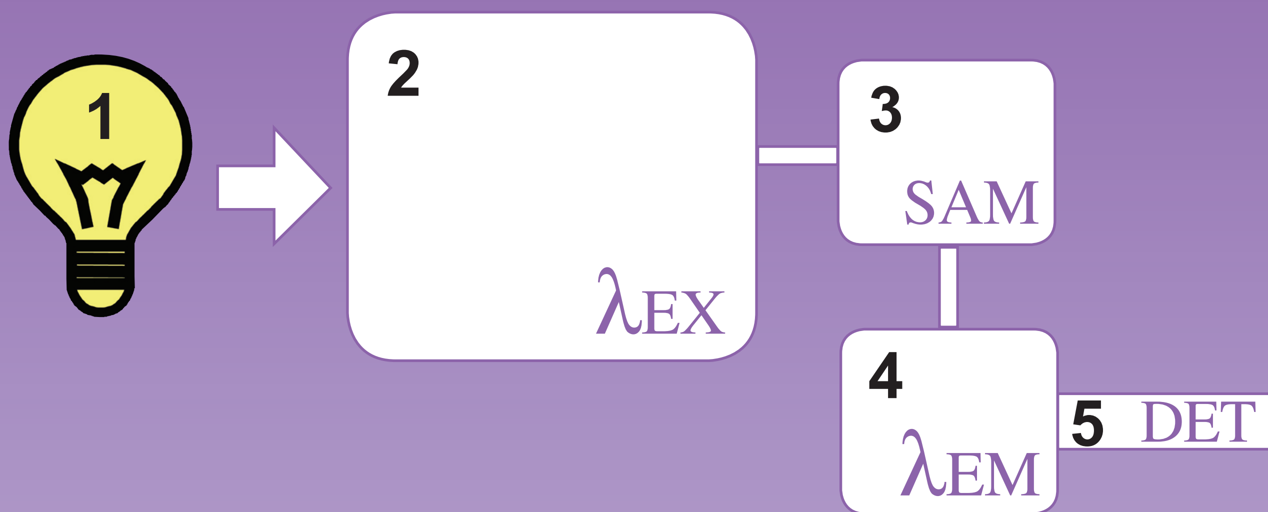
Creating the Optimal Fluorescence Spectrophotometer for your budget and experimental requirements.



With OLIS, you can specify exactly the best combination of components for your sensitivity, speed, and budget needs.

We have the expertise to produce the most advanced fluorimeter in the world, supporting millisecond scanning in both the excitation and emission. We can also produce a simple and low-cost model, perfect for a small teaching lab.

As you consider what could be exactly right for you, questions to answer include: How bright must the excitation be and at which wavelengths? Is the sample liquid or solid, and is variable temperature important? Which emission wavelengths are of interest and how sensitive must the detectors be? Is speed important?

You can tell us which components you prefer. Or, let us choose them after getting your requirements for sensitivity, speed, and price range.

Choose their "good" or "best." Or create what is "exactly right" for you.

Our expertise in designing and building precisely what our clients need is well documented worldwide. Let us build your system, too.

Choice 1: The Excitation Source

The excitation source determines how much light there is to the sample and which spectral range is available. “The higher priced, the better” does not necessarily apply. Exceedingly affordable LED and diode laser sources are bright, available in a range of wavelengths, and can be used alone or in multiples for higher illumination intensity. The sources are listed in increasing cost and versatility.

Diode Laser

An inexpensive and yet highly useful choice for specific visible & NIR excitation wavelengths. Diode lasers are color specific, so further refinement of the excitation source is not required (thus, Choice 2 can be “None”). These sources are small and easily exchanged one for another, so it would be practical to have several and change among them between measurements.

Pros: low cost, bright, already wavelength specific

Cons: limited color choices, not suited for scanning excitation

LED source

Also very inexpensive, but not as bright as a diode laser, LEDs are small and rugged. One can ring a sample with multiple LEDs of the same or different wavelengths and computer control their firing to get higher intensity (multiple of one color) or to simulate scanning (LEDs of different colors). OLIS software can pulse LEDs very rapidly. Neither an excitation filter nor monochromator (choice 2) is required.

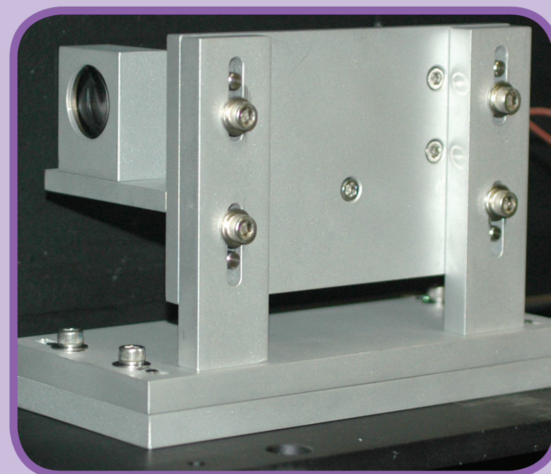
Pros: low cost, bright, already wavelength specific

Cons: limited color choices, not suited for scanning excitation

150 or 300 watt Tungsten lamp

A great choice when a broadband source with excellent stability is required, as when doing absorbance spectroscopy. **This bright tungsten lamp** has more output above 1000 nm than does the more expensive 300 Watt xenon arc lamp. A tungsten lamp's useful range is 400-2200 nm.

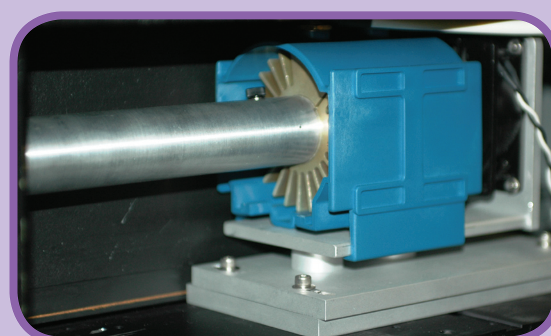
Pros: brilliant output in NIR, broadband to support scanning
Cons: less bright than Xenon below 1000 nm



Cermax 300W Xenon arc

Arguably the right choice for most laboratories. Useful from 230 – 1700 nn with very high intensity output. This source is measured to have only 20% less output than a typical 450 watt xenon arc. The sharp peaks of a xenon arc produce exceedingly high intensity at certain wavelengths, yet still less than a laser at most wavelengths.

Pros: brilliant output throughout entire UV/Vis/NIR region, broadband to support scanning
Cons: cost



Choice 2: Excitation Wavelength Selector

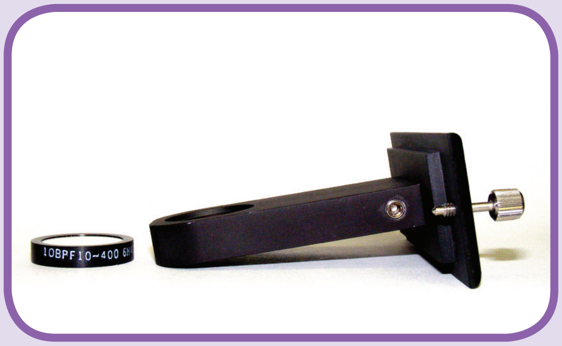
This component refines the excitation. Wavelength specific excitation sources might not require any further refinement. Broadband light sources will. The fewer reflective surfaces between the source and sample, the more of the excitation intensity is available for the measurement. These two pages show six choices ranging from ‘full excitation intensity and free’ to 50-70% of the excitation being absorbed before it reaches the sample and high price tag (double monochromators).

None

When using color-specific excitation sources (LEDs, lasers) there is no need for further refinement of the light, so an excitation monochromator is not required.

Pros: no cost

Cons: no scanning or wavelength refinement

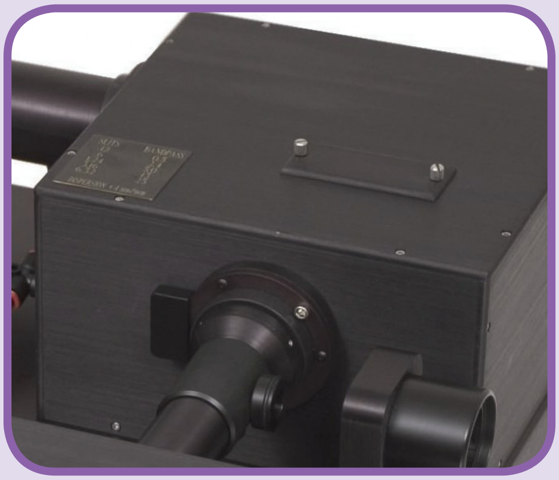


Filter

The next least expensive choice is a filter. Here, a filter holder is mounted between the excitation source and the sample compartment, so that you can insert or remove any band-pass filter appropriate to your needs for the experiment. A filter absorbs slightly less light than a single monochromator does but precludes any potential for scanning.

Pros: low cost, high throughput

Cons: no scanning refinement or limited to available filters



OLIS Single Grating Monochromator

The low cost, high throughput choice for those who want easy selection of multiple wavelengths and scanning. The single monochromator is physically small and modestly priced with higher stray light than a double monochromator. However, it can become a ‘double’ when a filter is added; and a filter must be added to remove second order light when working above around 800 nm. The wavelengths it selects for are determined by the gratings used. Choices exist for different wavelength spans and resolution, which you will specify at time of purchase and change if you care to.

Pros: scanning, small footprint, easily adapted for different spectral ranges

Cons: modest cost, higher stray light than double

Cary Prism + Grating monochromator

An outstandingly robust, versatile and effective choice for NIR scanning, this Cary monochromator features **a full 185-2600 nm scanning potential without any optical changes or additions**. The prism half of the monochromator removes second order light, so the addition of a second order rejection filter is never required. Slits are under computer control, so that wide spectral spans can be scanned while maintaining equal light levels across the region. This is a large and heavy monochromator, requiring 60 x 80 cm bench space for it alone.

Pros: Widest spectral range, easiest to use in NIR, modestly priced, “environmentally green”
Cons: Large, heavy

OLIS Double Grating Subtractive

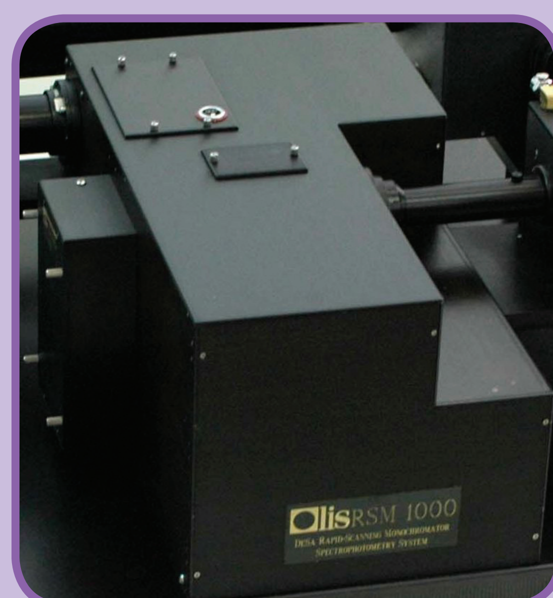
A superb choice for working within the UV/Vis or NIR regions. A tiny and ultramodern double grating monochromator with manual slit width adjustment and a place for a second order filter. Generally used with a brighter excitation source than a single grating monochromator. Secures very high photometric precision and very low stray light.

Pros: small, fast, homogenous beam
Cons: will require second order rejection filter for NIR use

DeSa Double Grating Subtractive with Rapid-scanning

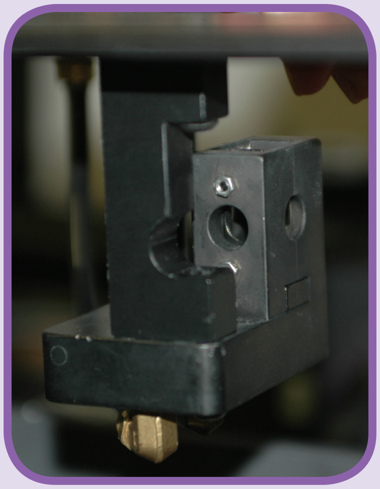
The premium choice for kinetic studies, this remarkable double grating monochromator supports millisecond spectral scan rates. Scan rates from arbitrarily slow to 1,000 scans per second make this model best in the world for situations calling for fast changing excitation. Spectral range is fixed by the easily exchanged 50 x 50 mm gratings.

Pros: extreme versatility and speed
Cons: high cost



Choice 3: Sample Holder

Unlike the other categories where all known options are presented, the sample holder options could be joined by others. Let us know what you need. We can make nearly any holder and can accomodate most third party products.



The basic 1 cm² cuvette holder
Low cost, general purpose. Can be used with a digital or analog water bath to thermal regulate the sample. Can be used with microvolume and short pathlength cuvettes, too. Six and ten position models are also available.

A Thermoelectrically controlled (Peltier) 1 cm² cuvette holder
Quantum Northwest rates these cell holders as useful from -55 to +105°C, with very fast adjustment. They are controlled through the OLIS software by means of an easily edited ASCII script. Comes with built-in stirring. Four and six position models are also available.

ISS Dewar Flask
Allows one to work with samples at liquid nitrogen temperatures.

Oxford Cryostat Holder
Control between ambient & liquid nitrogen temperature.Expensive, but exactly what is required for low temperature work.

OLIS Rotating Substrate Holder
Solidly constructed and easily adjustable solid sample holder with 1° precision. Samples of various lengths and thickness can be held. There is no thermal control. But, one can rotate the sample within the full 360º degree potential of the holder to select the optimal angle of incidence. A computer controllable version is available for collecting scans as a function of angle measurements.

View from top, showing dial that fixes angle at which sample is presented to the measuring beam.

View from underneath, where substrate is fastened into place.

Choice 4: Emission Wavelength Selector

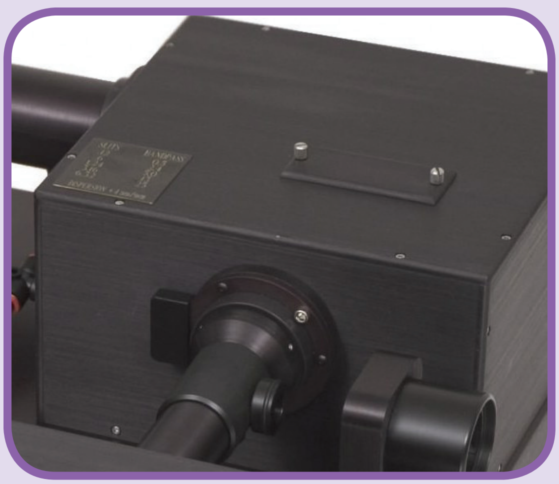
Unless one is content with collecting total fluorescence, which includes not only the emission of the sample but also any Rayleigh and Raman scatter from the single or multiple fluorophores, **he needs a wavelength selector**. Five choices are available, presented in order of increasing price. For very weak emitting samples, the lower cost choices will be better.

None

No wavelength selector is required if total fluorescence is wanted.

Filter

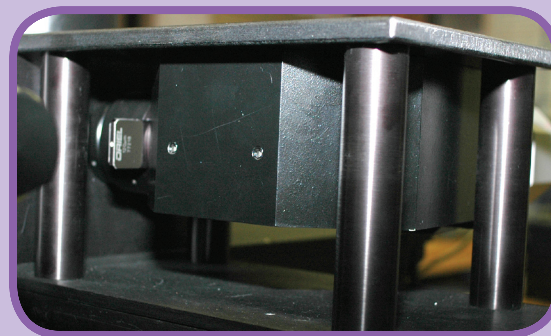
The next least expensive choice is a filter. Here, we would mount a filter holder between the sample compartment and detector. A filter absorbs slightly less light than a single monochromator does but precludes any potential for scanning the emission.



OLIS Single Grating Monochromator

The low cost, high throughput choice for those who want easy selection of multiple wavelengths and/or scanning. The single monochromator is physically small and modestly priced with higher stray light than a double monochromator. However, it can become a 'double' when a filter is added; and a filter must be added to remove second order light when working above around 800 nm. The wavelengths it selects for are determined by the gratings used. Choices exist for different wavelength spans and resolution, which you will specify at time of purchase and change if you care to. A single monochromator has higher light throughput and higher stray light than does a double monochromator.

Spectrograph



A third party product which is the required emission wavelength selector when a CCD InGaAs array detector is used to collect full spectrum emission readings. The spectrograph has high negatives: low light throughput, high stray light, and moderately high cost. It presumes use of the CCD InGaAs device, which has high negatives, too (see page 11).

OLIS Double Grating Subtractive

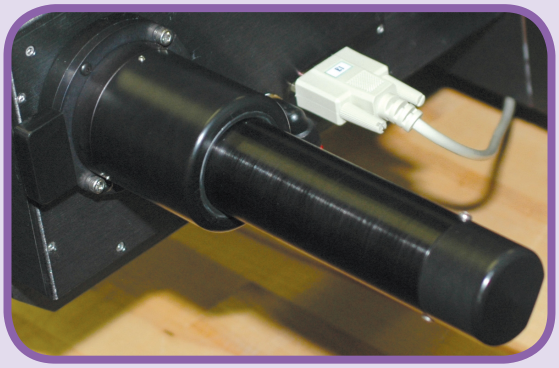
A superb choice for working within the UV/Vis or NIR regions. A tiny and ultramodern double grating monochromator with manual slit width adjustment and a place for a second order filter. Generally used with a brighter excitation source than a single grating monochromator requires for the same level of light output. Secures very high photometric precision and very low stray light.

DeSa Double Grating Subtractive with Rapid-scanning

The premium choice for kinetic studies, this remarkable double grating monochromator supports millisecond spectral scan rates. Scan rates from arbitrarily slow to 1,000 scans per second make this model best in the world for situations calling for fast changing emission. Spectral range is fixed by the easily exchanged 50 x 50 mm gratings. This monochromator has the unique distinction of easily converting to use as a single grating model, so that rapid-scanning emission with very high sensitivity is possible. The silver circle on the top of the monochromator (at right) is the cable port connecting to the “midplane” PMT or photon counter. When the detector is in the midplane rather than the exit port, four optical surfaces are eliminated from the optical train, exactly as if the double were removed and a single monochromator were put in its place.

Choice 5: Emission Detector Choices

Fundamental to the sensitivity of the fluorimeter is the detector. The choice must be made on spectral range, speed, and sensitivity. The following choices are like the rest in this document: least expensive to most. Here, we find an interesting paradox: the most expensive is arguably the least desirable.

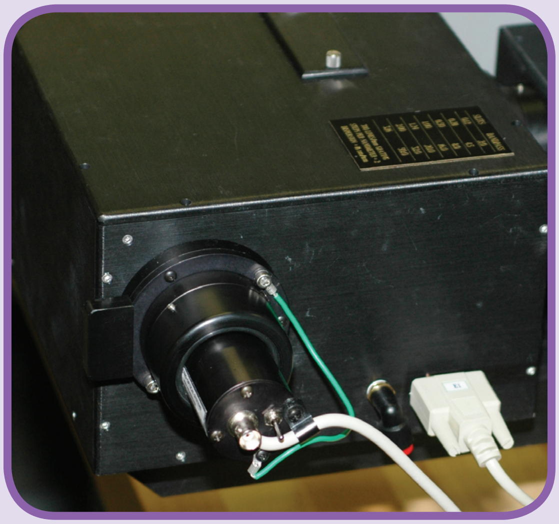


Photomultiplier Tube, UV/Vis only

Photomultiplier tubes are low cost, sensitive, and fast. And, because they are optimized for speed, they cannot be as sensitive as photon counters, which are optimized for low light level cases. They have no utility beyond around 850 nm.

Photon Counting Module, UV/Vis only

The first choice for fluorescence in the UV/Vis region when best sensitivity is required. The photon counting choice is slightly more expensive than the PMT, but it offers (at least) 20-fold higher sensitivity. The best model has the limited wavelength range (280 – 630 nm). Versions with wider ranges (180-850 nm) have 10-100 fold higher dark counts, which makes the incoming data much noisier.



Standard InGaAs Detector, NIR

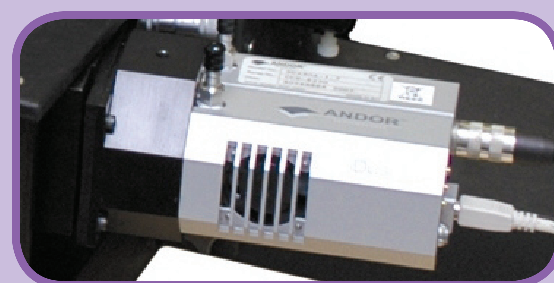
The first choice for fluorescence and other acquisition modes in the NIR region up to 1700 nm. Both thermoelectric (TE) and liquid N_2 cooling models are available. Full useful detection range is 800-1700 nm.

Extended Range InGaAs, NIR

The choice when detection up to 2500 nm is required. However, these extended range models are much less sensitive and more expensive than standard InGaAs, so they should be chosen only if the range from 1700-2500 nm is required. Full useful detection range is 800-2500 nm.

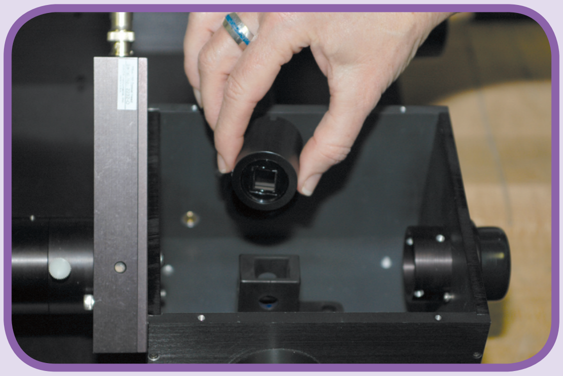
CCD InGaAs Array Detector, NIR

This detector has the appeal of collecting more quickly than the InGaAs detectors, but speed comes with a high price tag; a huge drop in sensitivity and the annoyance of “hot” or “dark” pixels. This detector should be chosen only when the emission is relatively bright, so that its low sensitivity does not preclude utility.

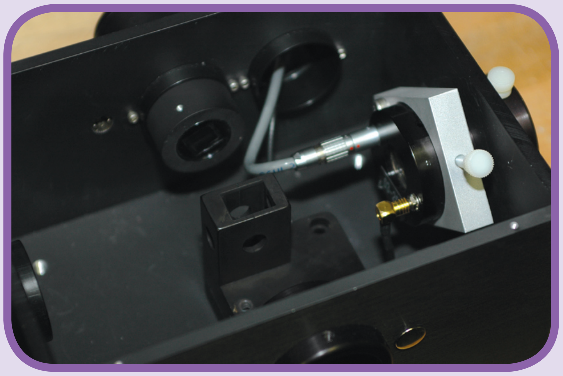


Economically Add Modern Digital Fluorescence Polarization, Anisotropy, Circularly Polarized Luminescence, and CD!

The OLIS Polarization Enhancement Toolbox



Mounting the polarizer in the PEM Toolbox



The LC is mounted within the chamber

OLIS PEM Toolbox, UV/Vis/ NIR

A remarkably diverse enhancement which adds anisotropy, polarization of fluorescence, circularly polarized luminescence, and even fluorescence detected CD! The PEM version (as opposed to the LCVR, next) supports high speed kinetic studies, such as stopped-flow. One can add the polarizers and PEM to an existing chamber or purchase a complete chamber which exchanges with another.

OLIS LCVR Toolbox, Vis/NIR

Identical to the previous item, but with a liquid crystal variable retardance device used to modulate the light left-right or parallel-perpendicular. Use of the LC allows exceedingly precise work but is limited in utility to 320 nm and above.

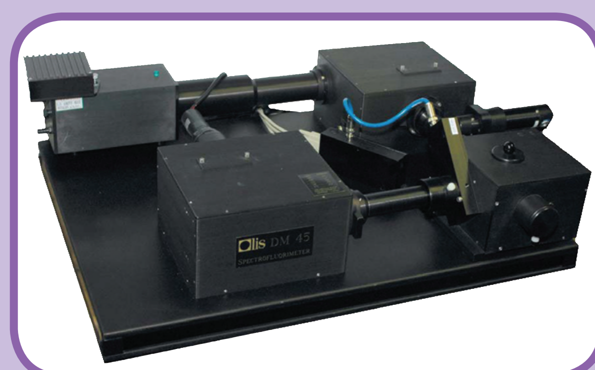
Four OLIS spectrofluorimeters

OLIS SM 45 Flash Fluorimetry System

This is a system designed for faculty at Furman University who wanted to do a range of flash and laser induced measurements. Starting from the left, visible in this photograph are the emission monochromator, the sample chamber with a cryogenic flask, the control box (slightly rear), and then the computer system. Not visible is the excitation source, which points directly into the sample compartment, thus at 90 degrees to the emission monochromator and detector.

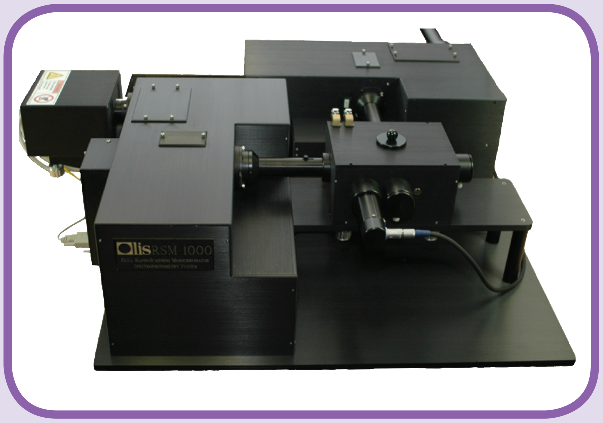
OLIS DM 45 Spectrofluorimeter with PEM Polarization Toolbox

The very popular OLIS DM 45, here enhanced with the quad-function Polarization Toolbox, making a remarkably affordable spectrofluorimeter for steady-state, scanning, synchronous scanning fluorescence, polarization of fluorescence, CPL, FDCD, and anisotropy. The useful range of this model can be 200-800 nm or 800-1700 nm.



OLIS 14 NIR Spectrofluorimeter

The outstanding Cary 14 finds yet another modern purpose, today as the excitation monochromator of the most popular OLIS NIR fluorescence system. Here, it is fitted with a single grating emission monochromator and the extended range InGaAs detector for scanning the emission in the 800-2500 nm. As noted on page 11, this detector is less sensitive than the alternative which extends to 1700 nm. The original sample and reference and detector chambers are retained on this system, letting us know that it remains as a dual beam UV/Vis/NIR absorbance spectrophotometer, too.



OLIS TWIN RSM 1000 Spectrofluorimeter

This amazing model supports millisecond scanning in excitation or emission. Thus, one might scan at a normal speed to excite fluorescence and then rapid-scan the emission. Concurrently, the excitation beam can be used to measure absorbance, light scatter, and red edge fluorescence. As shown, it is fitted with the 300 watt xenon arc lamp and has the emission monochromator working as a double (notice the photon counter at the exit position rather than in the midplane, as discussed on page 9). This exceedingly versatile model provides scan rates of 1000, 250, 60, 30, 10, 5, 2, and 1 scans per second, as well as normal slower speeds. The rapid-scan method of collecting emission spectra results in higher sensitivity faster than does slow scanning, since 99% of the time of rapid-scanning is spent collecting photons, whereas slow scanning involves downtime to move the gratings and adjust high volts. Ask to see the spectra comparing 10 seconds of rapid-scanning with 17 seconds of normal speed collection.

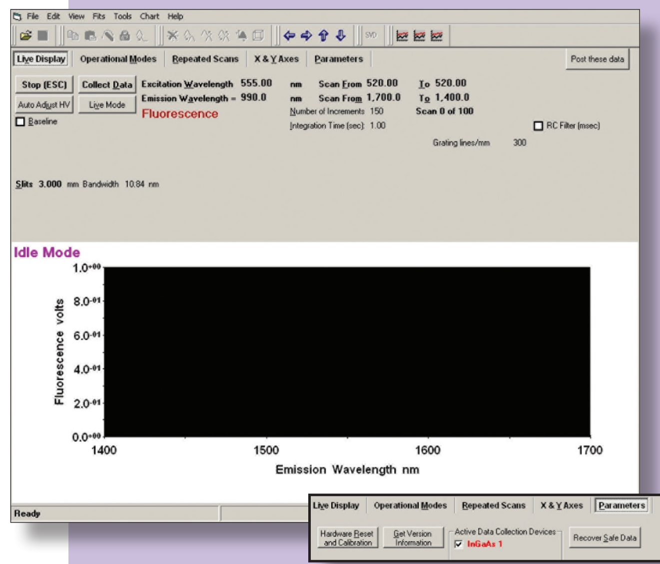
A screen from the OLIS SpectralWorks Data Collection module

All choices across the top (File, Edit, View, Fits, Tools, Chart) are pull-down menus. Icons on the next line are colored if active and uncolored if not active. Most here are shown uncolored, as there are no data present.

The "Live Display" button is depressed, causing the remainder of the screen to be as it is shown. Features and functions of the software when in "live display" include settings excitation and emission wavelengths, scan ranges of each, integration time, and number of repeat scans to take. We are also shown the number of increments, or points, to be collected along this 300 nm emission range ("150").

"Operational Modes," "Repeated Scans," X&Y Axes" and "Parameter" buttons will cause other information to be presented.

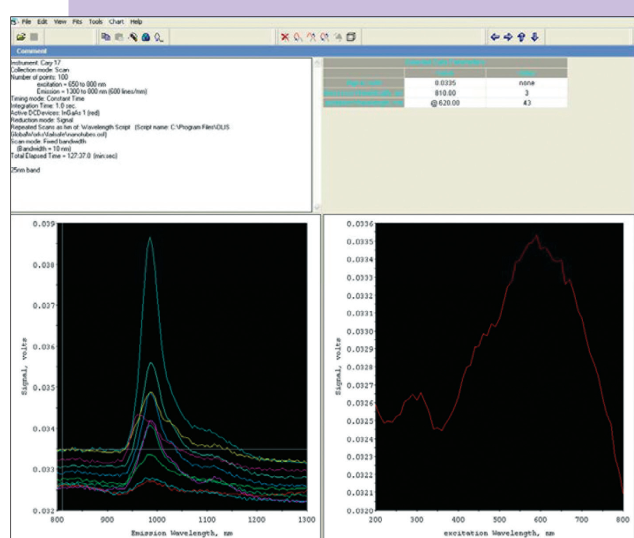
The inset shows the screen when the "Parameters" button is used, showing that this experiment was done with an InGaAs detector.

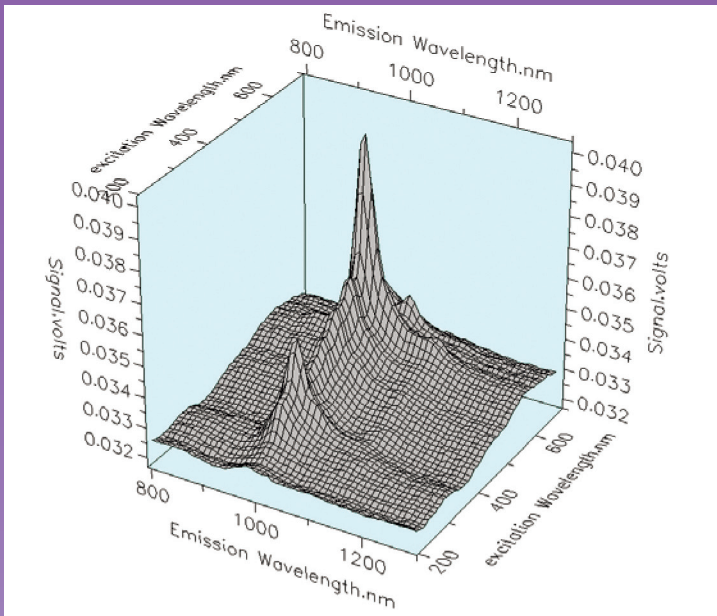


A screen from the OLIS SpectralWorks Data Display module

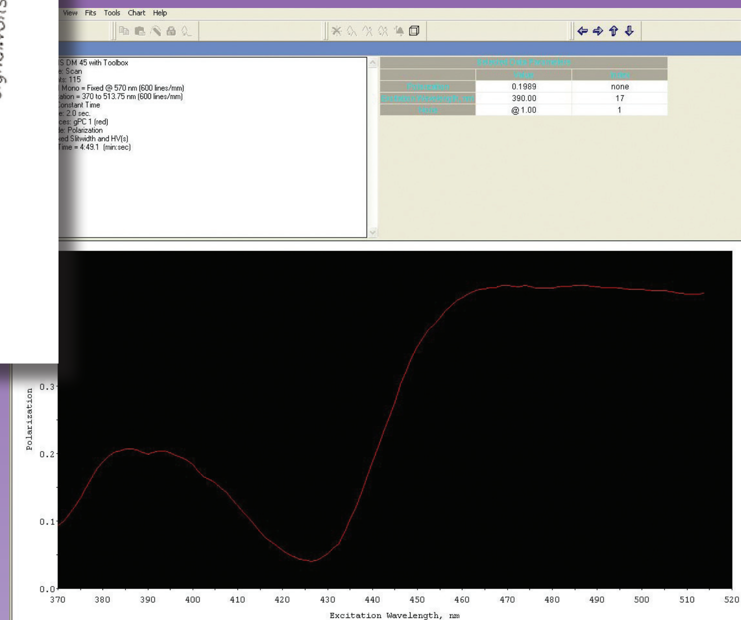
After data are acquired, the software shifts the information on the screen. Here, we have two graphs, one containing the emission spectra and the other the excitation information. This happens to be the 2D presentation of the excitation-emission matrix of a CoMoCat Nanotube suspension. (See back cover for the EEM in 3D of the same data; carbon nanotube sample furnished by Tobias Hertel, Vanderbilt (now, University of Wuerzburg.)

All information in the left-hand Comment box is automatically generated by the software, recording the instrument's settings for the acquired data. This Comment can be edited to any length. The information in the chart to the right corresponds to the data under the crosshair cursor. All scaling is automatic, although also under user control. The boxes at the far right can be displayed or hidden and correspond to the file(s) in memory.





NIR fluorescence of CNT,
acquired on OLIS 14 NIR (page 14)



Polarization of Fluorescence
acquired on OLIS DM 45 with PEM Polarization
Toolbox (page 13)

Olis

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