

Products and Technologies of the Jobin Yvon Group

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Abstract

As a technology leader in optical spectroscopy Jobin Yvon (JY) has developed core skills for the design and manufacture of diffraction gratings, monochromators, spectrometers and multi-channel detectors. Application specific instruments in the field of Raman, Fluorescence, Emission spectroscopy, Forensics and Spectroscopic Ellipsometry are offered to end-users making it easy for them to access ultimate optical performance.

1 | Introduction

Optical spectroscopy has played a key role in the development of modern physics, from the early confirmation of quantum mechanical predictions of the spectrum of hydrogen to the observation of stars and interplanetary matter by astronomers refining their theory of the universe. Today, optical spectroscopy has become a routine method for the physicists and the astronomers, but also gained acceptance with chemists, biologists and metallurgists, amongst others.

Since its founding in 1819 with the collaboration of such famous physicists as Fresnel and Arago, Jobin Yvon (JY) has consistently been one of the leading innovators of spectroscopic instrumentation, as witnessed by the introduction in 1900 of the first commercial Fabry Perot interferometer.

Today the heart of a state-of-the art optical spectroscopy apparatus is a single component that is most closely associated with spectroscopic performance : the diffraction grating. It is therefore no surprise to see that the study and manufacture of diffraction gratings remains the domain of excellence of JY. With its R&D Centers located in Edison (New Jersey, USA) and in Longjumeau (France, in the heart of the French Optics Valley), JY employs more than 70 PhDs, an unequalled force focusing on the advancement of diffraction gratings and their applications to optical spectroscopy. Each year the JY R&D teams are granted more than 10 patents worldwide.

This review presents the core technologies of the JY Group and introduces their application to the development of components and instruments that will be presented in subsequent articles.

2 Core Technologies

2.1 Diffraction Gratings

To manufacture gratings of the highest quality, JY benefits from the largest dedicated commercial clean rooms equipped with both ruling engines and holographic set-ups, and with the advanced metrology necessary to continuously improve the production processes. On site vacuum testing is available for UV applications, together with many other manufacturing tools.

The quality of the substrate on which the grating structure is ruled or recorded requires high performance polishing, down to 2 Å micro roughness, and JY realises this task internally for advanced applications. A dedicated chemical lab completes the technological core of the grating development and manufacturing capabilities of JY.

Fig. 1 shows the clean room for grating facility at JY.



Fig. 1 Clean Room for Grating Facility

2.2 Monochromators and Spectrographs

Around the gratings, opto-mechanical designs result in the famous JY monochromators and spectrometers, using today computer aided tools to improve the productivity and traceability of the results. The JY optics team uses several commercial and proprietary optical calculation software packages and a 3D mechanical CAD system, complemented by advanced tools for electronics design.

Fig. 2 shows a simulation design of a new monochromator using 3-D CAD.

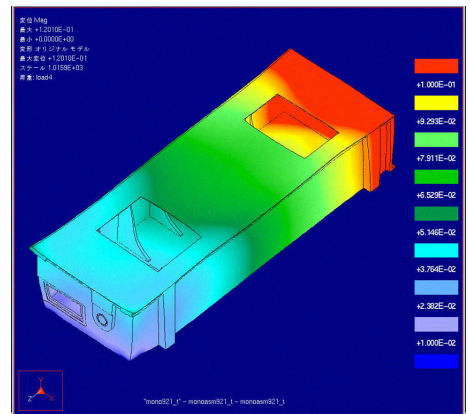


Fig. 2 CAD Characterization of a New Monochromator

2.3 Photo Detectors

While photomultiplier tubes still remain the preferred detection device for some applications, CCD detectors are gaining acceptance thanks to their flexibility and price advantage. JY electronics skill center pioneers the use of CCD technology for optical spectroscopy, developing high quantum efficiency cameras with ultra fast gating.

The Symphony CCD detectors (Fig. 3) are a family of array detectors from JY.



Fig. 3 "Symphony" Multi-Channel Detectors

3 Applications to Optical Spectroscopy Instruments

Diffraction gratings, monochromators, spectrographs and photo detectors constitute the key components of an optical spectroscopy application and, building on its core technologies, JY further developed its commercial reach by packaging these with other technologies to satisfy end-user markets.

While in an earlier era, end-users were experts with a high level of optical spectroscopy understanding, today most users require an instrument which allows them to focus on the application measurements and rely on the supplier to provide an easy to use tool for them to complete their work.

The end-user specifics of an application are more and more captured in the software that controls the components and samples, acquires, displays, analyses and archives the results. Software development for spectroscopic applications is thus characterized by both highly specific modules and many common modules. In order to provide economical and versatile software solutions, JY has therefore embraced the object oriented approach, adhering to industry standards and external packages wherever possible. A significant portion of this effort constitutes the A-design 21, Next Gen project providing the foundations for a unified software approach for all HORIBA analytical instruments.

The product development strategy of JY is therefore constructed as presented in Fig. 4, with the excellence of core components like gratings or detectors providing a competitive advantage for the products built upon them with commercial components and an application specific software. These products can be JY's own products, like the LabRam, Fluorolog®-3 or ULTIMA 2 described in subsequent articles, or products from our parent Group HORIBA, like the ABX next generation Pentra 400, the HORIBA Analytical Glucose Analyzer (in development) or the HORIBA Semicon UT300 automated Spectroscopic Ellipsometer, or products from outside the Group in the form of OEM agreements with major developers of Colorimetry, Chromatography, Lasers or Optical Bandwidth Analyzers for example.

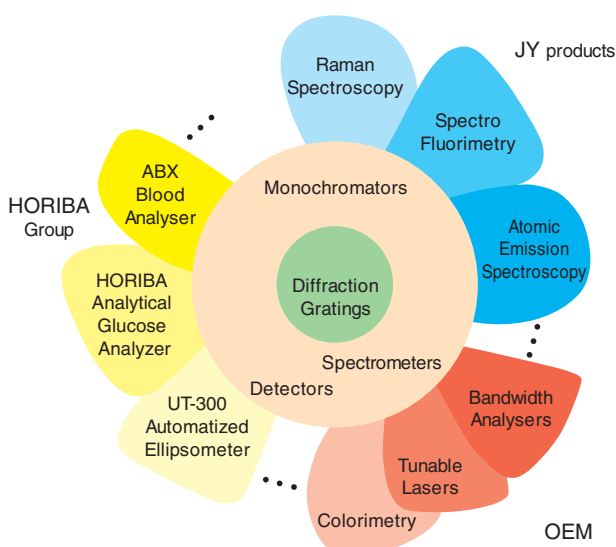


Fig. 4 From Gratings to Instruments

4 | Moving into the 21st Century

JY will continue to develop its core diffraction gratings technology and promising initial results can be noted using optimized multi-dielectric layers and other techniques to further improve the state-of-the-art. The miniaturization of core components will also be a trend, exploiting the advances of nanotechnology research to pave the way for ever more transportable and versatile solutions.

JY is also working in the multi-channel detector field to bring new cameras and devices to market that promise maximum performance for those applications demanding it as well as low cost, high performance systems that meet the needs of users and OEMs alike. Devices such as Active Column Sensor and novel IR arrays are presently under development along with a host of small low cost, temperature stabilized systems.

In terms of instruments design, it can be foreseen that, together with a general move to shorter UV wavelengths, data exploitation algorithms will play a growing role, with the advent of chemometrics as a routine technique to improve the understanding of complex data sets and the migration of a number of analytical techniques into the real time closed-loop process control arena. Also the requirements for safe and authenticated archiving of experimental conditions and result will become more important as instruments get integrated into laboratory automation information systems.

In this way, JY will strive to remain at the best scientific level, playing its role as a center of excellence in optics for the HORIBA Group and focusing its efforts on commercial targets where leading world positions can be attained.

Note

Fluorolog® is registered in the USA.



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