Selected Article

The World's Most Sensitive Spectrofluorometers

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HORIBA Jobin Yvon manufactures a large range of fluorescence spectrofluorometers, including benchtop models that make steady-state measurement to advance modular systems that can also measure fluorescence anisotropies and lifetimes of your samples.

Introduction

By virtue of its emission nature, fluorescence is an extremely sensitive technique, as compared, for example, to instrumentation involving absorption. You can think of emission techniques as analogous to weighing a penny by placing it directly on a scale, while absorption techniques are comparable to weighing an elephant with and without a penny on its back, then subtracting one value from the other to obtain the weight of the penny.

Because of fluorescence sensitivity, instruments to measure the emitted light from the UV through IR are widely employed in areas of biochemistry and technology, to probe molecular distances as well as the local environment of structures and cells. They are also common in materials science, especially now that nanotechnology rises in importance.

In the world of sensitivity, the instruments that are unchallenged in their ability to detect the weakest of signals are those from HORIBA Jobin Yvon. Whenever we set out to design a new generation of spectrofluorometers, our first criterion to consider is sensitivity. And sensitivity is achieved by attention to details such as optics, electronics, and software.

A Brief History

The original Fluorolog™, in 1976, was the most sophisticated spectrofluorometer available, distinguished as the first computerized fluorometer. Its successor, the Fluorolog-2, appeared in the early 1980s, and the latest generation, the Fluorolog-3, was first sold in 1996. Our first benchtop model, the original FluoroMax™, was introduced in 1990, and its great-grandchild, the FluoroMax-4, entered the market in 2006. To complement our steady-state and frequency-domain lifetime spectrofluorometry, HORIBA Jobin Yvon acquired the Scottish firm IBH in 2003 to include time-correlated single-photon-counting technology in our systems. HORIBA Jobin Yvon's main center of research and development is located in Edison, New Jersey. We continue to be the leading manufacturer of the best spectrofluorometric instruments available, and boast the highest sales of any company in the field.

All-Reflective Optics

One of the reasons our instruments are so sensitive is the fact that instead of lenses, mirrors are employed. The biggest advantage of mirrors is their ability to focus or collimate light without chromatic aberrations. This means that light is in focus no matter what wavelength is involved. Lenses are usually in focus at only one wavelength, and, as you move away from the focus, the ability of the instrument to transfer and collect light is limited, especially when sources, samples, and detectors, are small.

Photon Counting

Another feature that contributes to outstanding sensitivity is counting the pulses in a photomultiplier tube that result each time a photons strike these detectors. Instruments that employ analog techniques sum together not only the current originating from photons, but also that due to noise in the electronics. This limits, of course, the ability to discriminate the real sample signal from the background.

Blazed, ruled gratings, selected detectors, focal lengths, and sources also contribute to the sensitivity of these instruments. So why don't other systems incorporate all these features as well? Cost is the primary reason. If you want sensitivity, you have to pay for it.

Who Needs Sensitivity?

Sensitivity is more than the ability to detect signals from samples at lower concentrations. If you count more photons, obviously the accuracy of your answers is much higher as your statistical sample is greater as well. In addition, more signal means you can take data much faster and achieve the same accuracy.
Sensitivity, accuracy, and speed. That's what you get with instruments from HORIBA Jobin Yvon.

Bench-top Simplicity or Modular Flexibility

To meet the demands of researchers in many fields, HORIBA Jobin Yvon offers two types of instruments: the FluoroMax-4 and the Fluorolog-3.

The FluoroMax-4(Figure 1), the newest spectrofluorometer, is a benchtop unit that offers all the sensitivity and accessories necessary for state-of-the-art fluorescence investigations, but offers the simplicity and convenience of a self-contained unit. Features like self-calibrating wavelengths, computer controlled slits, and automated experiments in software are standard. Order a FluoroMax-4 and it arrives ready to take data right out of the box.

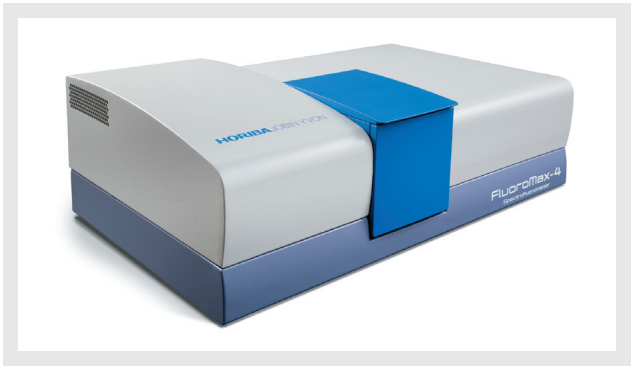

Figure 1 The FluoroMax™-4 Bench-top Spectrofluorometer

The Fluorolog-3 (Figure 2) is the most advanced instrument available. The most prominent feature is modularity, which encourages you to design an instrument that is ideal for your unique application. For example, you can add double monochromators to achieve higher throughput and better rejection of background radiation, or you can add a spectrograph and CCD detector to obtain complete spectra in a matter of milliseconds (Figure 3). You can operate in the ultraviolet, visible, or infrared by selecting from a variety of gratings and detectors. You can also choose to mount multiple detectors or sources that complement your application.

Figure 2 Modular Spectrofluorometer Fluorolog™-3

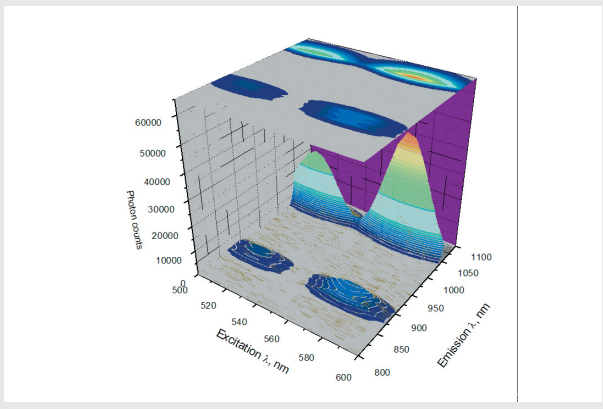

Figure 3 Near-IR Excitation/Emission Matrix Fully Characterizes This Nano Sample
On a Nanolog™, A Special Version of the Modular Fluorolog™-3

In addition to acquiring steady-state spectra of samples, accessories can be added to both FluoroMax and

Fluorolog to acquire lifetime data. Fluorescence lifetimes are the average time between absorption of the excitation light and emission of fluorescence. By acquiring lifetime data, information on the dynamics of processes within the samples will tell you more about the environment, size, and distances. HORIBA Jobin Yvon is the only company that supplies the two most prominent methods for acquiring lifetime data: Time-Correlated Single Photon Counting (TCSPC (Figure 4)) for ultimate sensitivity, or the phase/modulation method for the fastest acquisition, as fast as one millisecond. These techniques can characterize lifetimes as small as several picoseconds.

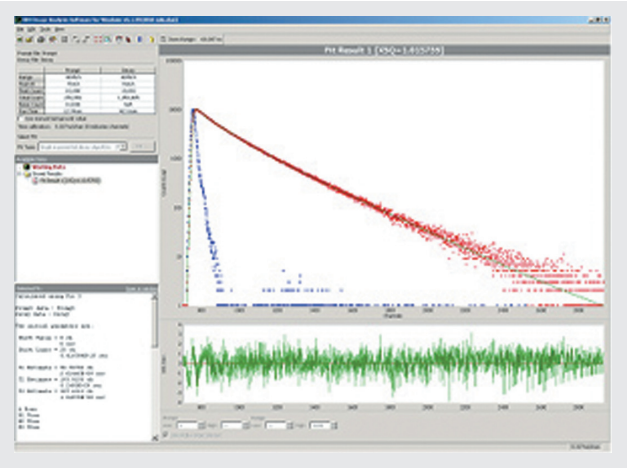

Figure 4 The TCSPC Lifetime Option Can Characterize Lifetimes as Short as Picoseconds

Conclusion

This gives you a brief introduction to HORIBA Jobin Yvon's Fluorescence product line. Of course, any of these instruments can be fitted with a vast variety of accessories, from heater/coolers, to microscopes, or polarizers to determine anisotropy.

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