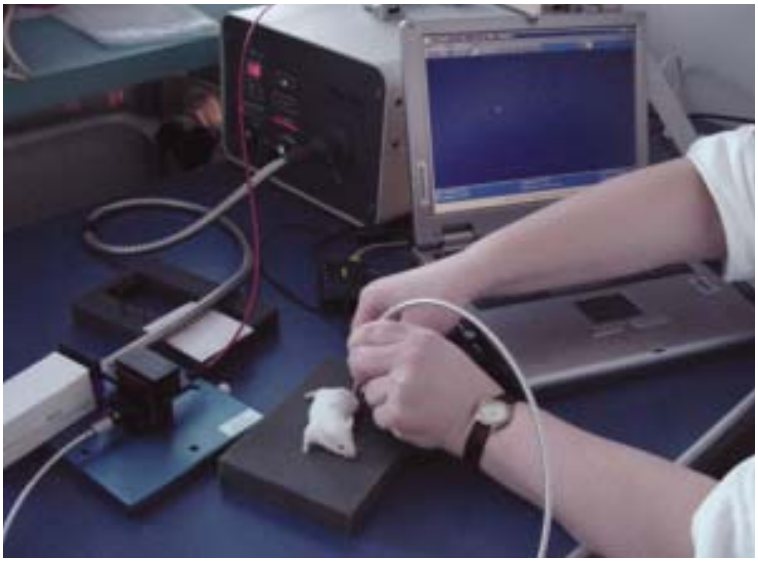
Applications/Sensors



Introduction - a wide range of application references

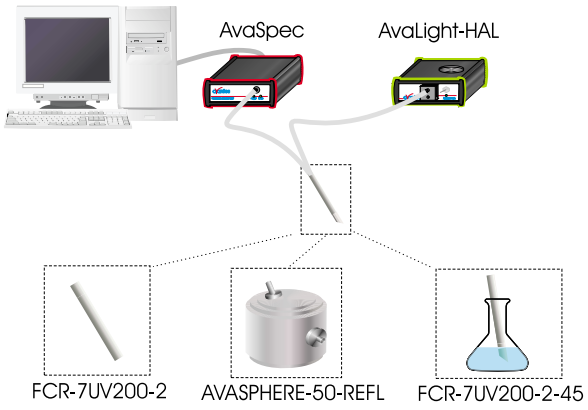
Avantes line of spectrometers enables the use in a very wide variety of sensing and sensor applications, such as:

- Agriculture - Measure oxygen content of soil, determination of chlorophyll by fluorescence measurements
- Astronomy - Measuring the spectrum of stars, planets and comets
- Automobile Industry - Measure in-line low concentration of water contamination in oil, measure coating on car glass windows
- Biology - To measure chlorophyll concentration and UV absorption, measuring color change and sexual behavior of fish under influence of sunlight
- Biotechnology - Measuring survival of microorganism's population after high UV pulsed light emission.
- Chemistry - Determination of Phosphates in burning processes, endpoint detection in crystallization processes, measuring oxygen concentration of gases
- Coating Industry - Measure layer thickness of optically transparent coatings
- Colorimetry - Color determination of plastics, textile, food, paints, birds, fish, lizards
- Construction - Measuring gas content of isolated double glass windows by high-energy spark light emission.
- Cosmetics - Measuring color of lipstick, nail polish and hair dye.
- Dairy industry - measuring color of milk products and yogurts, measuring consistency of cheese during fabrication process.
- Dental - Measuring the color of teeth and spectral analysis of residuals in gums.
- Dermatology - Measuring UV Absorption of the skin in correlation with UV protection of digested carotenoids. Determination of penetration of chemicals through the skin into the blood stream.
- Environmental - Water quality measurement (chlorine/nitrate) with deep UV absorption, measuring pH of seawater
- Film Industry - Controlling the color of thermo graphic films and lightning
- Food - Measure water content of tomatoes, potatoes, measure sweetness of carrots and tomatoes, measure origin of olive oil. Determination of soluable solids in apples, kiwifruit and peach, using NIR spectroscopy. Determination of odor and flavor of white wine. Detecting color change in ripening process of bananas. Measuring color change of meat during cooking process
- Gas Chromatography - UV absorption and gas detection
- Gemmology - Value determination of diamonds (synthetic/natural) by measuring absorption peaks, measure color of diamonds and other gemstones. Determination of authenticity of gemstones, using Raman spectroscopy.
- LCD industry - Measure transmission, retardance, twist angle, thickness and other optical properties of thin films
- Light Industry - Measure Laser diodes and LED's characteristics, measure irradiance values of light bulbs and UV-light sources, used for water purification
- Medical - Measure hemoglobin, cytochromes and -carotene non-invasively, measure CO2 and HbO2 in the heart to monitor myocardial ischemia during bypass operations. Measure oxygen consumption of tumors. Fluorescence measurements for cancer diagnosis
- Military - Identify color of smoke screens, transmission and illumination measurement on night vision devices
- Narcotics - Identification of drugs with Raman spectroscopy
- Nuclear Industry - To determine fluorescence in an active nuclear reactor
- Optical Filters - Quality control to determine absorption and transmission properties of interference filters
- Painting Industry - In-line measurement of color during color mixing process
- Paper Industry - Measure color/whiteness of paper, humidity determination of pulp.
- Particle Size analysis of cancer cells
- Pharmaceutical - Determination of bacteria concentration in fermentors, endpoint detection in crystallization processes.
- Plasma Etching - Layer thickness measurement
- Printing Industry - Color determination of ink, spectral measurement of high-power UV light sources for drying printing ink.
- Pyrometry - measuring temperature of turbine blades in electrical power plants
- Radiometry - measuring energy spectrum of light sources and the sun
- Raman Spectroscopy - Analyis of compounds in organic chemistry
- Semiconductor Industry - Layer thickness measurement and mapping of wafers
- Sun Glasses Industry - Measuring UVA, UVB, and UVC absorbance of sunglasses.
- Textile Industry - Measuring colors

For some of the applications a typical setup and more detailed information are given in the following paragraphs.

Color measurements

Generally, color measurements of objects and thick fluids can be done in different setups, e.g. using reflection probes or an integrating sphere. A spectrometer is needed with a range from 380 to 780 nm and a spectral resolution of 5 nm FWHM. Further a white continuous light source is needed as well as a white reflective tile. For the different applications, such as color of textile, paper, fruit, wine, bird feathers etc. different probes can be used. A typical setup for color measurements in reflection is given below.



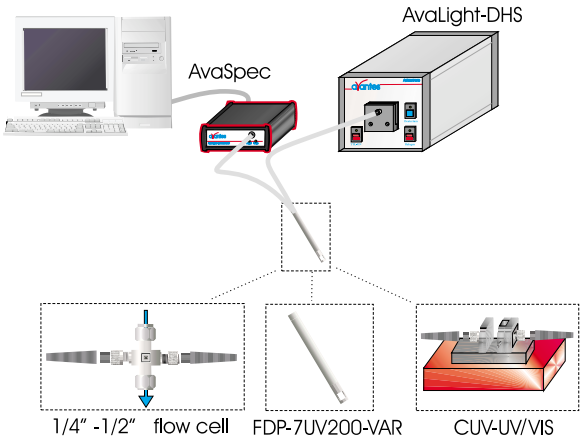
Components used in the color measurement setup are depicted in the following table:

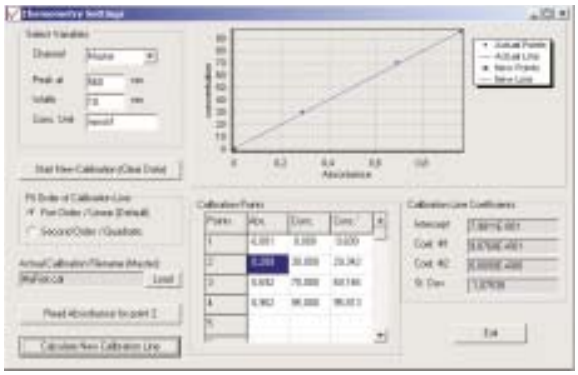
	Color Reflection with fiber optic probe	Color Reflection with integrating sphere	Color Reflection in thick fluids
Spectrometer	AvaSpec-102, Grating VA (360-780nm), 100µm slit AvaSpec-256, Grating VA (360-780nm), 50µm slit AvaSpec-2048, Grating BB (360-780nm), 200µm slit, DCL-UV*		
Software	AvaSoft-Full and AvaSoft-Color		
Light source	AvaLight-HAL with PS-24V-1.25A power supply		
Fiber optics	FCR-7UV200-2 Reflection probe with 6x200µm illumination fibers, 1 read fiber, UV/VIS, 2m, SMA	1 pc. FC-UV600-2 illumination fiber 600µm UV/VIS, 2m, SMA 1 pc. FC-UV600-2 detection fiber 600µm UV/VIS, 2m, SMA	FCR-7UV200-2-45 Reflection probe with 45 degree window with 6x200µm illumination fibers, 1 read fiber, UV/VIS, 2m, SMA
Accessories	RPH-1 probe holder WS-2 reference tile	AvaSphere-50-REFL integrating sphere WS-2 reference tile	WS-2 reference tile

**** not necessary for reflection probe, only for integrating sphere and high speed applications***

UV/VIS absorbance measurements

Absorbance measurements in fluids can be done in different setups and wavelength ranges, like with fiber optic dip probes or flow cells for in-line absorbance or a cuvette holder for absorption measurement in a sample. For UV/VIS measurements a spectrometer can be configured with a range from 200 to 1100 nm and a spectral resolution of 1.4 nm FWHM. Further a combined deuterium-halogen light source is needed. For the different applications different probes can be used. A typical setup for absorption measurement is shown below.





Components used in the absorption measurement setup are depicted in the following table:

	In-line Absorption with flow cell	In-line Absorption with Dip probe	Absorption with cuvette holder
Spectrometer	AvaSpec-2048, grating UA (200-1100nm), UV, slit-25, DCL-UV , OSC-200-1100		
Software	AvaSoft-Full optional AvaSoft-CHEM		
Light source	AvaLight-DHS Deuterium-Halogen light source		
Fiber optics	2 pcs. FC-UV200-2-SR detection fiber 200µm UV/VIS, solarization resistant, 2m, SMA	FDP-7UV200-VAR Transmission dip probe with variable path length, with 6x200µm illumination fibers, 1 read fiber, UV/VIS, 2m, SMA	2 pcs. FC-UV200-2-SR detection fiber 200µm UV/VIS, solarization resistant, 2m, SMA
Accessories	1/4"or 1/2"flow cell		CUV-UV/VIS cuvette holder

Irradiance measurements

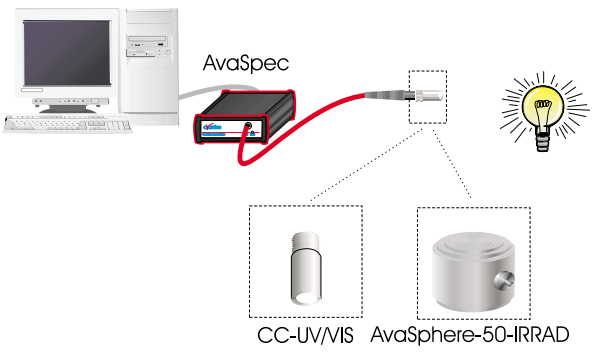
Spectral Irradiance measurements can be done in different setups and wavelength ranges, like with fiber optic cosine corrector or integrating sphere. Irradiance measurements can be done in the UV/VIS as well in the VIS/NIR range.

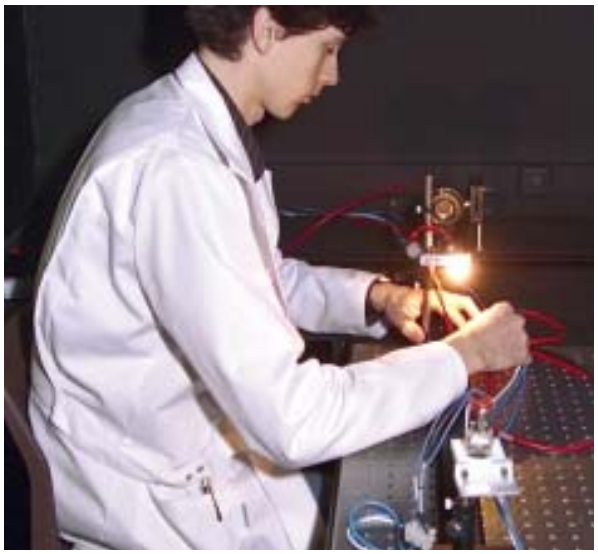
For absolute irradiance measurements a spectrometer can be configured and radiometrically calibrated in the Avantes calibration laboratory with a range from 200 to 400 nm or from 350-1100 nm or for a combined UV/VIS range of 200-1100nm. This calibration is done on a fixed setup, i.e. fiber optics and diffusor can not be changed afterwards.

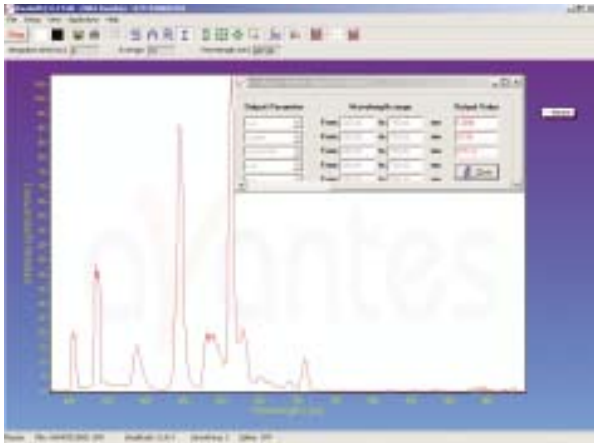
In order to be more flexible in the setup a calibration can be performed on location with a calibrated VIS/NIR light source (AvaLight-HAL-CAL) or calibrated UV/VIS/NIR light source (AvaLight-DH-CAL).

Our comprehensive AvaSoft-IRRAD software allows you to perform and load irradiance calibrations.

A typical setup for irradiance measurement is given below.







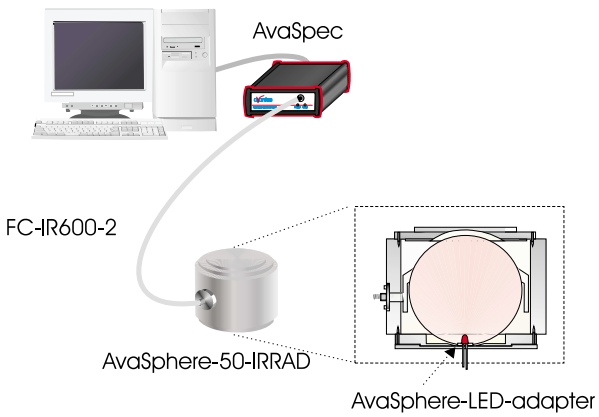
Components used in the irradiance measurement setup are depicted in the following table:

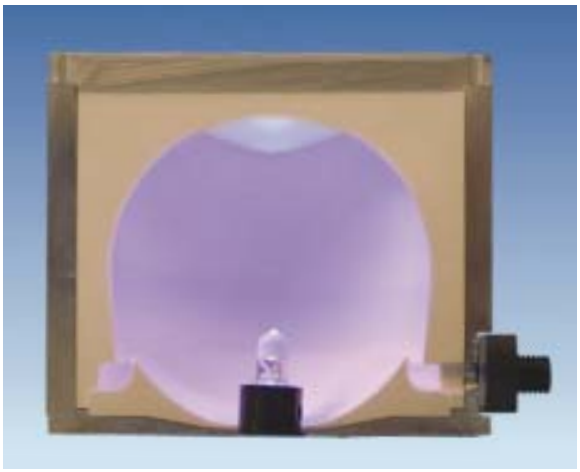
	UV/VIS Irradiance	VIS/NIR Irradiance
Spectrometer	AvaSpec- 2048	
	Grating UC (200-400nm), UV, 50 µm slit Grating UA (200-1100nm), UV, 50µm slit, OSC-200-1100	Grating VA (350-1100nm), 50µm slit, OSC-350-1100
Software	AvaSoft-Full and AvaSoft-IRRAD	
Calibration	IRRAD-CAL-UV (200-400 nm)	IRRAD-CAL-VIS (360-1100nm)
	IRRAD-CAL-UV/VIS (200-1100nm)	
Light source (optional)	AvaLight-DH-CAL Calibrated Deuterium-Halogen light source with CC-UV/VIS	AvaLight-HAL-CAL Calibrated halogen light source with CC-UV/VIS
Fiber optics	1 pcs. FC-UV200-2 fiber 200µm UV/VIS, 2m, SMA	
Accessories	CC-UV/VIS cosine corrector or AvaSphere-IRRAD-CAL integrating sphere	

LED measurements

Since it is possible to manufacture Light Emitting Diodes in a wide variety of colors and brightness, it is also necessary to accurately measure their optical characteristics.
There are two ways of measuring LED's, photometry and radiometry. Photometry only relates to visible radiation, like the human eye response. Radiometry is not limited to the human eye response. In both photometry and radiometry, the LED can be characterized in emitted power or in the intensity. The emitted power is all the power (flux) emitted from the LED in lumens or watts, collected and measured without regards to the direction of the flux. The intensity is the flux per unit solid angle directed toward the observer, usually along the axis of the LED and is given in candela's.

Because of their size, LED's are very difficult to mask and standards are not currently available defining how such measurements should be performed. Careful consideration in the design and use of LED test and measurement equipment is essential to achieve valid measurement results that fit the application.





The simplest and quickest way to measure the total luminous flux from an LED is to use an integrating sphere, coupled to an Avantes spectrometer. The integrating sphere a simple device for measuring optical radiation. The interior surface of the integrating sphere is perfectly diffusing and has spatially uniform reflectance. The radiant exchange from diffuse surface to diffuse surface integrates the light, resulting in equal radiance at any point on the sphere wall.

The system can be calibrated with a halogen light source AvaLight-HAL-CAL-ISP. With AvaSoft-IRRAD spectrometer software it is possible to calculate the parameters from the measured spectral distribution and to perform an absolute irradiance measurement. Also the intensity of the measured light can be calculated, displayed and saved as spectral irradiance in µWatt/cm²/nm. Further, the result of up to 10 of the following output parameters is displayed in a separate window: radiometric quantities µWatt/cm², µJoule/cm², µWatt or µJoule, photometric quantities Lux or Lumen, color coordinates X, Y, Z, x, y, z, u, v and color temperature. A typical setup for LED measurements is given below:

Components used in the LED measurement setup are depicted in the following table:

Spectrometer	AvaSpec- 2048 Grating VA (350-1100nm), 25µm slit , DCL-UV. OSC-350-1100	
Software	AvaSoft-full and AvaSoft-IRRAD	
Calibration	AvaLight-HAL-CAL-ISP Calibrated halogen light source	IRRAD-CAL-VIS (360-1100nm) irradiance calibration
Fiber optics	1 pcs. FC-UV600-2 fiber 600µm UV/VIS, 2m, SMA	
Accessories	AvaSphere-50-IRRAD-CAL integrating sphere or AvaSphere-80-IRRAD-CAL integrating sphere AvaSphere-LED-ADR(-80) adapter to hold 3,5,8 mm LED's	

Thin Film measurements

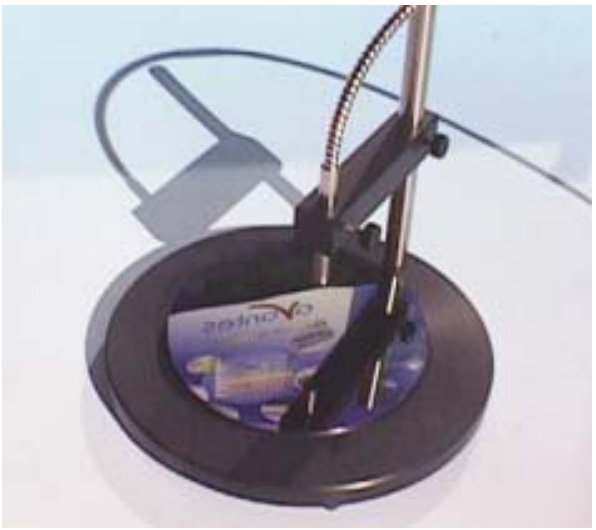
The Thin Film measurement system is based on white light interference measurement to determine optical thickness. This white light interference pattern is translated through mathematical functions into optical thickness calculation. For single layer systems the physical thickness can then be calculated when the n and k values of the materials are known.

The AvaSoft-ThinFilm software has an extensive built-in database of n and k values for most common used materials and coatings.

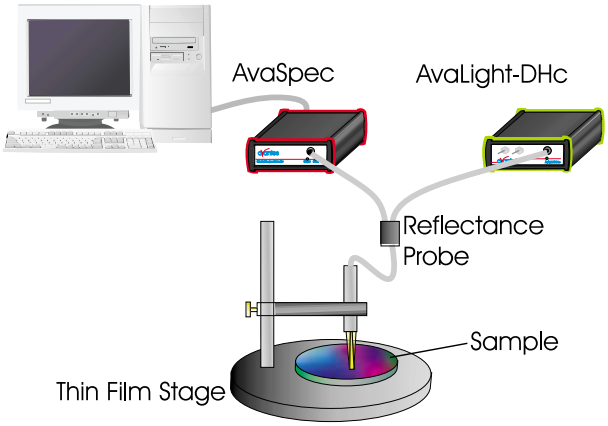
The AvaSpec Thin Film system can measure layers of 10 nm - 50µm, with a resolution of 1 nm.

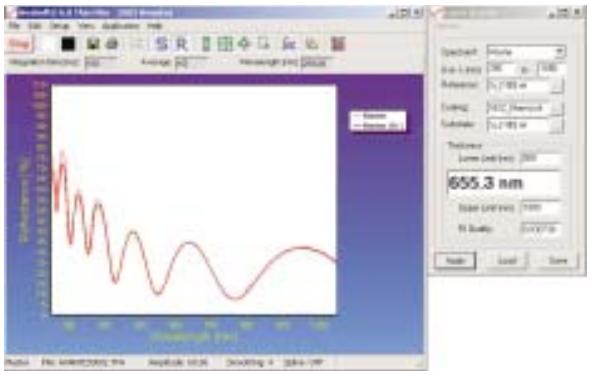
Thin Film measurement is frequently used in the wafer industry, where plasma etching and deposition processes need to be monitored. Other applications are in fields where optical transparent coatings on metals and glass substrates need to be measured.

The AvaSoft-Thin film application software enables on-line monitoring of layer thickness and has the possibility to be combined with other AvaSoft applications, such as XLS export to Excel and Process control.



A typical setup for Thin Film measurements is depicted on the left.





Components used in the Thin Film measurement setup are depicted in the following table:

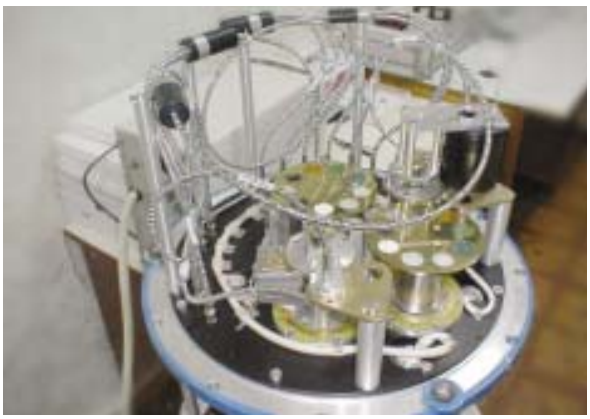
Spectrometer	AvaSpec- 2048 Grating UA (200-1100nm), DCL-UV/VIS , UV coating, OSC-200-1100
Layer thickness	10 nm- 50 µm, 1nm resolution
Software	AvaSoft-Thinfilm
Lightsource	AvaLight-DHc Compact deuterium-halogen light source
Fiber optics	FCR-7UV200-2-ME reflection probe UV/VIS, 2m, SMA
Accessories	THINFILM-STAGE to hold reflection probe

Monitoring coating processes in vacuum chambers

Important parameters that need to be monitored during coating processes, such as layer thickness, composition, surface finish, light transmission, reflectance, polarization ability, and others, can be done by spectroscopy and spectroscopic interferometry. Fiber optics provide a versatile tool to take light in and out of the remote vacuum and clean room chambers and at the same time organize the select measurement geometry for the coating analysis. The illumination of and detection from the coating layering can be organized at different fiber positions relative to the coating; to allow specular reflection, diffuse reflection, transmission, polarization, interference, fluorescence and even Raman scattering to be measured. The fiber optics can be arranged to monitor several parameters simultaneously or to measure at different spatial positions or masking conditions simultaneously.

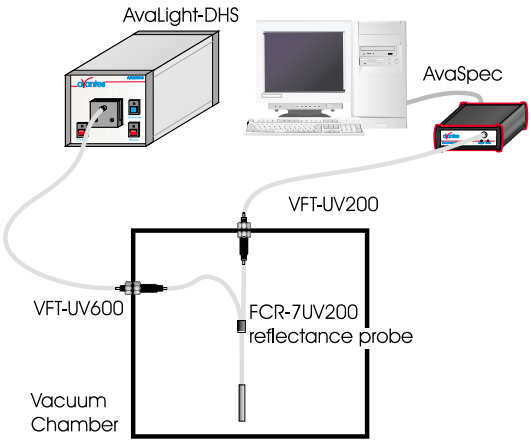
For on-line production several fiber optic sensors with suitable geometries can be placed across the web to monitor the production run. In some cases the ionic source; for example a plasma source, can be monitored for spectral emission to confirm its conditional efficiency during the operating process.

Most applications require a dedicated composition for the monitoring system. You can contact us for confidential advice on what items are best for your application. Here is just one system example.



In this case a reflection sensor is monitoring an on-line coating process on a web. Light is passed into the vacuum area via a vacuum feed through and then passes to the reflectance sensor. The reflected light returns via another feed through, to a measurement spectrometer channel. The reflectance sensor itself can be disconnected locally using the SMA interconnects. A second channel can be added for reference measurement and to compensate for fluctuations in the light source.

A typical setup for vacuum measurements is given on the left.



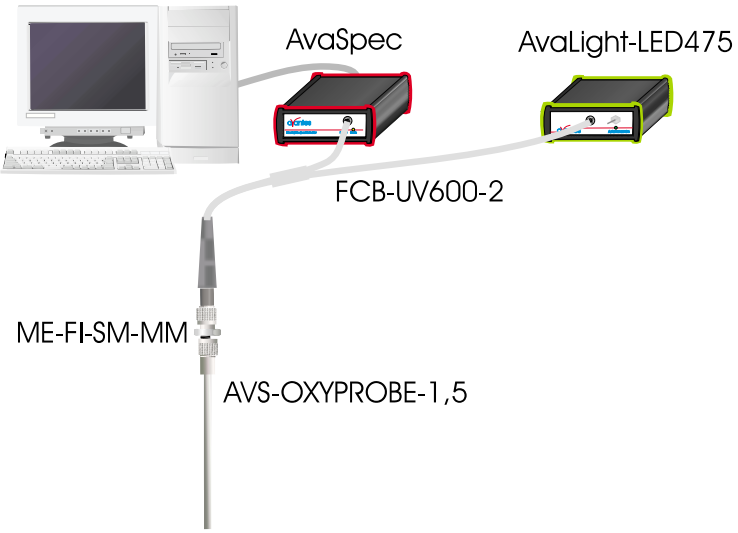
Components used in the vacuum measurement setup are depicted in the following table:

Spectrometer	AvaSpec- 2048 Grating UA (200-1100nm), 50µm slit , UV coating, DCL-UV
Software	AvaSoft-Full and XLS or PROC add-on
Lightsource	AvaLight-DHS deuterium-halogen light source
Fiber optics	FCR-7UV200-2-ME reflection probe UV/VIS, 2m, SMA FC-UV600-2 and FC-UV200-2
Vacuum Feedthrough	FC-VFT-UV200 and FC-VFT-UV600

Fiber Optic Oxygen Sensor

The oxygen sensor consists of a fiber optic fluorescence probe with a proprietary thin film coating on its tip, and a blue LED as the excitation source. The high sensitivity AvaSpec miniature spectrometer completes the system.
The sensor uses a fluorescence technique to measure the absolute concentration of oxygen. An optical fiber carries the light produced by the blue LED to the thin film coating at the probe tip. Fluorescence generated at the probe is then reflected back to the detector. When oxygen in the gas or liquid sample diffuses into the thin film coating, it quenches the fluorescence. The degree of quenching correlates to the oxygen concentration.

The AvaSoft-OXY application software is used to both calibrate the sensor and monitor oxygen concentration.
A typical setup for oxygen measurements is given below:

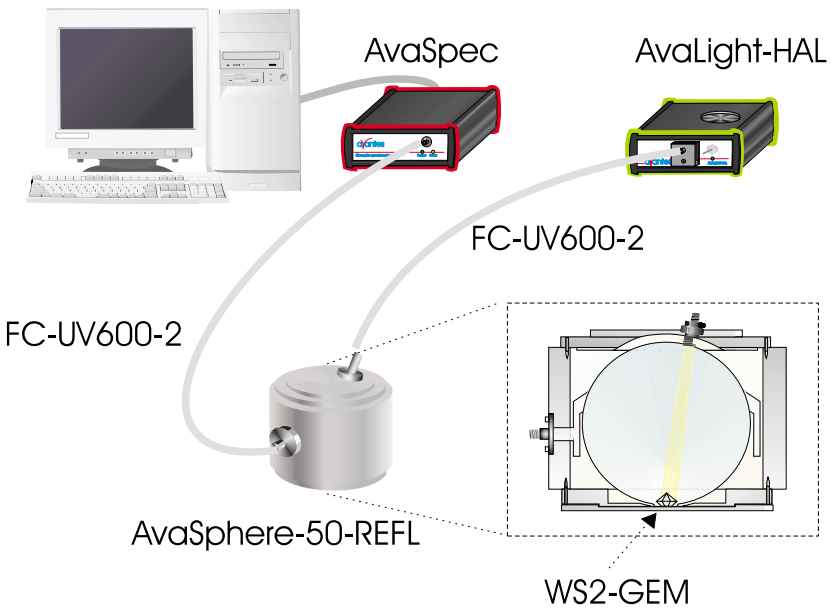


Components used in the oxygen sensor setup are depicted in the following table:

Spectrometer	AvaSpec- 2048 Grating VA (360-1100nm), 200µm slit, DCL-UV
Software	AvaSoft-Full and AvaSoft-OXY
Lightsource	AvaLight-LED-475
Fiber optics	FCB-UV600-2 Bifurcated probe UV/VIS, 2m, SMA ME-FI-SM-MM Fiber interconnect
Oxygen probe	Different types available, contact us for more details

Gemmology measurement setup

Color is one of the value determining factors in diamond, in research natural and treated diamonds can be measured in the spectral range of 400-750 nm. Interesting wavelengths can be found in the absorption spectrum at 415 nm and 478 nm (Type Ia diamond natural diamond), where artificial diamonds show no absorption peaks. For treated diamonds artificial coloring can be measured at a wavelength of 592 or 741 nm. The value difference between a natural and treated diamond may be as high as a factor 10. Of course other gem stones may be measured as well, like ruby, alexandrite, sapphire, etc.
A typical setup for gem stone measurements is given below:



Components used in the gemmology setup are depicted in the following table:

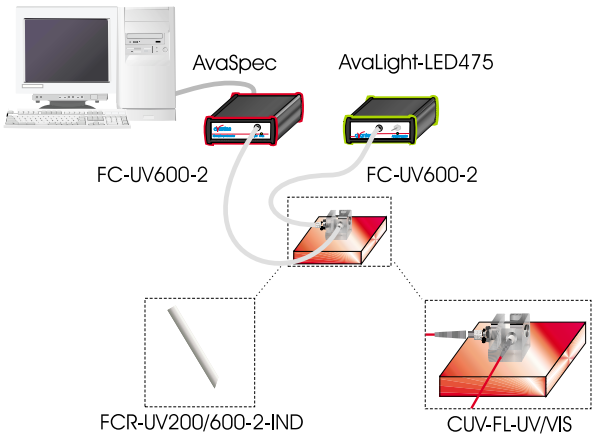
Spectrometer	AvaSpec- 2048 Grating VA (360-1100nm), 25µm slit, DCL-UV
Software	AvaSoft-Full
Lightsource	AvaLight-HAL halogen light source
Fiber optics	2 pcs. FC-UV600-2, UV/VIS, 2m, SMA
Accessories	AvaSphere-50-REFL Reflection sphere WS-2-GEM White reference tile with 10 mm radius hole, specially for gemstone measurement

Fluorescence measurements

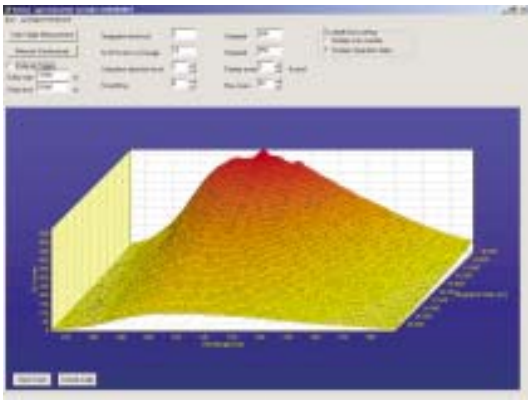
Fluorescence measurements are required in many biology (chlorophyll and carotenoid), biomedical (fluorescence diagnosis of malignancies) and environmental applications.
Fluorescence measurements typically need a high sensitivity setup (AvaSpec-2048TEC recommended for integration times > 5 seconds). For most fluorescence applications the amount of fluorescence energy emitted is only 3% of the amount of excitation light energy. The fluorescence light is of a lower energy (higher wavelength) than the excitation energy and is usually scattered light (emits energy in all directions).
Most important consideration for the setup is to prevent excitation light to enter the spectrometer.
This can be done with different methods, where one does not exclude the other:

1. Use an AvaLight-LED light source for excitation (small bandwidth), emitting no energy at fluorescence wavelength.
2. Use an (interference) band pass or low pass filter in combination with an AvaLight-HAL light source for high output, small bandwidth excitation
3. Make sure that the optical path for excitation light and fluorescence are 90 degrees perpendicular. This way the excitation light will not enter the receiving fiber (use of the CUV-UV/VIS-FL or the CUV-DA)
4. Use the fluorescence decay time to separate excitation energy from the integration time start pulse. For this a pulsed light source is required (pulsed laser or XE-2000 Xenon flash) and an AvaSpec-2048FT fast trigger spectrometer with programmable delay time.

A typical setup for fluorescence measurements is given on the left.



Fluorescence measurements on the Holy Shroud in Turin



Components used in the Fluorescence setup are depicted in the following table:

Spectrometer	AvaSpec- 2048 (optional –FT or –TEC) Grating VA (360-1100nm), 200µm slit, DCL-UV
Software	AvaSoft-Full
Light source	AvaLight-LED475 or AvaLight-HAL with CUV-HAL and interference filter
Fiber optics	FCR-UV200/600-2-IND with FCR-FLTIP-IND or 2 FC-UV600-2 fiber optic cable UV/VIS, 600 µm, 2m, SMA
Accessories	CUV-DA or CUV-HAL or CUV-FL-UV/VIS

Biomedical applications

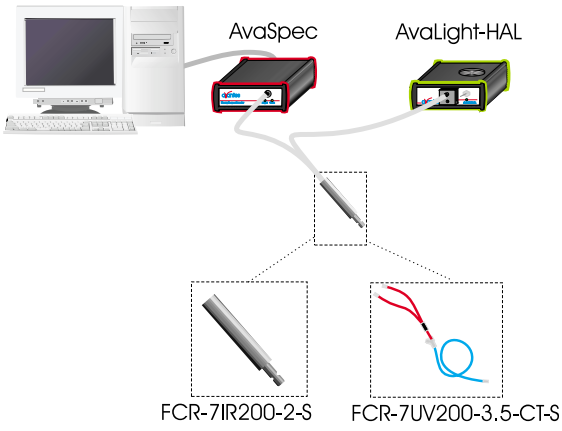
Over the last decade Avantes has helped many application engineers to develop both non-invasive and invasive spectroscopic methods for blood parameter measurements. Important medical indicators are oxygen, hemoglobin, cytochrome and water concentration measurements in tissue and in the veins. Non-invasive measurements are based on an AvaSpec-2048 single channel fiber optic spectrometer, an AvaLight-HAL tungsten halogen light source and a reflection probe.

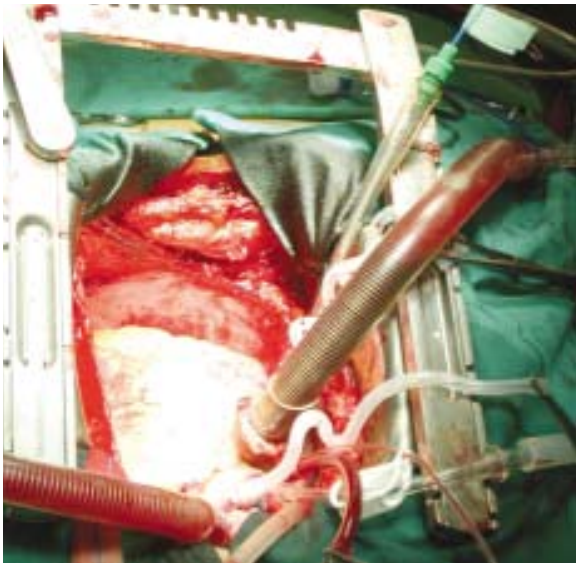
Invasive measurements can be done with a special reflection probe, built into a hart catheter, as can be seen in the picture.

Implementation of the system has been successful in medical applications in which continuous measurement of oxygen saturation, concentration of total, oxygenated and deoxygenated hemoglobin needs to be done.

The AvaSpec has been implemented successfully in the following fields:

- Angiology / Pharmacology - Monitoring of the oxygen saturation after the application of vaso-active substances. Oxygen changes caused by Reynaud syndrome and microcirculation diseases in tissue.





- Dermatology - Detection of local -regional perfusion diseases, recurrence of melanomas.
- Diabetology - Micro-angiopathy, early detection of Endotheld dysfunction and ulzeration.
- Cardio surgery - Oxygen consumption of the heart muscle during/after bypass operations.
- Neurosurgery / Oncology - Quantifying of oxygen consumption of (brain) tumors before/after radiation or operations.
- Pediatry / Gynecology - monitoring of oxygen concentration of critically ill newborn during birth.
- Plastic surgery / Transplantation medicine - Monitoring of transplanted and re-implanted tissues, bones or organs
- Accident surgery - Determination of surface of burned or frozen skin.

A typical setup for biomedical measurements is given on the left.

Components used in the biomedical setup are depicted in the following table:

Spectrometer	AvaSpec- 2048 Grating NB (500-1000nm), OSF-475, 50µm slit
Software	AvaSoft-FULL (optionally AvaSoft-CHEM)
Light source	AvaLight-HAL
Fiber optics	FCR-7IR200-2-S special PEEK reflection probe, can be sterilized or FCR-7IR200-3.5-CT-S special catheter reflection probe
Accessories	WS-2 white reference tile

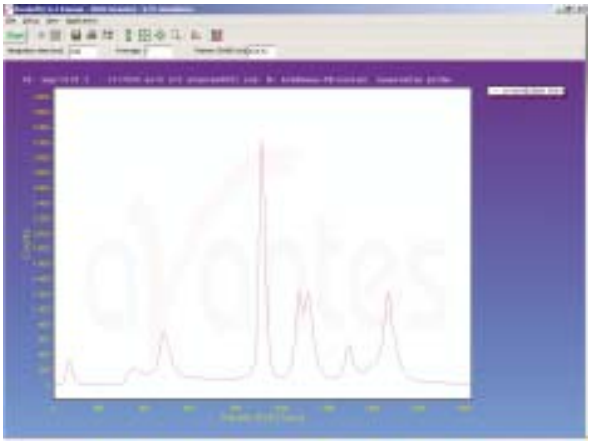
AvaRaman Raman System

The AvaRaman is a fully integrated, low-cost Raman system for applications requiring Raman techniques. The AvaRaman system consists of a laser diode, an AvaSpec 2048 CCD-array spectrometer, AvaSoft-Raman and an expanded range of fiber optic probes.
The AvaRaman System is available for multiple Raman wavelengths in 2 basic versions:

1. The low-cost non-cooled version with 25 cm^{-1} resolution, standard built-in solid state laser .
2. The high performance, TE-cooled version with a stabilized Laser that can achieve an optical resolution of 10 cm^{-1}.

Both AvaRaman systems come with special AvaSoft-Raman software (see software section). The AvaRaman System is optimized for maximum sensitivity. The maximum integration time is 60 seconds.
The AvaRaman is especially useful for analysis, such as reaction monitoring, product identification, remote sensing, and the characterization of highly scattering particulate matter in aqueous solutions, gels and other media.
The AvaRaman System is also available with different Laser types than the standard 785nm, such as Ar-Ion 514 nm, solid-state 50 or 100 mW green (532 nm) lasers or HeNe lasers 633nm.

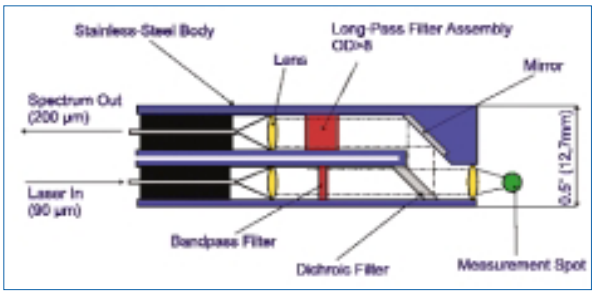
Raman signal for ethanol



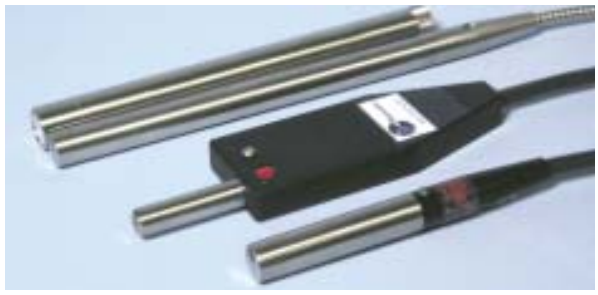
Technical Specifications

	AvaRaman	AvaRaman-TEC
Signal to noise Ratio	200:1 for Benzene	300:1 for Benzene
Resolution	25 cm^{-1}	10 cm^{-1}
Spectrometer	AvaSpec-2048 with grating IB (780-1100nm), slit-50, DCL-UV/VIS	AvaSpec-2048TEC with grating IB (780-1100nm), slit-25, DCL-UV/VIS, TE cooled
Spectral Range	100-2700 cm^{-1} (790-1050nm)	100-2700 cm^{-1} (785-1050nm)
Laser output (785nm)	500 mW, Class 3b	500 mW, Class 3b
Laser Wavelength	785 nm, optionally 532nm	785 nm optionally 514, 633 nm
Laser Bandwidth	Ca. 2.5 nm	< 0.2 nm
Fiber optic Probe	Different options available, see ordering information	
Dimensions housing	310 mm x 235 mm x 135 mm	320 mm x 450 mm x 135 mm

Focused Raman probes



Laboratory probes AvaRaman-PRB (-FP/FIP)



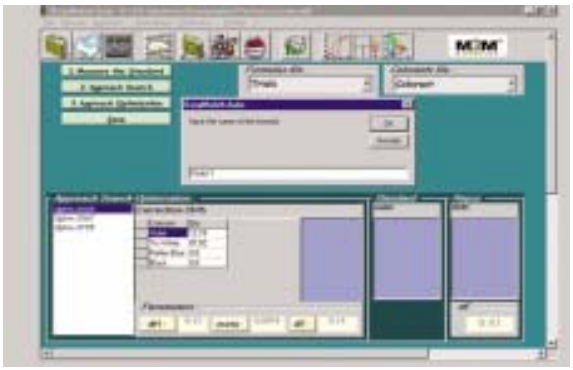
Industrial probes AvaRaman-PRB –FC

Sample Holder AvaRaman-SH

ORDERING INFORMATION	
All orders must include AvaRaman-GL unless letter stating ownership of proper laser safety goggles is submitted.	
AvaRaman	Consisting of following elements: Solid state 500mW laser 785 nm AvaSpec-2048 Spectrometer with 600 lines/mm grating set 780-1100nm, 50µm slit, DCL-UV/VIS AvaSoft-Raman Raman application stand-alone software for the AvaRaman system
AvaRaman-TEC	Consisting of following elements: Solid state 500mW laser 785 nm, FWHM 0.2nm TE Cooled AvaSpec-2048TEC Spectrometer with 600 lines/mm grating set 780-1100nm, 25µm slit, DCL-UV/VIS AvaSoft-Raman Raman application stand-alone software for the AvaRaman system
Different Raman probes available	
AvaRaman-PRB-XXX	1/2" SS laboratory low-cost focusing probe with a 90µm excitation fiber and 200µm read fiber. Multiple focal lengths available (5 mm (standard), 7.5mm, 10mm). Manual shutter included, 1.5 m fibers. Specify XXX=excitation wavelength
AvaRaman-PRB-FP-XXX	1/2" SS laboratory focusing probe with a 90µm excitation fiber and 200µm read fiber. Multiple focal lengths available (5 mm (standard), 7.5mm, 10mm). Specify XXX=excitation wavelength
AvaRaman-PRB-FIP-XXX	5/8" SS laboratory focusing insertion probe for in-situ measurements with a 100µm excitation fiber and 200µm read fiber. It can withstand 200 °C. Specify XXX=excitation wavelength
AvaRaman-PRB-FC	3/8" SS industrial process probe for in-situ measurements with a 100µm excitation fiber and 200µm read fiber. It can withstand 500 °C and 3000psi, the probe optics provide complete background filtering.
Other accessories	
AvaRaman-SH	Rugged sample holder for secure positioning of Raman probes
AvaRaman-GL	Safety Goggles for use with Raman system, obligatory

Color mixing and matching software

The Mix2Match software was developed to be used with the AvaMouse or SpectroCam, but can be used as well in combination with other AvaSpec spectrometers, that can do color measurements.
The main applications can be found in printing and painting industry.
Mix2Match is Color Matching Software. It creates new colors to match existing colors from a basic library and apply a correction. Its also possible to creates new colors to match from a colorant file. This colorant file has to be first built up from some specific color mixture. In general, Ink manufacturers provide us with these letdowns and Mix2Match will expend this file (library).



Mix2Match software does it in four steps:

1. Measure the original (with the Avamouse/SpectroCam)
2. Calculate the appropriate mixing formula with the computer
3. Compare the produced sample with the original
4. Optimize the formula using the correcting program.

ORDERING INFORMATION	
Mix2Match Pro	A full software package for color formulation, correction, quality control and colorant characterization. 3 versions are available with many parameter Tools.
	Market
Print Match module	Ink manufacturers large printing companies with Flexo, Serigraphic, offset production and a laboratory department.
Paint Match module	Paint manufacturers with laboratories (manual volumetric dispensers)
Mix2Match general	Plastics compounders and Master Batch producers, Pigments. Printing on Textiles, Ceramics, Cosmetics and Cement companies with laboratories
Mix2Match Auto	A full software package for color formulation, correction, quality control and colorant characterization. This software has fewer functionalities but is fully automated. In order to build a basic color library you will need to characterize the colorants of color guides. Customers can send us their colorant mixtures with the white and black additives. We measure and characterize the colorants and return the results.
Mix2Match Plus	A simplified version of EM Pro and EM Auto but it needs a color library to searches the closest color and adjusts the formula to match a standard. The QC package and Color Correction module is included. **Paint Market** Small Paint manufacturers and Paint shops **Printer Market** Printers who to use the Pantone Color Guide
Mix2Match Basic	The same version as Plus but no correction. The QC package is included. **Paint Market** Paint shops and small printers.
Mix2Match QC	Very useful in all applications where color is concerned. To measure and save colors while displaying all color differences.