JY Division Information
Raman

The LabRam Family

Micro Raman Systems

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Abstract

The most successful Raman system concept from the Raman Division of Jobin Yvon is certainly the LabRam (Laboratory Raman System), an integrated dispersive Micro Raman system. Since the introduction of the basic system 10 year ago at PITTCON® 1993 on ongoing development to further improve and optimize the analytical tool was supporting the various applications so we could follow closely the needs of research and industry. Up to now there is existing a whole family of dedicated systems for many different applications: high resolution, inverted, multiwell, UV and NIR, automated and combined with FTIR versions.

1 Introduction

The LabRam is a dispersive Raman system with an integrated microscope, working from the UV to the NIR excitation wavelength. It is a benchtop system, fast, easy to use and very compact compared to previous Raman instrumentation 15 years ago, which only specially trained and educated scientific engineers could handle. Collecting a Raman spectrum took a long time, where now, due to the innovations within the last decade, a spectrum can be taken in a fraction of time.

Since its introduction, the LabRam system evolved in various versions thanks to its modular concept and got optimized for many applications. The advantage of this modularity is, that the basic system remains the same. In some cases the optical and mechanical interface to the sample is changed, sometimes the software is modified to the special needs, the dispersive system is changed (HR version) or the detection part is optimized. This reduces production costs, it is easier to service and additional modules can be integrated quickly, so it is possible to react to the various needs of industry and research. The R&D and software teams can quickly create solutions, without designing a total new instrument.

2 LabRam and LabRam HR

The two basic systems differ only in the layout of the dispersive stage. Each system can be modified to all the other members of the family.

The "standard" LabRam has a focal length of 300 mm between the dispersing element, the grating, and the CCD-detector, resulting in a spectral resolution of 2-4 cm^{-1} which is suitable for common applications with laser excitations between 400 and 800 nm.

The so called LabRam HR (High Resolution) has an extended focal length of 800 mm leading to a spectral resolution which is around three times higher compared to the standard LabRam. This increase in spectral resolution is also important for applications in the UV range or investigations such as stress measurement of semiconductor materials, polymorphism or similar where only small band shifts are investigated.

Further flexibility is added to the LabRam HR with the capability to incorporate a second detector (InGaAs) to extend the detectable region to NIR (up to 1700 nm). An important application for this is the combination of Raman with photoluminescence measurements, where you can compare Raman with absorption/emission processes based on electronic transitions.

3 LabRam INV
Inverted Microscope

For biological and life science applications in particular, the conventional upright optical microscope has some limitations. For instance, biological cells need to be kept in a specific environment and are often routinely studied with an inverted microscope sampling due to their structure and properties. The LabRam systems can accept inverted microscopes to replace the standard microscope.

Fig. 1 shows the integrated microscope. It is possible to visualize the sample through the standard binocular and TV camera. White light images by transmission in brightfield or phase contrast observation are possible, as is visualisation by reflection for fluorescence observation. Typical biological applications for Raman applications include pathology, haem centre analysis, pharmokinetics, diffusion efficiency, phase determination tissue studies and cancer research.

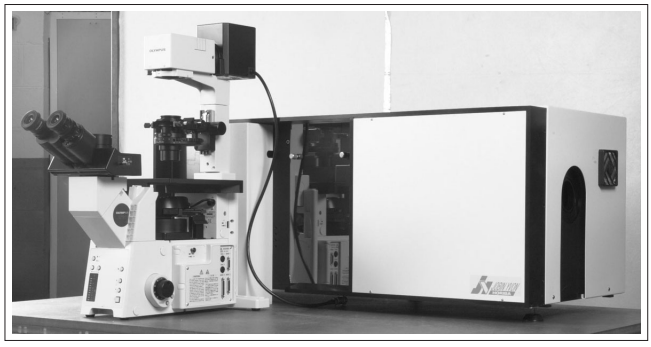

Fig. 1 LabRam INV

4 Multiwell LabRam
High Throughput Screening (HTS)

This member of the family was developed for pharmaceutical and biotechnology applications (combinatorial chemistry). The Raman microscope, which provides detailed molecular and crystallinity information has been adapted for automated studies of microarrays and multi-well plates. Application areas include lab-on-the-chip (for reactions, separations, etc.) solid-phase synthesis, genomics, proteomics and protein interactions (protein-protein, enzyme-substrate, hormone-receptor, antigen-antibody, etc.). Sample positioning is automated and acquisition/data treatment protocols are stored for future use. In combination with three-tired access, examination of large sample arrays can be automated for high throughput screening. The first Multiwell Plate reader was originally developed in a collaboration with BASF A.G. (Ludwigshafen, Germany).

Fig. 2 shows the sampling part of the instrument, with a standard multi-well plate loaded on the motorized XY stage. To ensure that the sample position relative to the objective is always correct, the position of the objective is controlled by a motorized Z-axis adjustment with autofocus function to compensate for the anticipated unequal filling of the wells. This capability is well adapted to the examination of combinatorial chemistry beads used in the pharmaceutical as well.

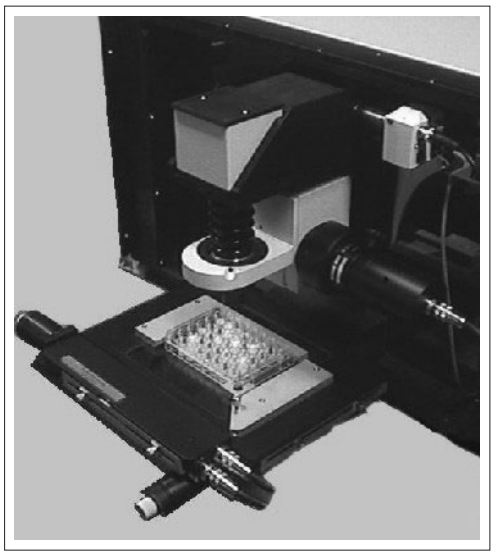

Fig. 2 Multi-well Plate Loaded on the Motorized XY Stage

5 Slider LabRam / DiskRam
Analyzers for Hard Disk Technology

These two members are compact instruments for monitoring hard disk coatings (DLC films) in the industrial field for Quality Assurance or Quality Control (QA/QC) applications. In recent years the computer hard disc manufacturing industry has implemented hard carbon overcoatings on all disc media for protection the magnetic media with hard, non-brittle films. The coatings provide wear protection against head slider repeatedly dragging and slapping on the disc surface during the start and stop cycles during normal operation. Usually the coatings contain some amount hydrogen and nitrogen which is added to improve the corrosion protection of the underlying magnetic layer, to increase the film hardness and to optimize interaction with lubricants in order to eliminate friction problems.

The content of hydrogen/nitrogen and the film thickness can be analyzed with the DiskRam and Slider-LabRam. The systems has been engineered to facilitate and significantly accelerate the acquisition of Raman spectra of hard carbon films without damaging the films. Subsequent data reduction automates the derivation of the physical properties of interest. Optional automated robotic handling for disk positioning is available.

6 LabRam IR
Combine Raman and FTIR

This new version is a combination of dispersive Raman and FTIR microscope, winner of the Gold Award for the best new product at PITTCON® 2002. The two complementary vibrational spectroscopic tools provide solutions to problems where the information from either technique is incomplete. SameSpot™ Technology allows both Raman and FTIR spectrum to be measured from the same place on the sample without having to move or transfer the sample. A detailed description is given already previously in HORIBA Technical Reports: Readout No.25, September 2002.

Fig. 3 illustrates Product System of LabRam Family.

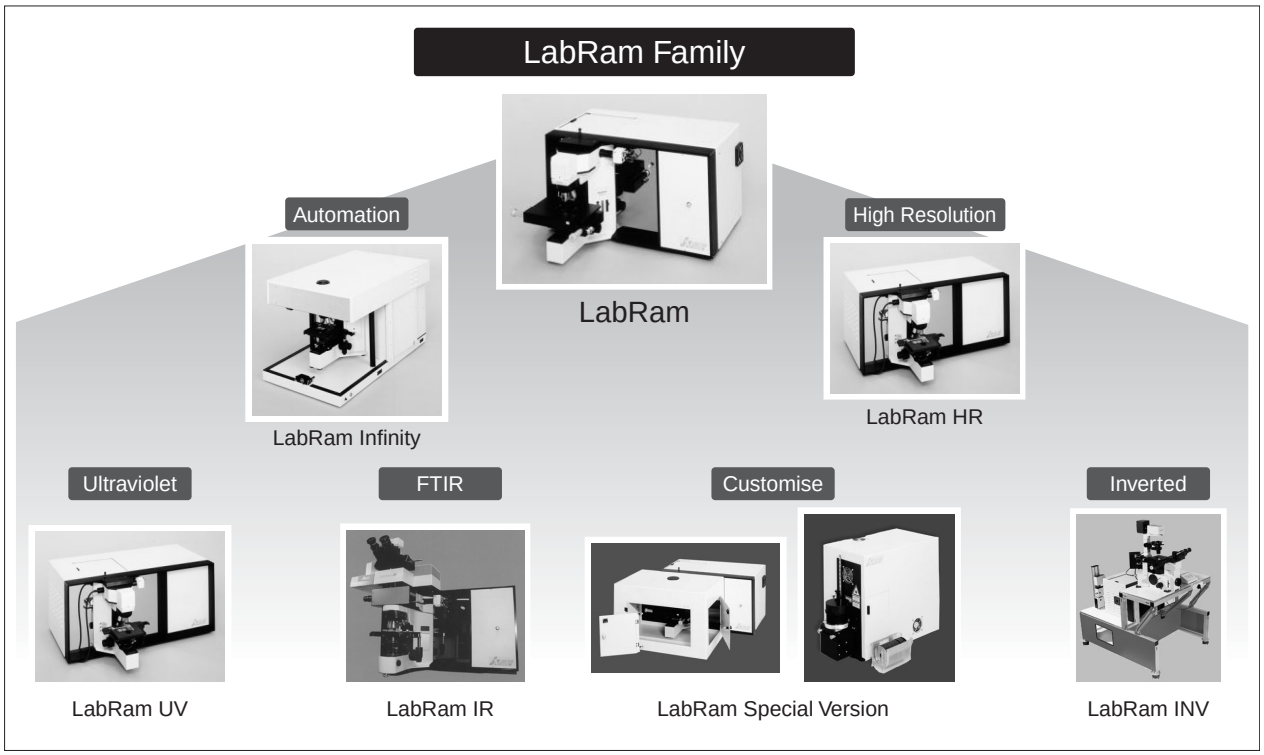

Fig. 3 LabRam Family

7 Conclusion

The Micro Raman systems are featured with a strong advantage enabling valuable information on molecule structure as well as crystallinity brought by a wide range of excitation wavelength from ultraviolet to near-infrared rays. They are attracting expectations and requests from a variety of industry fields such as semiconductor, chemical, medical and biotechnological production sites as well as laboratory institutions. We will continuously strive to meet these requests as a pioneer in this field, so that our LabRam series can further contribute to a new, progressing business field.

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