Updated: 06/15/2012

MPROBE : QUICK SETUP

The Purpose:

This document describes the setup of new MProbe system and taking the first measurement. It is intended as a quick introduction.

The following instructions assume that the MProbe system, cables and accessories have been unpacked and that you have a computer with 32-bits Windows OS (2000/XT/Vista/Windows7). Minimum 1GHz CPU, 512MB RAM and 100MB free HD space are recommended.

Estimated time: 10-15 min
Tools: No tools required
Power requirements: MProbe system uses universal power supply that is working with 220V/50Hz and 110V/60Hz. MProbe Vis consumes <20W, MProbe UVVis/UVVisNIR requires<60W.

In depth description of software functionality, measurement procedure options and application examples are presented separately and are not part of this document.

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I. Setting – up the system.

1. Install TFCompanion software from CD and update it to the latest version (installation and update instructions are on CD). DO NOT CONNECT USB CABLE TO MPROBE BEFORE SOFTWARE IS INSTALLED.
   Note. If computer was included with your system – software is already installed and configured – please skip this step.

2. Connect MProbe to computer using USB cable (USB socket located on the back panel of the instrument). Plug USB socket fully. Windows should detect USB device and automatically install it. If automatic installation is not successful – point driver installer to CD and let it search it for a suitable driver

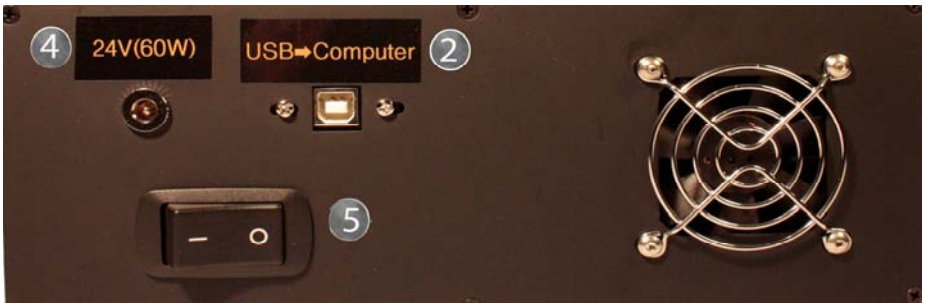

Fig. 1 Back panel of MProbe UVVis system
2 – USB connector to communicate with the computer
4 – Power plug to connect DC adapter
5 - Power switch

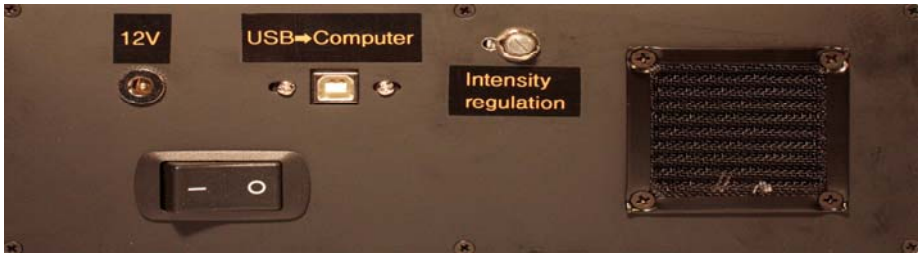

Fig. 2. Back panel of MProbe Vis system
(intensity regulator is optional)

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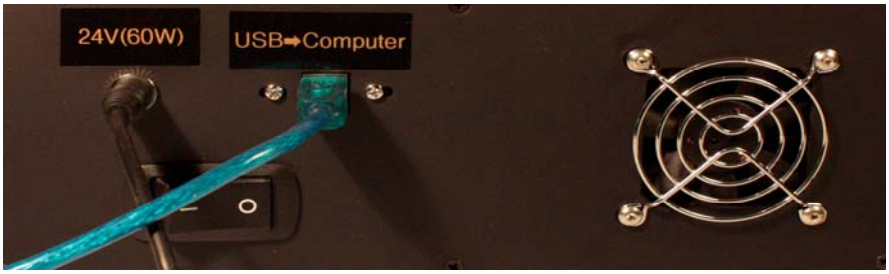

Fig. 3 Back panel of MProbe UVVis/UVVISNIR system with USB cable and power adapter connected

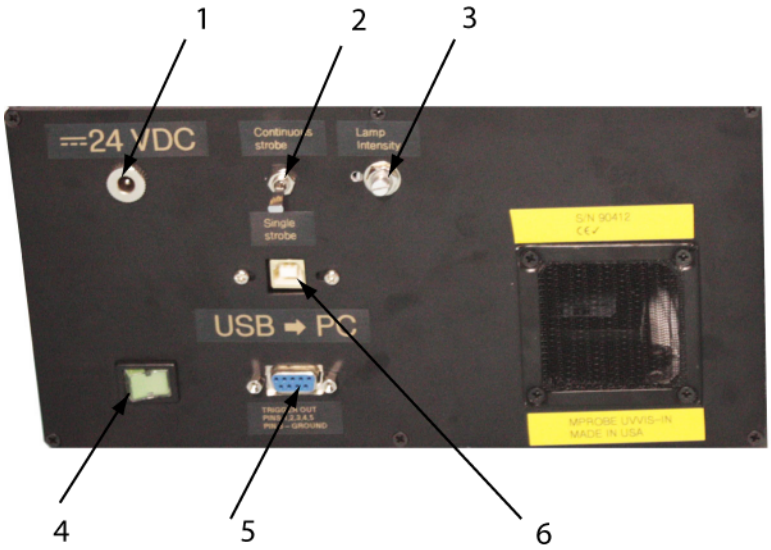

Fig. 4 Back panel of MProbe UVVis-IN with Xe flash lamp.

1 – power plug to connect 24V DC power adapter
2 – toggle switch to select "Single Strobe" of "Continuous Strobe" option
3 – potentiometer to adjust lamp intensity
4 -- power switch
5 – Trigger-Out connector
6 – USB connector to communicate with computer

3. Plug-in USB dongle (hardware license) in one of the USB ports on the computer

4. Connect power adapter (supplied with the instrument) to a socket on MProbe's backpanel. When adapter is connected to power outlet – the green LED on the front panel of MProbeVis should lit-up. **Note**. For MProbeUVVis front panel LED will lit-up only on step 5 (next step)

5. Switch-on power (power switch is on the back panel of the instrument).
For MProbeVis – the light source will start working on this step and the light will shine from the SMA adapter marked "Illumination".
For MProbe UVVis – the light source will NOT shine until corresponding button on the front panel is switch on.

Note. In case of the flash lamp, the strobes need to be started from the software. The front panel button can be used to switched on/off lamp after is was activated by the software.

Warning! Never look directly in the incoming light. This is especially dangerous if UV light is switched on Permanent eye damage and blindness can occur.

Fig. 5 The front panel of the MProbe Vis (or VisNIR) system

Fig. 6 The front panel of MProbe UVVis system (shown with dust covers removed from SMA adapters)

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Fig. 7 The front panel of MProbe UVVisNIR system. Notice two separate spectrometer inputs: use Yellow coded end of reflectance probe for IR channel (Green for UVVis channel)

Fig. 8 The front panel of UVVis-IN (with Xe flash lamp)

6. Remove the dust covers from SMA adapters on the front panel (there are two SMA adapters: “Illumination” and “Spectrometer”)

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Fig. 9. Illumination SMA adapter

7. Connect Reflectance Probe SMA terminated legs to SMA adapters on the front panel of the instrument. “Spectrometer leg” of the reflectance probe is marked as “Read”.
   Note. In case of in-situ system with oblique incidence configuration – two separate fiber optics cable are used instead of reflectance probe.

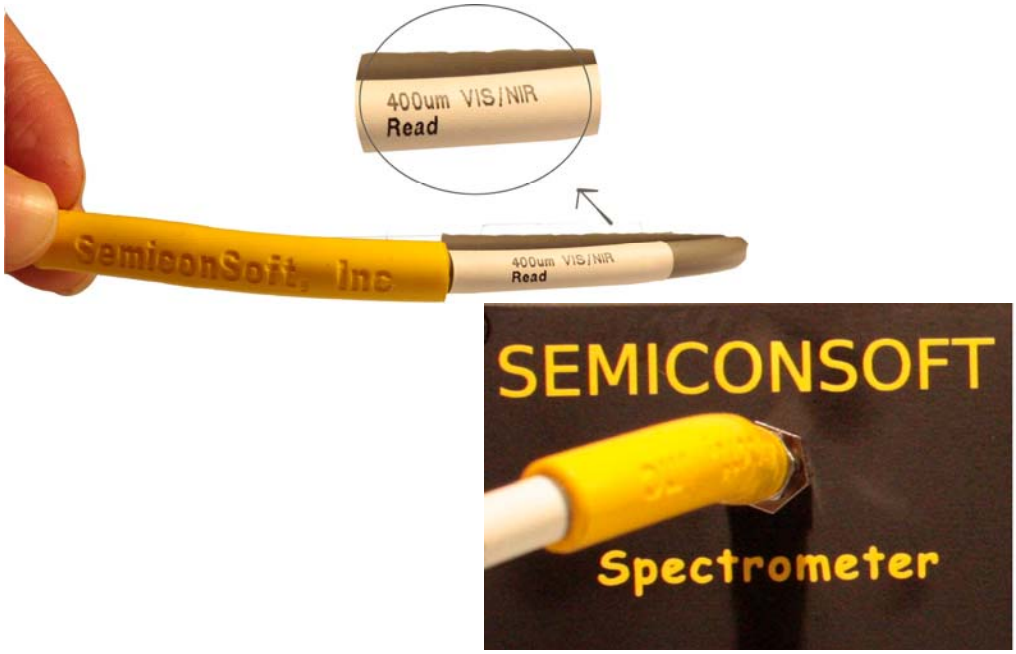

Fig. 10 Reflectance probe’s leg connected to spectrometer input SMA adapter.
Note. Fiber marking can be directly on the jacket sleeve or heats shrink (as shown)

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8. Connect other leg of reflectance probe to the SMA connector marked "Illumination".

Fig. 11. Illumination leg marking of reflectance probe

Note. Fiber marking can be directly on the jacket sleeve or a heat shrink (as shown)

9. Slide Reflectance probe ferrule end in fiber holder of SS100 sample table and put Si reference sample on the table.
   Note. If your system includes a Focusing lens. Attach the Focusing lens to the threaded end of the fiber holder before inserting the ferrule.

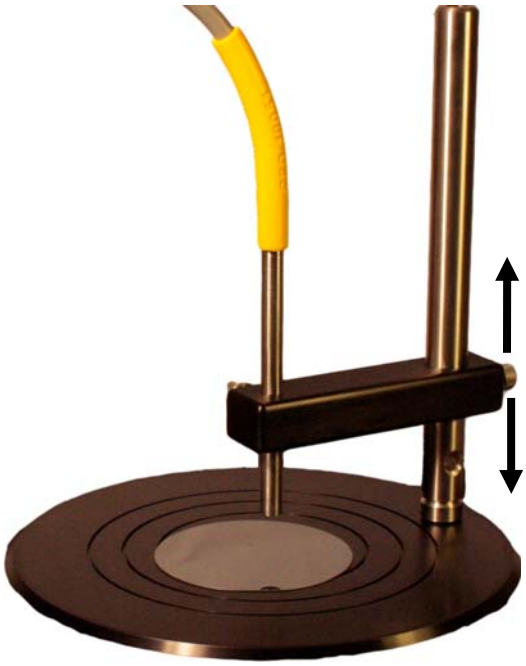

Fig. 12. Reflectance configuration face-up (standard)

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Fig.13 Intensity **regulator potentiometer on the back panel (optional).**

Fig. 14 Face-down configuration. Reflectance probe (SMA terminated) is attached to a adapter under the table. Light shines up and the sample should be place face-down on the table.

10. If you are using a Face-down configuration: attach 4 legs (4" posts) to the threaded holes in the corners on the baseplate (Fig. 14). Attach the adapter in the center threaded hole in the base plate and attach SMA connector of the reflectance probe to the adapter. You can convert Face-down table to a Face-up configuration using extra accessory (post with the probe holder).

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Fig. 15. Face-down configuration converted to a Face-up configuration

11 Start TFCompanion software. Select "Admin_hdw" user, password: psw (You can create individual users/profiles later for each user with different privileges). After software is started – you should see signal monitor showing signal from spectrometer. See TFCompanion set-up tutorial for detailed instructions.

12. Adjust the distance between reflectance probe and the sample (for standard configuration Fig. 12) and integration time as necessary (see the test results for your system for reference). If you are using the system w/o focusing lens, the typical distance between the probe and the sample is ~ 5 to 10mm (for Vis system) and 3 to 5mm (for UVVis system). If you are using a focusing lens, the distance between the lens and the sample is ~ 10mm. For "Face down" configuration (Fig. 11) the distance between the end of the probe and sample is fixed – one can only adjust integration time and light intensity.

Integration time for MProbe Vis system is, typically, in 10ms -50ms range. For MProbe UVVis is, typically, in 20ms-100ms range. Note. Integration time is given for the full signal (16bits ~ 65000 counts) reflectance from Si sample.

If the unit has an intensity regulator on the back panel, you can adjust light intensity, if necessary.

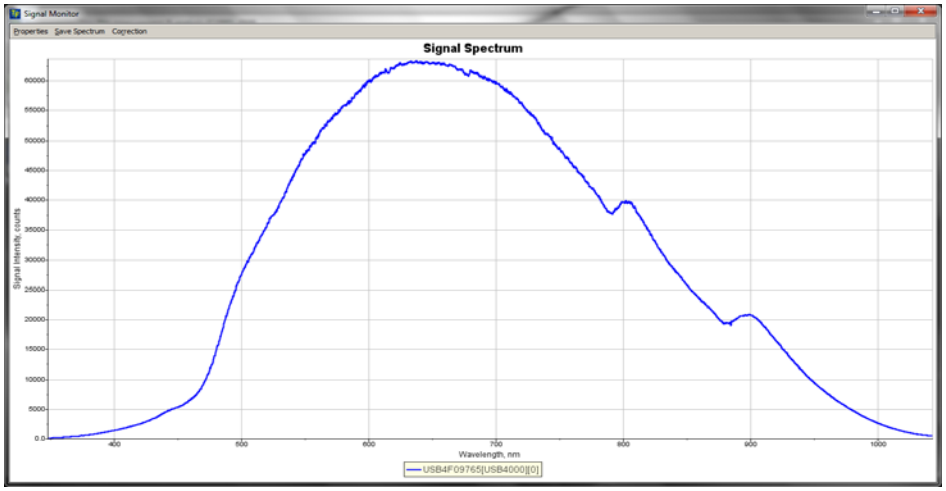

Fig. 16 MProbeVis: typical raw reflectance signal displayed by Signal Monitor (reflectance from Si wafer on step 12)

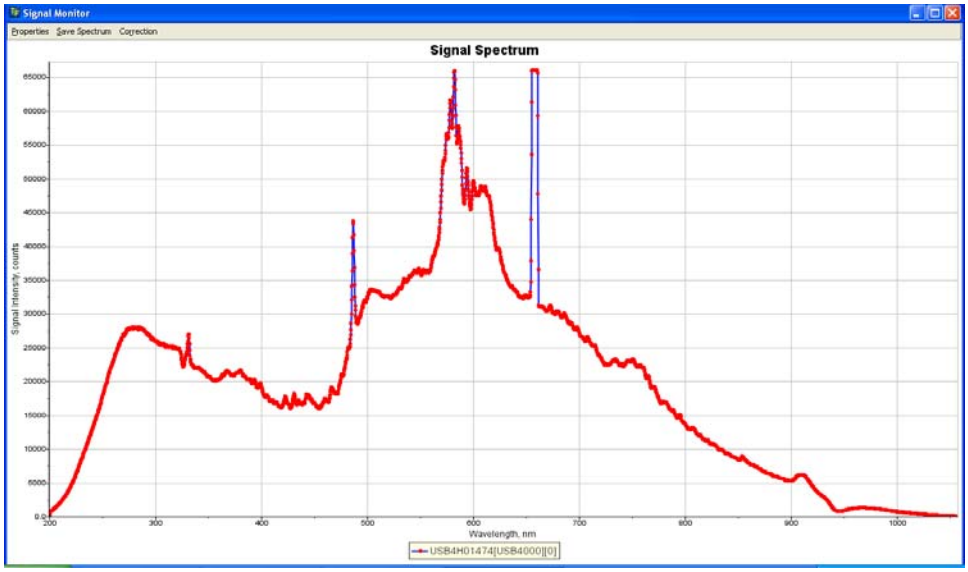

Fig. 17 MProbe UVVisSR: typical raw reflectance signal displayed by Signal Monitor (reflectance from Si wafer on step 12)

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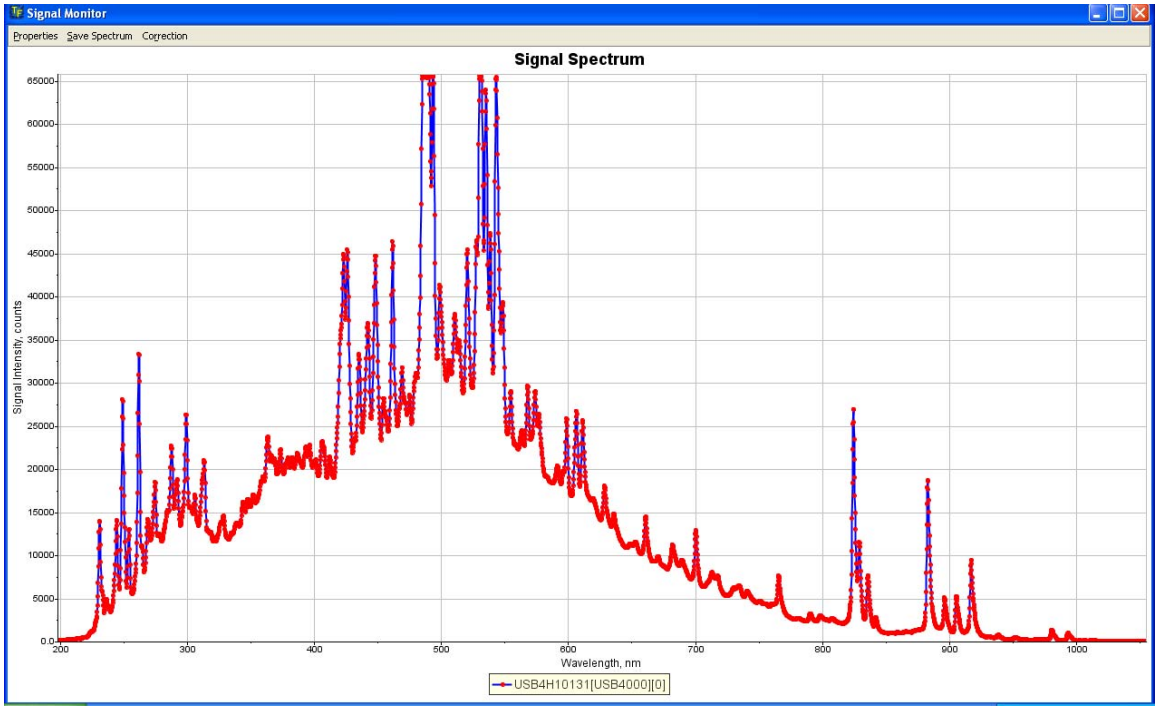

Fig. 18. MProbeUVVis (Xe Flash lamp) typical raw reflectance signal displayed by Signal Monitor (reflectance from Si wafer on step 12)

II. Sample Measurement

We are ready to take the first measurement. This will be an oxide sample SiO2/Si. MProbe performs spectroscopic reflectance and/or transmittance measurement. Physical properties of the sample are determined/inferred from the fit of the filmstack model (representing the sample) to experimentally measured data.

MProbe controls the measurement process using measurement recipes. If you do not select/load a specific recipe, a default recipe will be created when you click "Measure" button (you can configure default recipe parameters in configuration). MProbe database includes several optimized recipes (see Appendix I) – it is recommended to use these recipes for best measurement precision.

Measurement includes, actually, two steps:

a). taking spectroscopic measurement

b). analyzing the data to determine physical properties of the sample (thicknesses and n, k values of the layers).

Measurement recipe can handle both steps smoothly and transparent to the user.

Before taking measurement, instrument need to be calibrated. Reflectance calibrations is done using a sample with know reflectivity – the default calibration sample is bare Si (other samples like Al or BK-7 glass can be used as well but it need to be set explicitly in software). The purpose of the calibration is match measured light intensity with the known reflectivity. It is important that calibration and measurement are done at the same conditions. In case of face-up configuration this means, in particular, that the

distance between the probe and calibration sample has to be the same as the distance between the probe and the measured sample (i.e. calibration and measured samples substrates has to have the same thickness).

1. Place calibration sample (bare Si) on the table.
2. Select the measurement recipe (**Refl_Vis_Calc or Refl_UVVis_Calc**)
3. Select Measure/Clear calibration from the main menu (this forces software to request calibration.) ***Note.*** You can skip this step for your first measurement
4. Follow the prompt to first calibration step : measurement of calibration sample
5. Follow the prompt to calibration step 2 (measurement of dark current/background). Remove the sample and place black pad on the table (for face-up configuration). For face down configuration remove the sample and switch of light in the room.
6. When calibration is completed, you will be prompted to measure your sample. Place the oxide sample on the table and click"Continue" to proceed.

   You should see measurement results like on Fig. 15 below.
   Note. We rely here on the fact that software loads a default filmstack oxide2000 (SiO2/Si) at start-up. When you measure different type of the sample – you need to change to a corresponding filmstack. See details in the Measurement Guide: MProbeMeasurement101.

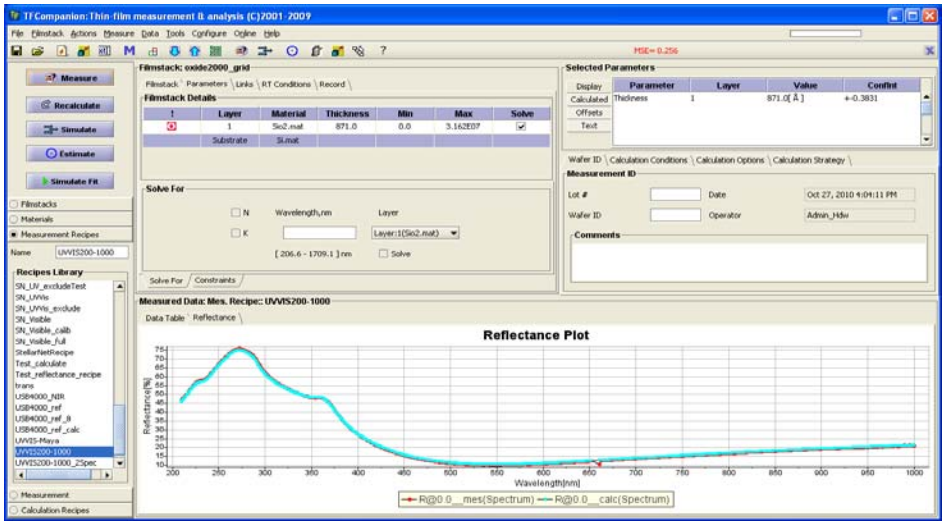

Fig. 15 MProbe UVVisSR measurement of SiO2 (nominal thickness 100nm)

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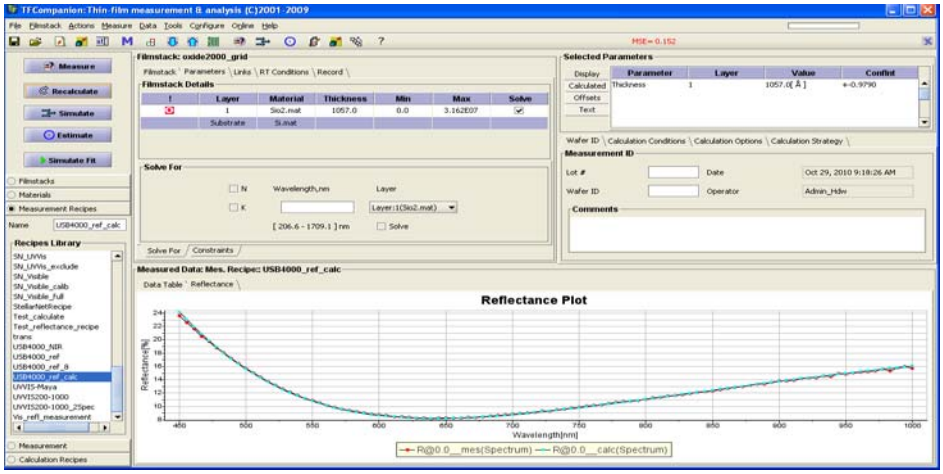

Fig. 16 MProbeVis measurement of SiO2 (nominal thickness 100nm)

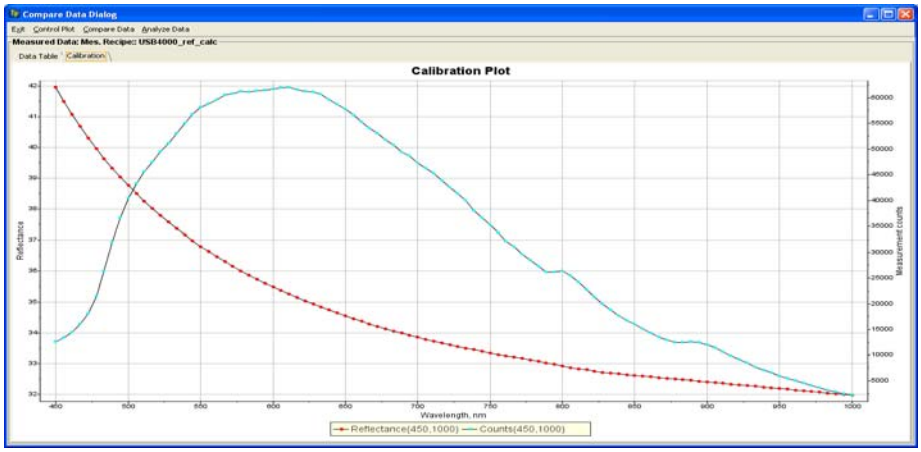

Fig.17 MProbeVis calibration chart. Blue actual intensity measurement, red – Si reflectivity

III Specifics of using UVVis system with the flash lamp.

1. Xe emits very short flashes of light that are triggered by the TTL pulses. There are two operational modes that are supported in MProbe system:
   a). Single strobe. In this case, the strobe is synchronized with the data acquisition cycle. The user can specify a delay of the strobe relative to the start of acquisition cycle (delay of 10 to 100 µm is typically used)
   b) Continuous strobe. In this case, used can specify the frequency of the strobes – there will be no synchronization with the acquisition cycle. Note. Maximum frequency with full intensity is < 100Hz. Decreasing the intensity allows higher frequency

Operational mode is determined by the toggle switch at the back of the unit and software selection.

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For thickness measurement Single strobe mode is typically preferable.

II. Starting the lamp and selecting the mode.

Use Actions/FlashLampController (FlashLamp plug-in need to be installed to support this functionality)

Select "Enable Lamp" to start the lamp or deselect it – to stop the lamp.

Fig. 18. Flash lamp control

NOTE 1. When the "Single strobe" option is selected to enable the lamp, the strobe is synchronized with spectrometer data acquisition cycle. Spectrometer is typically in the free running mode with the integration time of ~ 20ms. Select "Measure/Intensity monitor" from the main menu and set the integration time to check synchronization of the pulses.

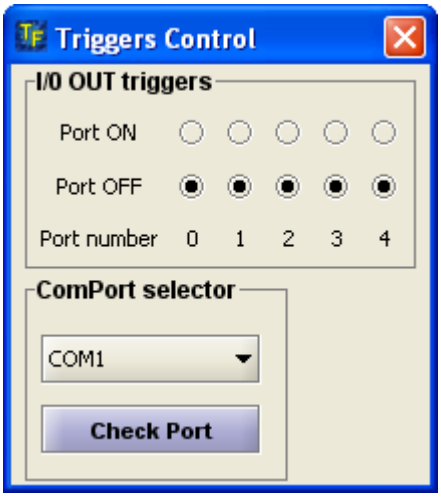
If the toggle switch **(**back of unit**)** switched "Continuous Mode" and Single Mode is selected in the software – both Continuous and Single/synchronized strobes will be active.

III. Measuring with the flash lamp.

Intensity of the lamp need to be adjusted manually (using potentiometer) and, in case of continuous strobe – frequency of the strobes.
Measurement recipe need to have a fixed integration time, manually selected depending on the application (integration time adjustment that is used with continuous light sources cannot be used here **).**
Flash Xe spectrum has few sharp peaks around 500nm. Unless these peaks are excluded in the software, dynamic range can be very limited. To exclude the peak one needs to remove small portion of the spectrum (few nm) so there is a trade-off. Normally, intensity is adjusted depending on the application and saturated (flat) portion of the peaks is defined to be excluded in the measurement recipe.

IV. GPIO input/output

In-situ systems typically have GPIO input/output. This provides 5 ports that can be programmed to create +5V TTL signal. In can of input mode, they can accept +5V TTL external triggers.



Triggers can be tested/configured using Trigger control Panel (Configure/Configure GPIO). GPIO plugin need to be installed

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Appendix I. Measurement recipes

MProbe measurement process is controlled by a measurement recipe. If no recipe is loaded – user is prompted to select a "default" recipe type and the recipe is created automatically. Default recipe is using the full range of the spectrometer and all pixels of the CCD. In many cases, the signal at the end points of spectrum is too weak and averaging/ smoothing several pixels works better as well.
Recipes database include several optimized measurement recipes that can be loaded and used for measurement.
Below is a list of included recipes with description.
"_Raw" recipes allow to collect reflectance or transmittance spectrum and perform data analysis separately. "_Calc" recipes integrate data collection and data analysis.

Recipe Name	Applicable system	Description
Refl_Vis_Calc	MProbe Vis	Reflectance measurement with automatic data analysis
Refl_Vis_Raw	MProbe Vis	Reflectance measurement :only reflectance spectrum – no automatic data analysis
Trans_Vis_Raw	MProbe Vis	Transmittance measurement :only transmittance spectrum – no automatic data analysis
Trans_Vis_Calc	MProbe Vis	Transmittance measurement with automatic data analysis.
Refl_UVVis_Calc	MProbe UVVisSR	Reflectance measurement with automatic data analysis. Deuterium alpha line exclusion
Refl_UVVis_Raw	MProbe UVVisSR	Reflectance measurement only: no automatic data analysis. Deuterium alpha line exclusion
Trans_UVVis_Calc	MProbe UVVisSR	Transmittance measurement with automatic data analysis. Deuterium alpha line exclusion
Trans_UVVis_Raw	MProbe UVVisSR	Transmittance measurement only: no automatic data analysis. Deuterium alpha line exclusion
Refl_Vis-NIR_Calc	MProbe VisNIR	Reflectance measurement with automatic data analysis.
Refl_Vis-NIR_Raw	MProbe VisNIR	Reflectance measurement only: no automatic data analysis.
Trans_Vis-NIR_Calc	MProbe VisNIR	Transmittance measurement with automatic data analysis.
Trans _Vis-NIR_Raw	MProbe VisNIR	Transmittance measurement only: no automatic data analysis.
Refl_UVVis-NIR_Calc	MProbe	Reflectance measurement with

	UVVisNIR	automatic data analysis.
Refl_UVVis-NIR_Raw	MProbe UVVisNIR	Reflectance measurement only: no automatic data analysis.
Trans_UVVis-NIR_Calc	MProbe UVVisNIR	Transmittance measurement with automatic data analysis.
Trans _UVVis-NIR_Raw	MProbe UVVisNIR	Transmittance measurement only: no automatic data analysis.
Refl_UVVisF_Raw	MProbe UVVisF	Version for flash lamp. Exclusion ranges need to be customized based on application.

Appendix II. MProbe Troubleshooting

	Problem	Reason	Solution
1.	TFCompanion software shows message. ”Your software is not registered. Starting in Evaluation mode”	Software requires USB dongle (hardware license key). Software cannot find the license key.	Check that USB dongle is plugged in the USB port. LED at the end of the dongle should be lit-up. Try to remove the dongle and plug it in again. If the problem persists – try another USB port.
2.	The error message after software loaded is displayed: ” No spectrometers are connected”	Software cannot find spectrometers. USB cable maybe disconnected or USB connection timed-out because computer was in stand-by or sleep mode	Exit the software. Unplug MProbe USB cable from the computer and plug it in again. Start TFCompanion software. If the problem persist, unplug USB cable again and try another port. Please note that some systems (e.g. VisNIR) require USB2.0. If you use USB1.0 or USB1.1 spectrometer driver may not install and function properly
3	No light is coming when the unit is switched on	In Vis and VisNIR system the light is switched on by the power switch on the back panel. In UVVis system the button on the front panel need to switched in addition to power switch on the back panel.	If you followed instruction to switched the light but there is no light: a). Check if you have potentiometer/ intensity regulator on the back panel. Try to turn it and check if it solves the problem b). You bulb may need replacement
4	TFCompanion software does not exit.	It maybe waits for spectrometer or other hardware to close. Typically, the message indicating wait time is displayed	Disconnect MProbe USB cable from the computer and try exit again. In unlikely case that problem persists -use Windows Task Manager to “kill” TFCompanion process and report the problem.

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5	TFCompanion software becomes sluggish and does not respond	There maybe several different issues: a). Low-memory (see 6) b). Spectrometer integration time increased too much (see 7)	
6	Software memory problem	If software becomes sluggish this maybe because of low allocated memory	Check the memory use (Help/Memory Monitor). If you see 90% or more memory used – you need to increase the memory allocation. Use Configure/Configure Launcher to set memory allocation. You need to restart the software to new memory allocation to take effect
7	Spectrometer integration time problem	Integration time in spectrometer is adjusted automatically for the best precision depending on the light intensity. If your signal is very low - typically, one may click measurement when there is no sample, etc.- integration time may increase significantly (limited in the measurement recipe)	Select Measure/Signal monitor and select Measurement Conditions to set lower integration time. If it takes a long to wait for spectrometer to respond, you can disconnect the USB cable and restart the software.
8	Measurement recipe does not match calibration	Calibration need to match recipe condition exactly – if you change a recipe, you need to recalibrate!	Select Measure/Clear Calibration. You will prompted to perform calibration when you try to do measurement