nitride on Silicon	Negative resist on Silicon
Polysilicon on Oxide	Negative resist on Oxide	Nitride on Oxide
Thin Oxide on Silicon	Thin Nitride on Silicon	Polyimide on Silicon
Positive resist on Silicon	Positive resist on Oxide	Red resist on Silicon
	Thick Films	

Nomenclature Key

- Questions posed by software are in **Bold** and begin with caps.
- Specific keys located on the keyboard are surrounded by < > in this document.

Machine Operation

Power Up

1. Power on the monitor
2. Power on the PC – located below the monitor
3. Log In
4. Allow 30 minute warm-up before using

Initialization

1. **Enable Datalink?** <NO>
2. **UV Optics?** <NO>
3. **VT?** <NO>
4. **Infinity Objective?** <NO>
5. **Variable Exit Slit?** <NO>
6. **Is Configuration Correct?** <NO>
7. **Is Wavelength 480?**
   a. Check wavelength display, which is located on the lower right of the front face of the spectrophotometer head.
   b. Answer question.
   c. If <YES>, move to step 3.
   d. If <NO>, then Enter Wavelength on wavelength display
   e. Return to step 2.
8. **Refractive Index Option?** <YES>
9. **Enable Printer?** <YES>

Set Gain Control

1. Use (a) bare Si wafer (no oxides), (b) 5x objective
2. ***Focus*** on reference
   a. Focus is achieved when an octagon (8-sided polygon) with crisp edges is realized. A black dot in the center of the octagon is also apparent.
   b. Use focus knobs located below stage to focus.
   c. Be sure black dot is located within boundaries of any features on the substrate.
      i. If black dot is too large, then use a higher power objective and refocus.
   d. ***Critical Focus*** required for film thickness suspected to be <200 A:
      i. Focus using 50x objective
      ii. Switch back to 5x objective for use. Do not alter focus.

3. Adjust Gain Control knob until the Photo Intensity Meter reads between 65.0 and 67.0.
    a. Gain Control knob located inside the cover on the bottom right of the spectrophotometer head. Adjust if by inserting a forefinger in the open back of the cover. **DO NOT ADJUST "ZERO", located to the left of GAIN.**
    b. Photo Intensity Meter located on left side of front face of spectrophotometer head.
4. Press <ENTER>

Setup

1. Available Test Program Menu page
    a. Review description of each Program Test attached at the end of this document.
    b. Note: may want to measure thickness of underlying film before depositing resist or outer film. Or can simultaneously measure underlying film and outer film thicknesses; but this option allows increased chances for error if unconventional underlayer films are used.
2. Enter program number
3. Focus on sample using the method described in Step 2 of Set Gain Control on page 1 of this document with a chosen objective lens
    a. Specific objective lens may be necessary. See technical description of Program Test attached.
4. **Enter Objective Lens:** Enter the code for the objective lens in use.

Referencing

1. Be sure to use a reference if the machine is just powered up, or if your program requires referencing every 30 minutes.
    a. A reference is typically a clean, bare silicon wafer, which is stored near machine.
2. If not necessary, then skip to Measuring section.
3. Place reference on stage and focus.
4. Make certain the 5x objective lens is selected. Programs 7 and 8 require Critical Focusing, as described on page 1 of this document.
5. Press <MEAS> to measure the film thickness of the reference.
6. Remove the reference.
7. **Enter Calibration Sample Thickness:** this step is only appears for thickness measurements <200 Å (Programs 7 and 8).
    a. Place calibration sample on stage and focus.
    b. Press <MEAS> to measure the film thickness on the calibration sample.
    c. Remove the calibration sample.
8. **Scan New Reference?** <NO>

Measuring

1. **Enter Sample ID:** Any identification system you want to use to organize your samples is appropriate for sample ID.
    a. Up to 25 alphanumeric characters, case sensitive.
2. **Enter Oxide Thickness:**
    a. The oxide is the underlayer thickness deposited prior to the layer being measured.
    b. If thickness is known, enter value if using programs 4, 5, 6, 11, or 253
    c. If this layer is unknown, see *Determination of Underlayer Thickness* on page 3 of this document.

3. **Enter Refractive Index:** (of film being measured)
   a. Default Value: Press <ENTER> to use the default values determined by selection of the program in Step 1 of Setup.
   b. Known Value: Or enter the Refractive Index of the film being measured.
   c. Unknown Value: See *Determination of Refractive Index* on page 3 of this document.
4. Place sample on stage and focus.
   a. For Programs 7 and 8 Critical Focusing is necessary.
5. Press <MEAS> to obtain film thickness.

6. **Accept Measurement?**
   a. Determine if measurement is acceptable and answer with <YES> or <NO>. If errors are present, decide if error disqualifies data – see error Messages attached to this document.
   b. The <MEAS> key accepts the current measurement and then proceeds directly to next measurement.
7. Continue taking measurements until satisfied.
8. To repeat this same test on another wafer applying a new sample ID, press <NEW TEST>. Return to instructions in Step 1 of Measuring.
9. To select a new Test Program, press <CALIB>. The Available Programs Menu will appear. Return to instructions in Step 1 of Setup.

Determination of Underlayer Thickness

- Allows simultaneous measurement of underlayer and outer film layer thickness using Programs 4, 5, 6, 11, or 253.
  1. With Available Programs screen displayed, toggle <F12>
     - Ensure the "Calc OX" message appears in upper right corner of screen.
     - Select one of the above listed programs that meet the sample and testing specifications.
  2. **Calculate Oxide Thickness?** Press <YES> to permit simultaneous determination of both layers' thicknesses.
  3. **Enter Oxide Layer Thickness Estimate:** Enter the best guess of the underlayer thickness. Press <ENTER>.
  4. Locate, focus, and measure a sample as described in Measuring section.
  5. Resulting data presented as tu / t1
     - tu = thickness of oxide or underlayer
     - t1 = thickness of outer or film layer

Determination of Refractive Index

- Allows easy and convenient determination of both outer film thickness and refractive index.
  1. With Available Programs screen displayed, toggle <F13>
     - Ensure "Calc RI" message appears in upper right corner of screen.
       - If so, move to Step 2.
       - If not, type RESET while pressing <CTRL> to initialize machine. Then press <YES> in response to Refractive Index Option?
       - Start again with Step 1 of this section.
  2. Select a Single-layer test program that meets sample and testing specifications.
  3. **Calculate Refractive Index?** <YES>
  4. Resulting data presented as t / n
     - t = thickness of film
     - n = refractive index of film

Reflectance Mode

- Allows % reflectance data determined from 3 different user selected wavelengths between 370 – 800 nm.

1. Select Test Program 12 on Available Programs Menu.
2. **Number of Reflectance Wavelengths:** select 1 – 3, press <ENTER>.
3. **Enter Desired Wavelength:** type the wavelengths and press <ENTER>
    - If use wavelength <460 nm, remove yellow filter in vertical illuminator slot located just behind the viewing assembly.
4. Locate, focus, and measure a sample as described in Measuring section.
5. Resulting data determined for each wavelength and presented in thickness of film (t) and % reflectance (n).

Printing

1. Press <PRINT SCRN>
2. If doesn't work, then enable printer:
    a. Type PRNTR while holding <CTRL>. This immediately activates the printer.
    b. Press <PRINT SCRN>

Power Down

1. Remove sample
2. Power off PC (lower rear of PC)
3. Power off CRT
4. Log Out