JY Division Information

Optical Spectroscopy

Products and Technologies of the Optical Spectroscopy Division

Salvatore Atzeni

For decades, Jobin Yvon (JY) has been a leading manufacturer of state-of-the-art spectrometers and spectrographs for scientific research. These products are used to generate and analyze ultraviolet, visible and infrared radiation. JY's Optical Spectroscopy Division (OSD) offers a complete selection of spectrometers to meet the demands of any research, testing or quality-control application. In this article, we will review the products and key technologies including Monochromators and Spectrographs, Multichannel and Single Channel Detectors, Light Sources, Software, and custom products.

1 Introduction

Jobin Yvon (JY)'s Optical Spectroscopy Division (OSD) is a retail division that provides spectroscopic hardware, software and technical expertise to solve our customer's spectroscopic problems. We have the best tools available to generate, direct, sample and analyze light from the ultraviolet (UV) to the near infrared (NIR) regions of the spectrum. Our core competency is in providing the best spectroscopic components in the marketplace – and expertise to support our customers who use them. They come to us knowing our experience and quality will provide the right solution for a reasonable price. And, of course, our post-sales technical support, including applications scientists and a Service team dedicated to the OSD Product Line, makes a customer's purchase a true investment with a company who values the total customer satisfaction experience.

At OSD, we provide optical components and specialized systems constructed using them. Unlike our sister divisions, who sell turnkey retail instruments dedicated to specific application types, we fill the market need for applications that don't fit well with other retail groups. These customers might be using our components to build a more extensive apparatus in their own laboratory, or designing a new application measurement that is not easily obtainable as a turnkey solution from any other source. Sometimes, we build a custom system for a user, and it is so specialized that it is a unique instrument – no other one like it exists in the world. Other times, we discover emerging markets when we see requests for the same application several times giving us an opportunity to create a new product that is able to perform the measurement before any of our competition even realizes that the application exists.

Our hardware components can be grouped into four categories: 1) Monochromators and Spectrographs, 2) Detectors, including multichannel as well as single channel detection systems, 3) Light sources and 4) A host of spectroscopy related Accessories. Software, an integral part of each system, controls the devices, acquires data from them, and presents and displays the results. Our components are utilized in diverse systems ranging from biomedical applications, to process control, to basic research and education. We provide a flexible and easily adaptable software platform to bring a solution to the customer in a time-effective manner. Let's examine some highlights and examples of each of the categories – our toolbox to solve the customer's problems.

2 Monochromators and Spectrographs

At JY, one of our core technologies is diffraction gratings. In OSD, we use these gratings in optical assemblies to separate and analyze light in monochromators (single-point, scanning instruments) and spectrographs (sharp focal plane, optimized for multichannel spectroscopy and imaging). Fig. 1 shows a triple grating turret.

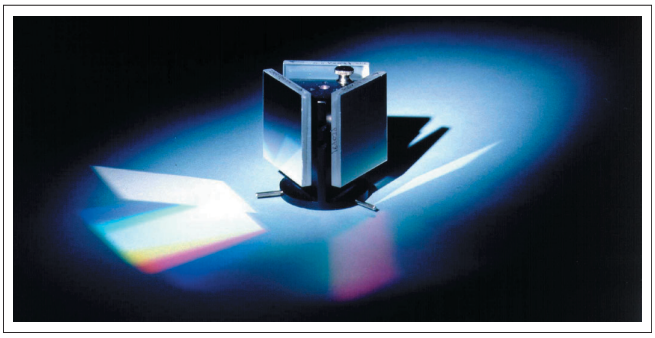
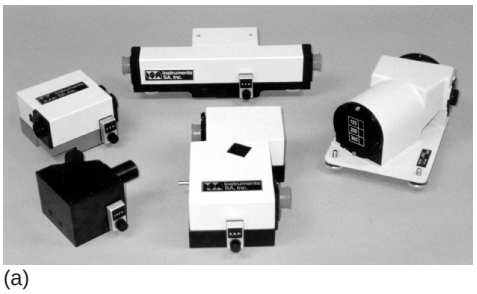


Fig. 1 Triple Grating Turret

We offer scanning instruments from 0.1 meter focal length designs to 1.25 meter focal length designs, depending on the requirements of the application. Some of these instruments fit in your hand, and the longer focal lengths will want their own laboratory bench. The instruments range in their level of computer control from units that are fully manual, to those that have complete automation of their moving assemblies including grating turrets , slit mechanisms and beam steering mirrors. Grating options from the deep UV to long IR are available, as are special coatings to enhance reflectivity of the optics in the device for particular wavelength regions. Fig. 2 shows examples of the various spectrometers.



(a)

(b)

(c)

Fig. 2 Various Spectrometers
(a) Small Spectrometers
(b) Versatile Spectrometer for Multichannel Detection, “TRIAX 322”
(c) Research Spectrometer “1000M”

3 Detectors

3.1 Multichannel Detectors

Multichannel detectors are used to capture an entire spectrum or image at once. For kinetic studies, this ability to simultaneously capture all wavelengths, makes experiments possible that you could not perform with a scanning instrument because it would take too long to scan over the wavelength range of interest and during the scan, the signal would have changed. We can collect spectra as a function of time, using Fast Kinetics and Blast Modes of operation. In these modes, acquisition of up to several hundred spectra per second is possible. Our software package can automatically collect and display the data as a three-dimensional plot of intensity, wavelength and time.

Our Multichannel Detector product line includes array detectors arranged in line arrays, square or rectangular area arrays, of various pixel size and densities. A very common type is a 1024 by 256 pixels device, using 26 μm pixel size. As with our Single Channel detectors, there are many device materials and construction techniques available, to optimize the performance and speed in different parts of the electromagnetic spectrum. Depending on the customer requirements, we can provide UV-VIS arrays as well as InGaAs (indium-gallium-arsenide) arrays, which cover a total wavelength range from roughly 200 nm to 1700 nm. With our double-exit spectrograph products, we can fit two array detectors onto a single spectrograph, giving the customer the ability to acquire data rapidly over a broad wavelength range.

To achieve the best low-noise performance, cooling of the sensor is required. We offer various styles of thermoelectric (TE) cooling, or, for the ultimate in low-noise performance, a liquid-nitrogen (LN_2) cooled unit.

Fig. 3 shows JY's CCD Detectors the "Symphony" with TE Head and LN_2 Dewar

Fig. 3 CCD Detectors the "Symphony" Series

3.2 Single Channel Detectors

We offer single channel detectors including photomultiplier tubes, silicon and germanium solid-state devices and InGaAs devices. Customers select appropriate detectors, depending on the application with regards to wavelength range, noise properties and timing performance. Photomultipliers offer fast rise times (typically a few nanoseconds) and generally cover the ultraviolet (UV) from approximately 180 nm to the beginning of the near-infrared (NIR) range of the spectrum, near 1 μm. Above this wavelength, we offer various solid-state devices, along with light choppers and phase-sensitive detection electronics required to operate them.

Single channel detectors are typically used in scanning instruments, where high gain and sensitivity are required.

Fig. 4 shows a LN_2 Cooled InGaAs single channel detector

Fig. 4 LN_2 Cooled InGaAs Single Channel Detector

4 Light Sources

Many users require a light source, to excite a sample, to initiate a chemical reaction, attach to a microscope, and other uses. The differences in light sources we offer is mainly in the energy of the photons emitted (wavelength range) and the power (number of photons per unit time). Depending on each of these parameters, the method used to generate the radiation differs. Simple solutions using a quartz-halogen lamp are often used, more powerful arc sources using Xenon or Mercury filler gas are also available from JY. For work further into the NIR and IR, we offer various elements such as Nernst glowers of different power and form factors.

5 Software

No modern instrument is complete without proper software. We offer a complete Windows®-based software package to configure and control all aspects of the hardware, collect data, analyze results and prepare them for presentation. For users who need it, low-level support is available via LabView Virtual Instrument (VIs) for many of our monochromators, spectrographs and detector components, allowing users to integrate OSD components into their research easily.

6 Custom Spectroscopy Systems

The OSD team can provide specialized spectroscopic solutions to our customers. Using the tools outlined above, we work closely with each customer to understand their requirements, and keeping in mind their budget, design and configure a solution that meets their needs. Fig. 5 is an example of custom reflectance measurement system built by JY Inc.

We also provide the other Divisions of JY with our components – for example, the Fluorescence Division uses our imaging spectrographs on their instruments. We're available to help our colleagues and customers find the right answers to their toughest spectroscopic problems. As the Specialists in Spectroscopy, we take great pride in solving unique problems. Put us to work for you, and let our combined decades of experience help your laboratory get it right – the first time.

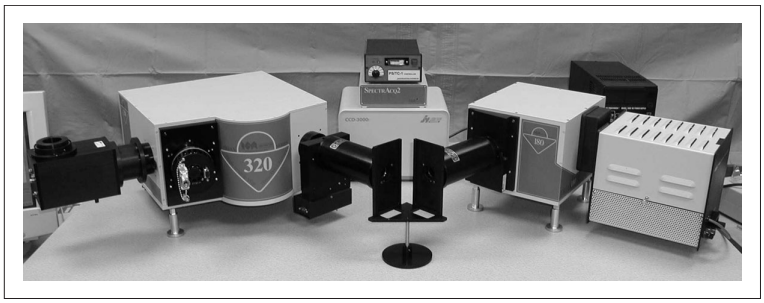


Fig. 5 Custom Reflectance Measurement System

Dr. Salvatore Atzeni

Jobin Yvon Inc.
Optical Spectroscopy Division
Director