



Operating Instructions

SpecEI-2000-VIS-NIR

Revision 042009

Read this manual before you attempt to use this instrument

1 Safety Instructions

Instructions: All the safety and operating instructions should be read before the unit is operated. Before using the power supply for the first time check for transport damage.

Warning: All warnings on the unit and in the operating instructions should be adhered to.

Operating Environment:

Moisture:

The unit is designed for operation in dry rooms only

Ventilation:

The unit should be situated so that its location or position does not interfere with its proper ventilation

Heat:

The unit should be situated away from radiators, hot bodies, ovens or other heat sources

Power sources:

The unit should be connected to a power supply only of the type described in the operating instructions or as marked on the unit

Object and liquid entry:

Care should be taken that objects do not fall, or liquids spilled into the enclosure through openings.

Contents:

Your package should contain

- SpecEI-2000-VIS-NIR
- SpecEI Power Supply
- Power Cable with Country Connector
- Computer with Keyboard and Mouse
- USB Interface Cable
- Serial Interface Cable (male-female)
- Serial Interface Cable (female-female)
- Software CD
- SpecEI-2000-VIS-NIR Operating Instructions
- Scout Software CD
- Scout Protection Key (USB-Dongle)
- Scout Manual

Unpacking:

1. Unpack your new assembly carefully. Dropping this instrument can cause permanent damage
2. Inspect the outside of the instrument and make sure that there is no damage to your unit. In case of damage contact the dealer immediately and **DO NOT USE THE INSTRUMENT!**
3. Use this instrument in a clean laboratory environment

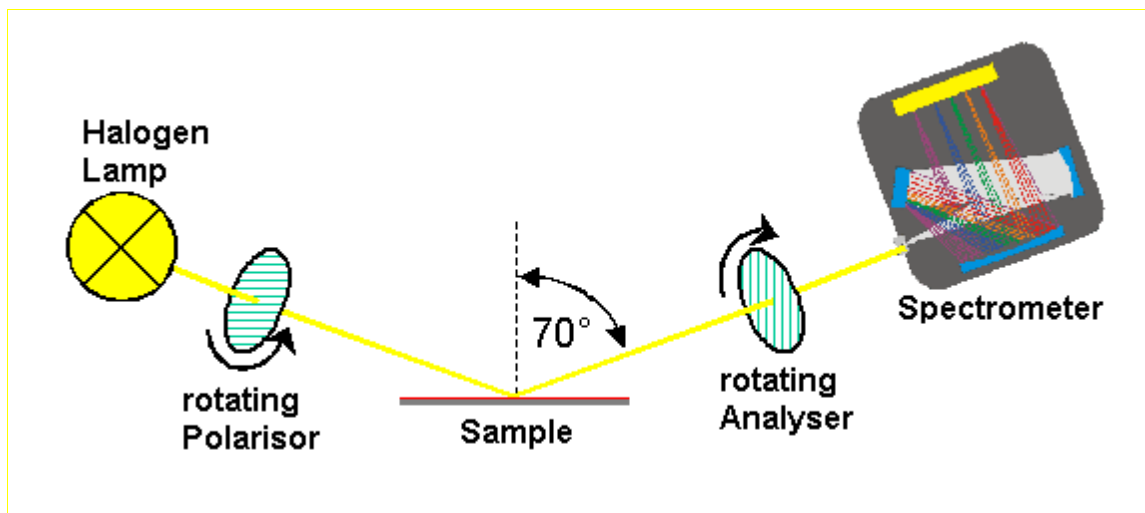
2 Instrument Description and Options

SpecEI-2000-VIS-NIR is a system to extract the thickness and optical data of thin and transparent layers on different plane substrates

2.1 Description of Measurement Principle

In general ellipsometry is a non-contact, non-destructive, optical techniques for the characterization of thin films on surfaces. When a surface or interface is struck by polarized light, ellipsometers measure the change of the reflected light beam by detecting and quantifying the change in the amplitude ratio and phase induced by the reflection of light on the sample surface. In case of a spectroscopic ellipsometer like the SpecEI-2000 these changes are measured not only for different polarization angles but also over a wide range of spectral wavelength.

Spectroscopic Ellipsometer requires neither reference nor reference beam.



3 SpecEI-2000 options

- Measurement of multi layers (weakly absorbing or transparent) on top of a substrate
- Highly accurate thickness measurements between 1nm (10Å) up to about 10µm with a resolution of 0,1nm (1Å).
- Different solution algorithms
- Online measurements (optional)

4 Optional available Accessories

4.1 *SpecEI-2000-VIS-NIR System*

Vision-Option

Video microscopy, with Zoom-Objective, integrated light source, frame grabber and Software Module.

MicroSpot

Reduces the standard spot size of 0,3x1,2mm to a spotsize of 200x400µm, with motorized z-axis (10mm), and autofocus capabilities. This Option is only useful in combination with the Option SpecEI-Vision.

Reference

Si-SiO₂-Step-Wafer , 5 Steps 0-500nm, Calibrated

4.2 *Software SpecEI*

SpecEI

User-friendly, simple-to-use 32-bit Windows™2000 / XP Software

For Ex Situ direct measurement of thickness and n & k coefficients, recipe structure, administrator/user capabilities.

SpecEI-Online

Online software module for In-Situ measurements (requires SpecEI Software) Online display of XY-graphs and histograms of layer thickness and removal rate. End point detection, on-line check of layer thickness. Recipe, result list, statistics with ASCII-data transfer.

SpecEI-Vision

Software module for video microscopy, with zoom-objective. Video image is displayed as a selectable Window in the main SpecEI user screen. (Requires hardware option: Vision-Option with integrated light source and frame grabber)

5 System Setup and Installation

5.1 System Description



- 1 Satellite 1 (sending module, polarizer)
- 2 Satellite 2 (receiving module, analyzer)
- 3 Chuck
- 4 Power switch ON/OFF – for SpecEI light source only

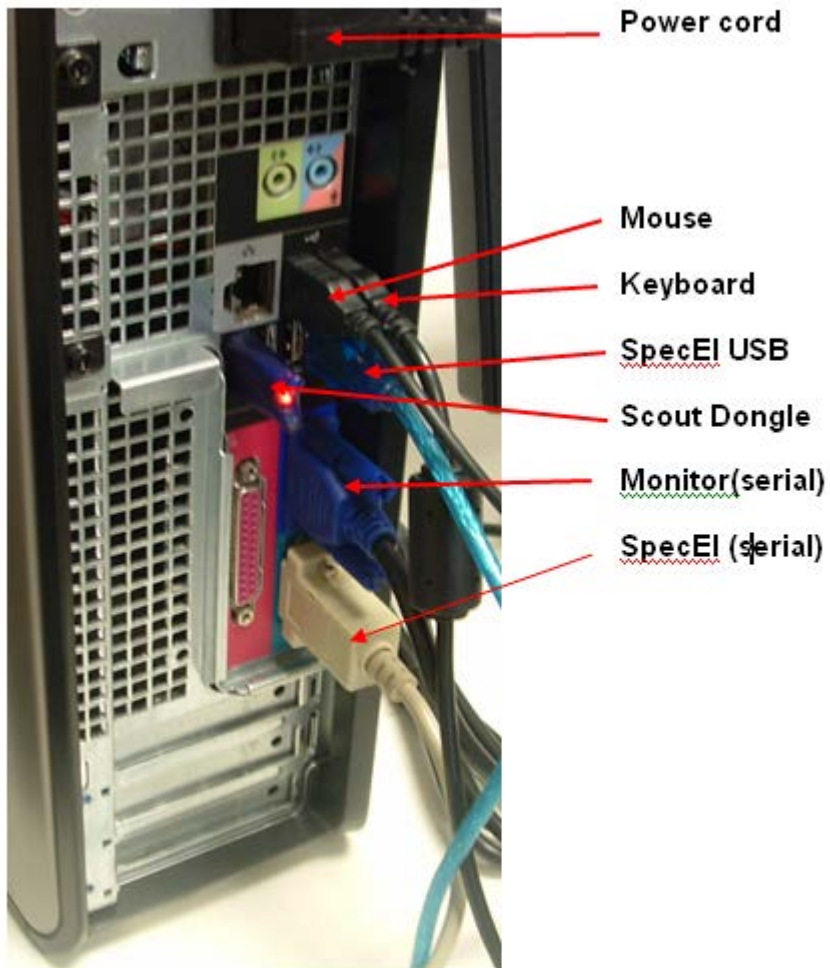
5.2 *Installation*

The ellipsometer system consists of the main device, the power supply and the system controller (PC). Connections between computer and ellipsometer are established through one 9-pin D-Sub connector cable and one USB-cable that run between the serial port of the PC and the corresponding plugs on the backside of the system.

Power supply connection between SpecEI and Power Supply



Back view of PC cable connectors



Cable connection between SpecEI and PC

1. Connect the USB cable between the PC USB-port and the SpecEI main system
2. Connect the Serial cable from COMport 2 of the PC to the serial port of the SpecEI main system
3. Connect the Power Unit-EL cable to the SpecEI main system
4. Connect the power cable of the Power Unit
5. Connect the power cable of the PC
6. Connect the power cable of the Mapping-Unit
7. Connect the serial cable from Com port 1 of the PC to the serial port of the Mapping table

Switch On Instruction

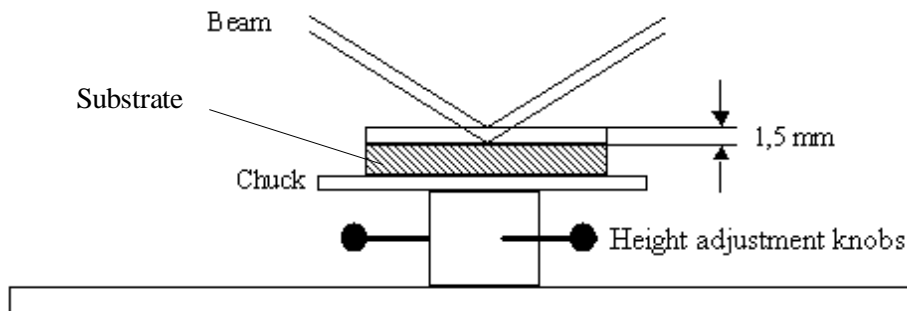
After all cables are connected as described above, the PC and the ellipsometer can be switched on. To avoid problems, PC and ellipsometer should use a common power line connection. Please tighten all plugs with the corresponding screws to secure proper connection.

Starting Sequence: Wait until the computer is ready with booting. Switch on the SpecEI - light source [4] at front side of instrument. Now start the SpecEI software by double clicking on the SpecEI icon

Chuck Height Adjustment

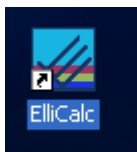
The default height setting is for wafers!

The SpecEI-2000 system accepts a wide range ($\pm 1,5\text{mm}$) of height difference of sample thickness. If this tolerance is not enough to achieve a good signal, the chuck height can be adjusted by rotating the bottom part of the stage using the three height adjustment knobs.

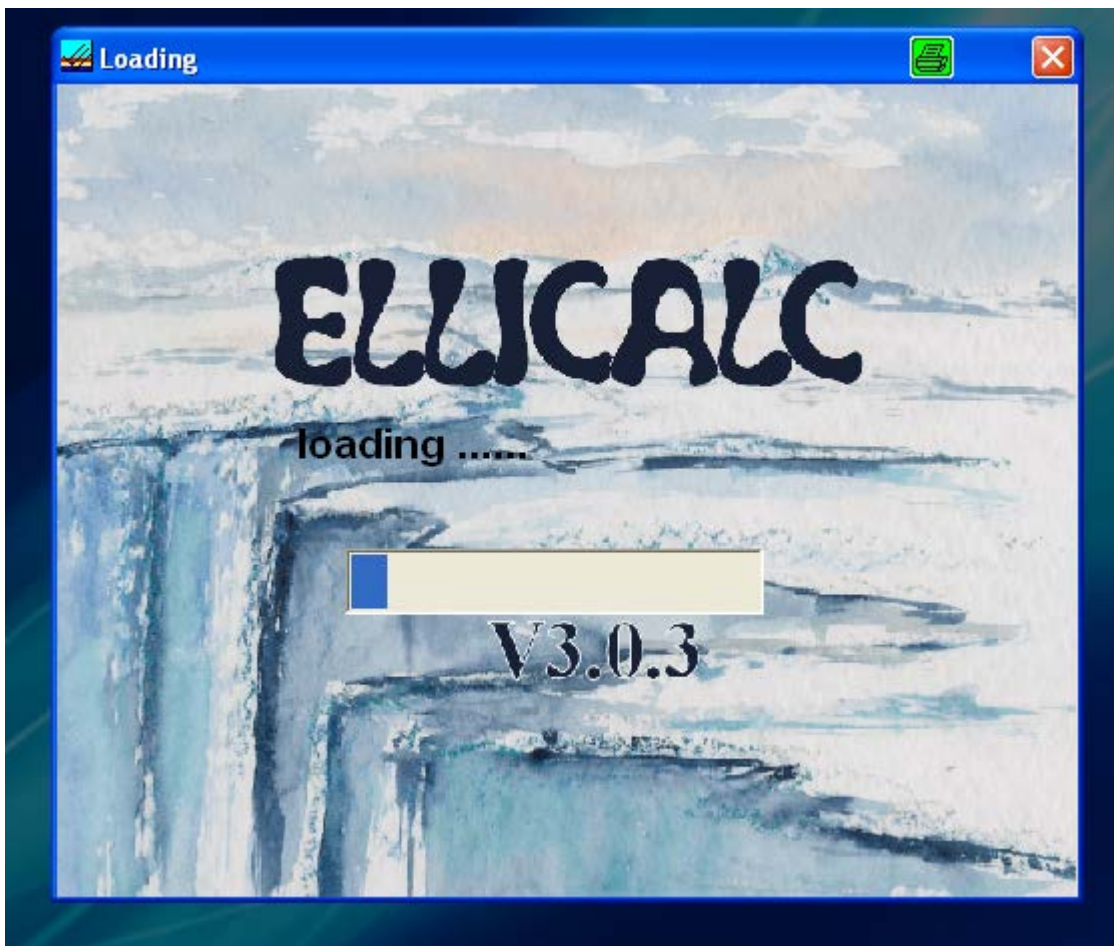


See chapter 7.2 **Fehler! Verweisquelle konnte nicht gefunden werden.** for the height adjustment procedure to get an optimized signal.

Starting the SpecEI Software Start the program by double clicking on the ElliCalc icon on your desktop.



First the following dialog box informs you that the instruments is initializing. This takes several seconds for resetting the motors, etc.

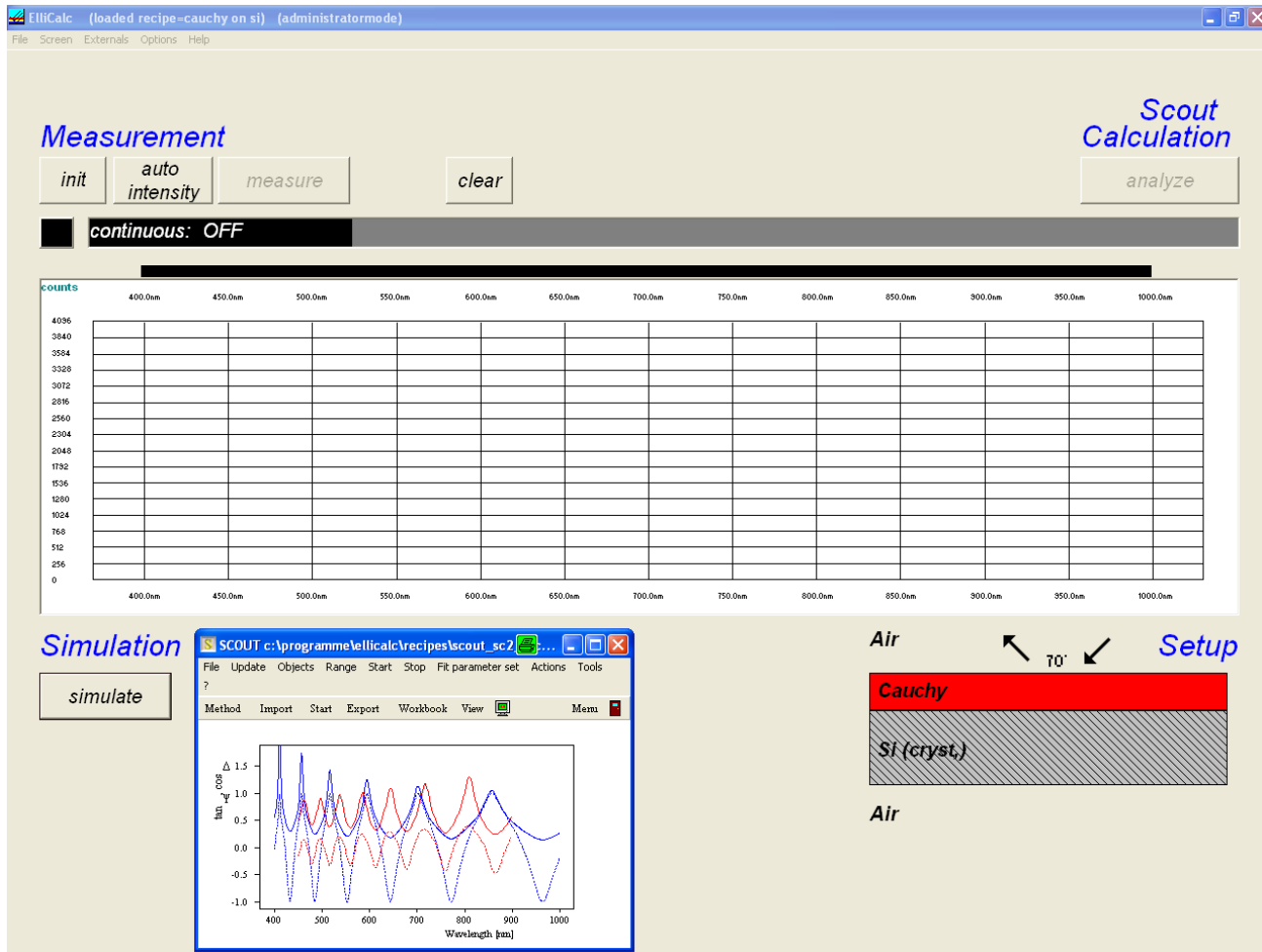


If the SpecEI software does not start after this initialization message, please check that the SpecEI system has power. If the system was without power, stop the ElliCalc.EXE Software by using the Task Manager of Windows 2000 / XP (Ctrl + Alt + Del) and start the software again after turning on.

6 Software

6.1 The Main User Interface with Scout

The working area on the screen is divided into two sections. A general screen for ellicalc measurement and in the upper left corner a screen view for scout.



The screenshot displays the Ellicalc software interface. The main window title is "Ellicalc (loaded recipe=cauchy on si) (administratormode)". The interface is divided into two main sections:

- Measurement Section:** Located at the top left, it features a "Measurement" header and a "Scout Calculation" header. Below these are buttons for "init", "auto intensity", "measure", "clear", and "analyze". A "continuous: OFF" indicator is visible below the buttons.
- Simulation Section:** Located at the bottom left, it features a "Simulation" header and a "simulate" button. It shows a window titled "SCOUT c:\programme\ellicalc\recipes\scout_sc2" containing a graph of $\Delta n_{\text{eff}}^{\text{cos}}$ versus Wavelength [nm]. The graph shows several oscillating curves between 400 nm and 1000 nm.
- Setup Section:** Located at the bottom right, it shows a schematic diagram of a layer structure. The top layer is labeled "Cauchy" (red), the middle layer is "Si (cryst)" (hatched), and the bottom layer is "Air". An angle of 70° is indicated between the top and bottom layers.

The central part of the interface is a large grid for data collection, with "counts" on the y-axis (ranging from 0 to 4036) and wavelength on the x-axis (ranging from 400.0nm to 1000.0nm).

6.2 The Main User Interface without Scout (File: Load Ellicalc Layer recipe)

On the right side you find the button edit structure for edit the layer structure

Click with the left mouse button, the edit layer structure button opens.

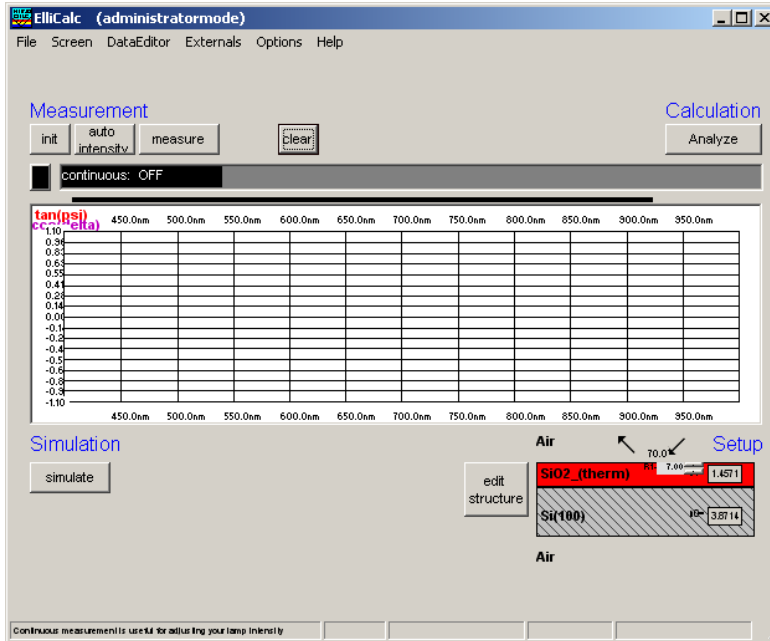
	catalogue	material	d	R	n	k	f	estimated lower limit	estimated value	estimated upper limit	limits mode
L3	semiconductors	Si_poly_50	0.0					0.0	3.0	93.0	narrow
L2	oxides	Al2O3	0.0					0.0	40.0	130.0	narrow
L1	oxides	SiO2 (therm)	0.0					0.0	500.0	1100.0	wide
L0	semiconductors	Si(100)									

number of layers: 3

7 Basic features of ellicalc

7 Basic features of ellicalc

7.1 Init



This button performs 2 tasks:

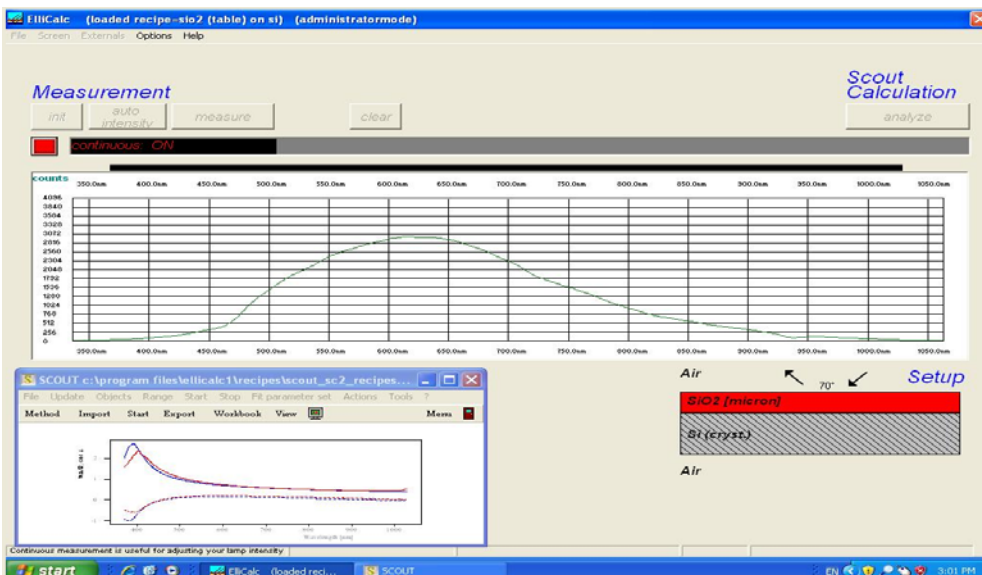
- initialize the motors for polarizer and analyzer (e.g. end positions)
- automatically set the integration times to good values (so there is no need to press “auto intensity” directly after an init procedure).

hint:

If you change your sample you may run into saturation of the spectrometer = a (nearly) horizontal part in some of the measured curves near to the upper limit of the plot.

7.2 Continuous on and adjust sample stage height

Put the reference stepwafer (uncoated position) on the chuck and press the continuous on button to get the maximum intensity by adjusting the sample stage height.



7.3 Auto intensity

This option automatically adjusts integration times.

This button has to be pressed if you use a completely different sample (each sample has a different reflectivity, so a different integration time). Normally the "init button" already has performed such an auto intensity procedure.

If your sample is of the same type as your last sample (=has nearly the same reflectivity) it is not necessary to press this button.

AutoIntensity tries to get 75% of the maximum allowed value.

7.4 Simulate

This routine simulates a spectrum.

- in SCOUT-mode: from the .sc2-layer recipe data within SCOUT
- in ElliCalc internal mode: from the data in EditStructure (identical to the data in Thinfilmm.ini-file)

Hint:

If you want to have a short check which structure is simulated at the moment, put the mouse cursor over the appropriate layer for some seconds and you see the layer thickness.

OR:

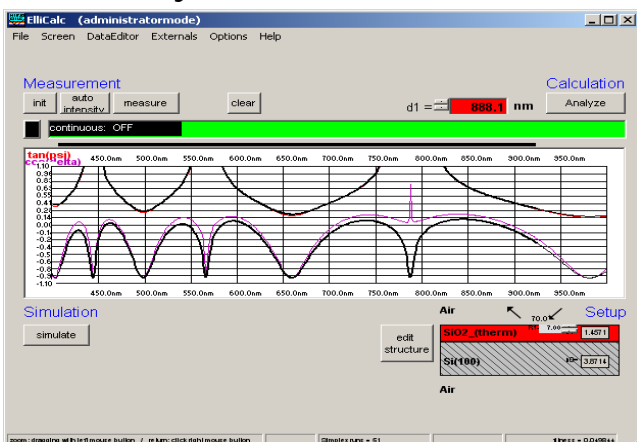
Leave your mouse cursor for some seconds over the button SIMULATE and look at the text in the status bar.

7.5 Measure

This routine measures the ellipsometric spectra of your test device.

If you use a double spectrometer, you had to adjust the crossover wavelength. Below this wavelength the data are collected from channel A ("master spectrometer"), above this wavelength they are collected from channel B ("slave spectrometer").

7.6 Analyze



This routine analyzes a spectrum (either simulated or measured) within the data extraction limits.

- In SCOUT-mode: SCOUT is doing the calculations. The structure that is simulated may only be changed within SCOUT.
- In ElliCalc's internal mode: ElliCalc is doing the calculations (only thickness at the moment)

Hint:

To have a short check which structure is simulated at the moment, put the mouse cursor over the appropriate layer for some seconds and you see the layer thickness.

OR:

Leave your mouse cursor for some seconds over the button SIMULATE and look at the text in the status bar.

7.7 Continuous mode

The continuous button switches between continuous mode (=red button) and "stop continuous" (button =black). Then there will be a continuous measurement of the signal (necessary to adjust the height and tilt of your stage !!)

All others buttons of ElliCalc are disabled until you finish the continuous mode.

Fitness

Any extraction of parameters is accompanied by a value of "fitness". This is the sum of the mean square deviations between measured and simulated curve (normalized to the range of extraction). The fitness is a rough guide whether your thickness value is "good" or not.

In the file "Thinfilm.ini" you will find 3 entries in section [fit]:

Failure_RedLevel=1

Failure_YellowLevel=0.1

RYG_LevelsAreDisplayed=False

If you change the variable RYG_LevelsAreDisplayed from "False" to "True" (in main menu "Fitparameters"), the usual rainbow pattern on the screen will disappear and a simple color will show up.

- If the fitness is below Failure_YellowLevel=0.1 you will see a GREEN color.
- If the fitness is between Failure_YellowLevel=0.1 and Failure_RedLevel=1 you will see a YELLOW color.
- If the fitness is above Failure_RedLevel=0.1 you will see a RED color

Attention:

If you measure very thick layers (with a good correlation between maxima positions, but bad correlation between signal heights) you may end up with high values of fitness, but nevertheless the thickness results may be o.k.

For detailed measurement information, see in the ElliCalc manual!

8 Lamp Replacement

Lamp Replacement

Replacement of Halogenmodule **SpecEI-2000-VIS/NIR-BM**

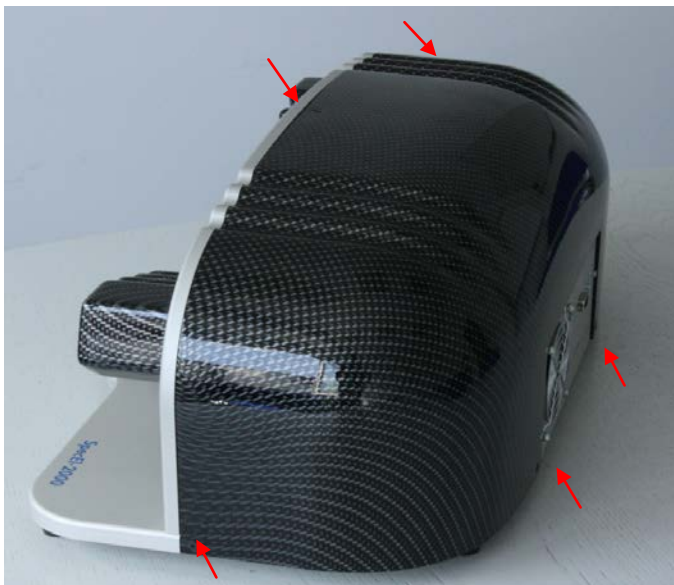
General information for the use of halogen light bulbs.

Lifetime is approx. 1000h

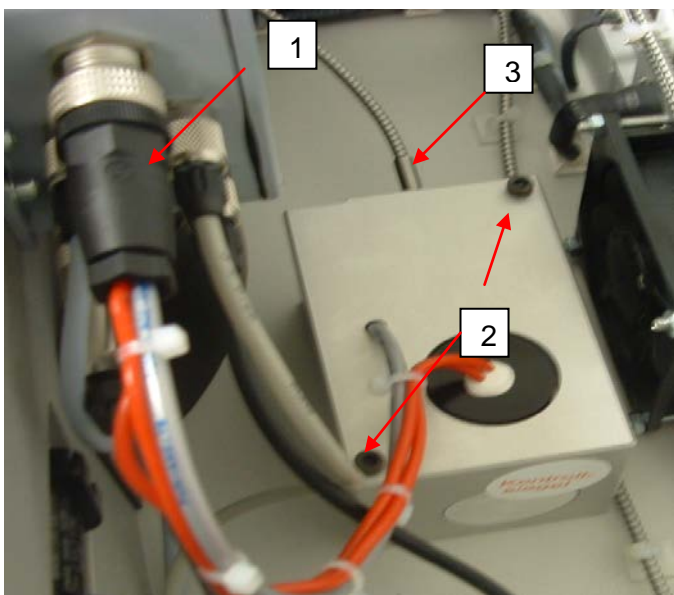
The warm-up time is within seconds for measurement $\geq 50\text{nm}$ (500\AA). For high performance and $\leq 50\text{nm}$ (500\AA) wait approx. 10 min for lamp stabilization)

To save lifetime you can switch on and off the light source by using Light source switch for every Measurement campaign(it is not necessary to let run the light bulb all the time)

Replacement



1. Shut down all power
2. Disconnect the unit from the power supply
3. Open the black SpecEI housing by removing the screws (5x)



1. Unplug the HL-Module connector
2. Unscrew the two HL-Module screws
3. Unplug the fiber very carefully
4. Replace complete SpecEI-2000-VIS-NIR-HL Module
5. Do all steps again in reverse direction
6. Calibrate the ellipsometer again.

Order Information:

- SpecEI-2000-VIS/NIR-BM** (Halogenlightsource module for replacement)
- SpecEI-2000-VIS/NIR-B** (Replacement of the bulb at the supplier or factory side)

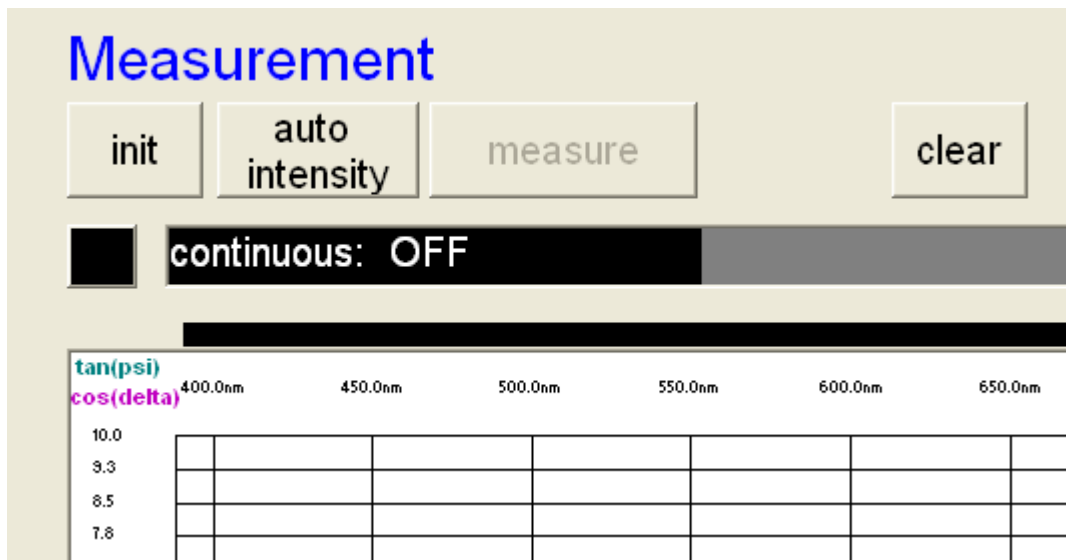
9 Trouble Shooting

No Correct Measurement

Go to configuration and run the Automatic mode for adapt Integration time and do measuring again.

- Check recipe
- Check the correct sample stage height , see chapter 7.2 continuous on and adjust sample stage height and try it again
- Light source may be weak, replace light source , see chapter 8 Lamp Replacement
- If there has been a mains power interruption, restart you PC, switch off and on the SpecEI-2000-VIS-NIR system

Calibration (Init)



The calibration needs some time, please wait till the progress bar is ready .



10 Contact

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Germany

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Fax: +49 (0)711 34 16 96 85
E-Mail: Thinfilm@oceanoptics.eu

11 Warranty

Mikropack GmbH warrants to the Original User of this instrument that it shall be free of any defects resulting from faulty manufacture of this instrument for a period of 12 months from the original date of shipment. There are no warranties for the Halogen Bulb (Spare Part: SpecEL-2000-VIS-HM and SpecEI-2000-VIS-HB).

This **instrument should not be used for any Clinical or Diagnostic Purposes.** Data generated is not warranted in any way by Mikropack GmbH. Any defects covered by this Warranty shall be corrected either by repair or by replacement, as determined by Mikropack GmbH.

There are no warranties which extend beyond the description herein.

This Warranty is in lieu of, and excludes any and all other warranties or representation, expressed, implied, or statutory, including merchantability and fitness, as well as any and all other obligations or liabilities of Mikropack GmbH, including, but not limited to special or consequential damages. No person, firm, or corporation is authorized to assume for Mikropack GmbH. Any additional obligation or liability not expressed provided for herein except in writing duly executed by an officer of Mikropack GmbH.

Warranty Handling

Clear with your local distributor the problem or fault.

In case of warranty your local distributor will give you a RMA number.

Send your instrument free of charge and insured to your local distributor.
Please take care of secure and proper packaging. Use a palette!

Your distributor will inform you on delivery time. If there is repair out of warranty you will be informed about repair cost. The system will be on hold till you have officially ordered the repair.

The system will be send back to you free of transport cost and insured (in case of warranty)