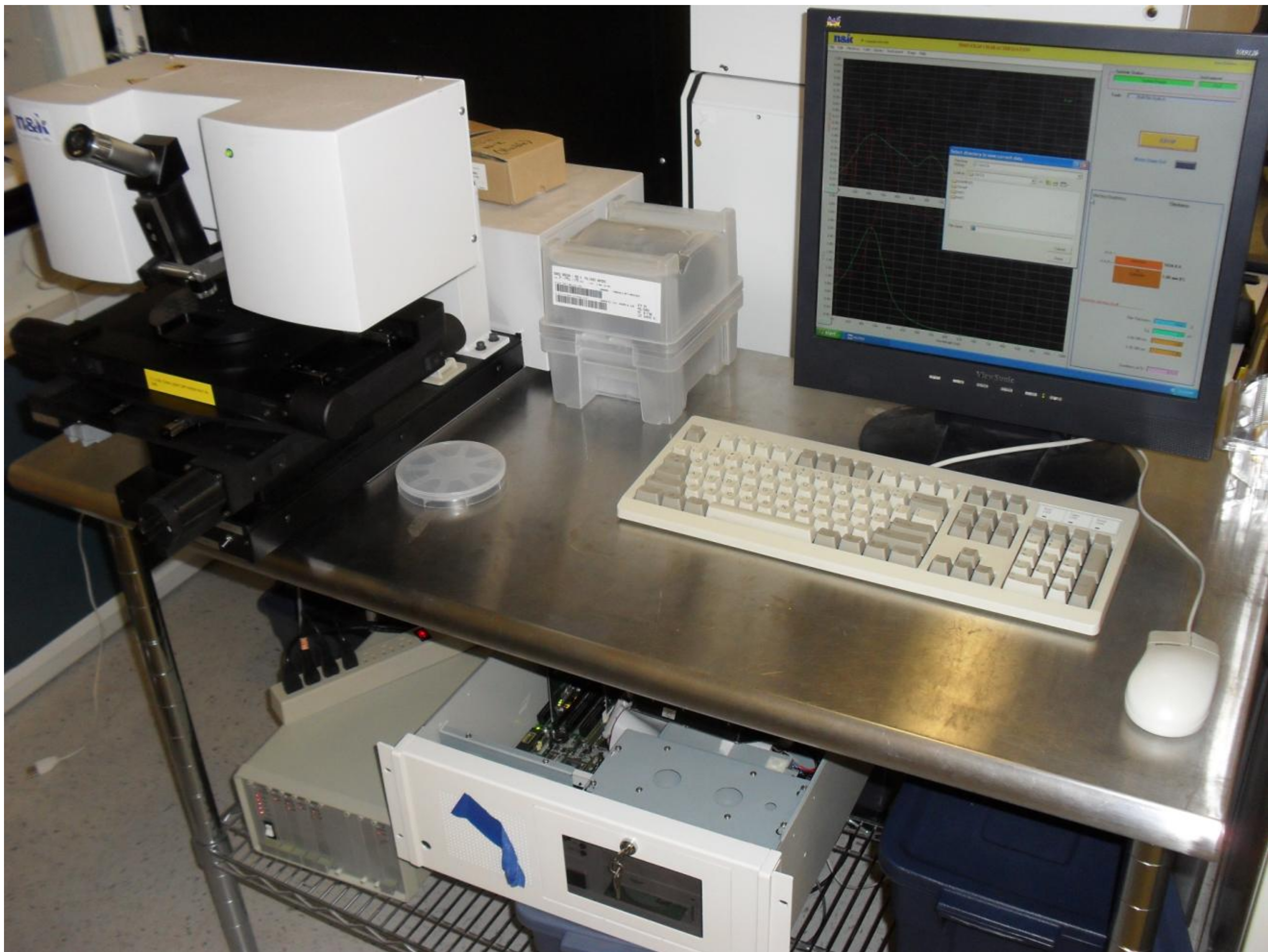
N & K 1500 Analyzer SOP



1. Scope

1.1 This document provides procedures for setup and operating the N & K 1500 Thin Film characterization system.

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3. Reference Documents

3.1 Referenced within this Document

3.1.1 None

3.2 External Documents

3.2.1 Help file from N&K 1500.

4. Equipment and/or Materials

4.1 N & K 1500 Analyzer System

4.2 Wafer

5. Safety

5.1 Follow all Nanofab safety procedures.

6. Setup Procedures

6.1 Power ON the X-Y stage, if needed (it will normally be ON; Lit red lights indicate that it is ON). See *Figure 1*.

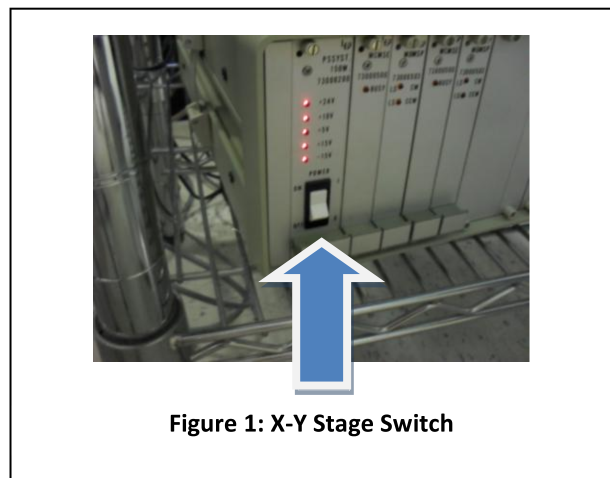

Figure 1: X-Y Stage Switch

6.2 Power on the spectrophotometer switch. Green light is lit when it is on. See *figure 2*.

6.2.1 Wait for spectrophotometer LED to turn green. See *Figure 2*.

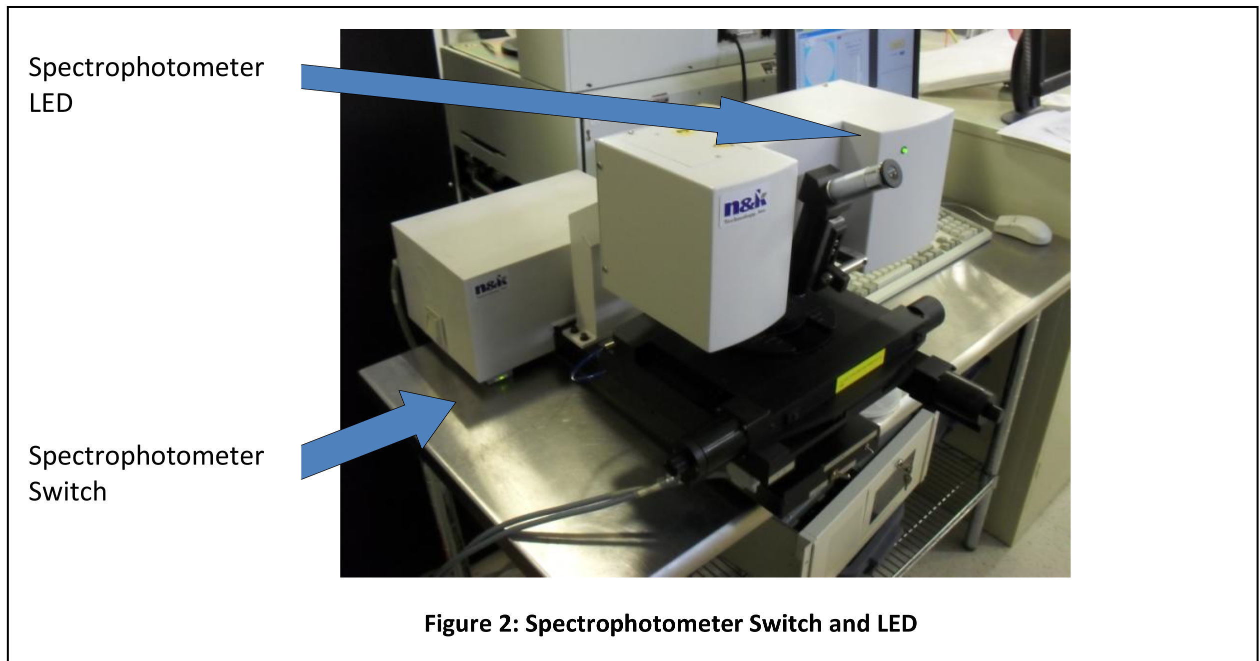

Figure 2: Spectrophotometer Switch and LED

6.2.2 Turn on the PC and monitor (if not already on).

6.2.3 Start software for N&K (if not already on screen)

6.2.3.1 Select START, PROGRAMS, STARTUP, and then click on N&K Software.

6.2.4 **Wait 1 hour for the spectrophotometer to warm up and stabilize.**
Before any measurements, the spectrophotometer must be allowed to warm-up for 1 hour after power-on. Failure to do so may result in inaccurate measurements.

7. Procedures

7.1 Do a baseline measurement

7.1.1 Click on the Move Stage Out button on the N&K software screen to move the stage out. See *Figure 3.*

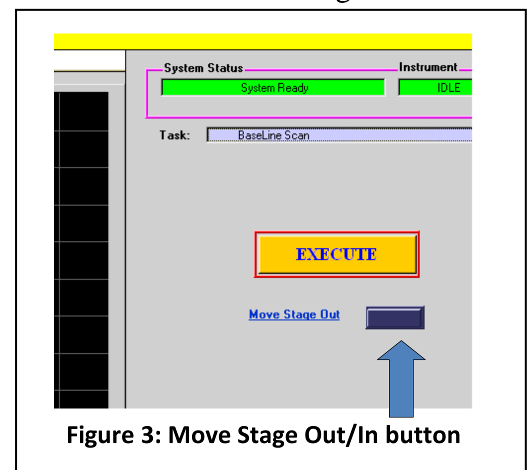

Figure 3: Move Stage Out/In button

7.1.2 Place a clean bare silicon wafer or smaller piece (face up) on the chuck.
(The thickness of the sample used for baseline measurement must match that of the samples that are being measured. To measure 4" wafers, perform the baseline using a 4" bare silicon wafer and to measure 6" wafers perform the baseline with a 6" bare silicon wafer. If measuring smaller piece(s), do the baseline with bare, clean pieces of the same thickness as sample that will be measured.)

7.1.3 Click on the MOVE STAGE IN button to return the stage back to the center. See *Figure 3*

7.1.4 Select Baseline scan from the Task menu

7.1.5 Click on the Execute button

7.1.5.1 The fluctuation of the baseline will be displayed after the measurement. Click on OK if values given are ≤ .15%.

7.1.6 Visually inspect the base line to make sure that it is flat on the 0.99-1.01 scale.
This indicates that the lamps have had time to warm-up, the optics are properly aligned, the system has reached a stable equilibrium and sample measurement can take place.

7.1.7 Click on the Move Stage Out button on the N&K software screen to move the stage out. See *Figure 3.*

7.1.8 Remove baseline Wafer.

7.2 Repeat baseline scan every 4 hours if the machine has been continuously on.

7.3 **Load wafer:**

7.3.1 **Place the sample to be measured on the wafer holder.** Set the wafer face up and the flat side (or notch) sitting toward the back of the machine. Center the wafer on the wafer holder.

7.3.2 Click on the MOVE STAGE IN button to return the stage back to the center. See *Figure 3*

7.4 Click on Stage on the menu bar, then select Map Wafer from the dropdown menu**.**

7.5 In the Mapping window, click on Wafer on the menu bar then select Size from the dropdown menu. Choose the appropriate size for the wafer. Select 4 inch wafer size for pieces ≤ 4 inches.

7.5.1 Choose map by selecting file then open. Then select desired map. For smaller pieces 1cmx1cm9pts or 25pts may be selected.

7.5.1.1 Click on load.

7.5.2 Close the mapping window.

7.6 **Do a sample measurement**.

7.6.1 The measurement can be done by either selecting Single Measurement/Data Collection and analysis or selecting Multiple Measurements/Data collection and analysis in the Task menu.

7.6.2 Click on the Execute button.

7.6.3 Save the results by selecting File from the menu bar then Save data and then select Analysis Results

7.6.3.1 Create a file for your data.

7.6.3.2 Give your data a name and save it.

7.7 **Analyze Data - Select a film structure**.

7.7.1 Select Task/Data Analysis then select single or multiple, (Notice this will toggle it between single or multi in the purple task bar, no new windows will open).

7.7.2 Choose the film structure matching that of the sample by selecting FilmStruc/Default Film Structures and selecting the proper one from the list. <u>**If film is not found go to Sec 8.0**</u>

7.7.3 If layer thicknesses need to be set, select FilmStruc from the menu bar then select R&D.

7.7.3.1 Enter the thicknesses in the window that pops up.

7.7.3.2 Click on OK to close the window.

7.7.4 Click Execute.

After a short wait the calculated reflectance spectrum will be shown on the graph with the measured reflectance spectrum. In addition, the n and k spectra will be plotted on the lower graph.

Once a film structure is selected, it will stay there until a new one is created. Therefore, you only need to do it once if you are analyzing a set of samples with similar film structures. It is very important to choose a film structure as close as possible to the actual case in order to obtain an accurate result.

8. Build up a film structure

8.1 **Analysis/Build up of film structure <u>with no more than 1 unknown.</u>**

8.1.1 Select Task/Data Analysis.

8.1.2 Choose FilmStruc from the menu bar and select R&D.

8.1.3 In the window that pops up select the proper number of layers for the film structure at the top of the window. A diagram of the film structure is shown in the middle of the page.

8.1.4 For each layer with n and k known click on the layer in the diagram and select the proper n and k table from the list. For the unknown layer choose Unknown.

8.1.5 Select the proper starting point for the unknown layer in the lower left corner of the screen. If the proper starting point doesn't appear in the pop-up a different group can be selected by clicking on the button labeled Library to switch to another group.

8.1.6 Enter starting values for all thicknesses. If you are very confident about any of the layer thicknesses they can be fixed by toggling the Fixed/Vary button to Fixed.

8.1.7 Enter the surface roughness, if any, and fix it or allow it to vary as appropriate.

8.1.8 Click OK to close the window.

8.1.9 Click Execute to begin fitting the reflectance data. In a few moments the result will be displayed on the screen.

8.2 **Analysis of Samples <u>with More than One Unknown Layer</u>**

If a sample has more than one unknown layer (meaning that the n and k spectra are unknown for more than one layer) a series of samples must be prepared. For this description we will

assume that the substrate is a type which has already been characterized and, therefore, has an n & k table. If the first film (the film directly on top of the substrate) is unknown one sample should be prepared which has just the first film on the substrate with no other films. If the second film is also unknown a second sample needs to be prepared which includes the first and second films on the substrate.

The procedure is:

8.2.1 Analyze the sample that has been prepared with this one unknown film. This sample is analyzed as described previously in 8.1.

8.2.2 After analysis of the first sample the n and k spectra for the unknown layer can be saved by selecting the Library menu item and clicking on N & K Table….

8.2.3 Click on Add File. Enter a descriptive name for the new n & k table. Now this n and k table is available to be used in the analysis of the other samples.

8.2.4 Repeat steps 8.2.1-8.2.3 for the next sample that has just one unknown film. After performing this procedure for each sample, the n and k tables will exist for all layers except for one; therefore the original sample structure can now be analyzed.

Samples with up to six films on the substrate can be analyzed. The n and k spectra for all but one of the films and of the substrate must be known and the software will determine the n and k spectra for the unknown film. The thickness of all the layers can also be determined.

Once a film structure is built, it will stay there until a new one is created. Therefore, you only need to do it once if you are analyzing a set of samples with similar film structures. It is very important to build up a film structure as close as possible to the actual case in order to obtain an accurate result.

9. Shutting Down the System

9.1 Turn off the off the spectrophotometer. See *figure 2*.(unless you will be using it again the same day)

9.2 Leave computer and software ON.

10. Revision History

Rev	Date	Originator	Description of Changes
1	9 May 2012	S. Butler	Initial Release.