Fiber coupled microscope and multichannel detection system for Raman spectrometer

A fiber coupled Raman microscope with multichannel detection system was acquired in 2009 under the CARE scheme. This instrument allows non-destructive characterization of materials using inelastic light scattering methods. Microprobe allows data collection from very smallsample sizes (as small as ~ 100 microns). The spectrum provides a method to obtain information about the local structure at the nanoscale by recording the lattice vibrational spectrum. Comparison with known standards allows quantification of information obtained such as ratio of crystalline to amorphous phases and determination of the diameter of single walled carbon nanotubes.

Raman spectroscopy has become an important analytical and research tool. It can be used for applications as wide ranging as pharmaceuticals, forensic science, polymers, thin films, semiconductors and even for the analysis of fullerene structures and carbon nano-materials. Raman spectroscopy is a light scattering technique, and can be thought of in its simplest form as a process where a photon of light interacts with a sample to produce scattered radiation of different wavelengths. Raman spectroscopy is extremely information rich, (useful for chemical identification, characterization of molecular structures, effects of bonding, environment and stress on a sample).

When monochromatic radiation is incident upon a sample then this light will interact with the sample in some fashion. It may be reflected, absorbed or scattered in some manner. It is the scattering of the radiation that occurs which can tell the Raman spectroscopist something of the samples molecular structure.

If the frequency (wavelength) of the scattered radiation is analyzed, not only is the incident radiation wavelength seen (Rayleigh scattering) but also, a small amount of radiation that is scattered at some different wavelength (Stokes and Anti-Stokes Raman scattering). (approx. only 1×10^{-7} of the scattered light is Raman). It is the change in wavelength of the scattered photon which provides the chemical and structural information.

Salient features: Raman microprobe is a standalone microscope in which the excitation source (Argon ion laser at 514.5 nm) is fiber coupled into the microscope and the scattered light is filtered and the Rayleigh background minimized by using a razor edge sharp filter. The cleaned up signal is then sent through another optical fiber to a monochromator. This monochromator enables light to be dispersed using a diffraction grating and anlaysed for its spectral response using a charge coupled device photon detector. The digital data collected in real time is displayed on the computer attached to the instrument and can be ported to other computer applications for further processing. The microscope is also equipped with another camera allowing visualization of sample spot from where spectroscopy data is being collected.

Remote fiber coupled Raman microscope

The remote fiber coupled Raman microscope from HORIBA Scientific provides a unique facility for microscopic Raman, photoluminescence (PL) and fluorescence analysis. Ideal for complementing existing instrumentation or for analysis in restricted environments such as fume cupboards and clean rooms, the fiber microscope offers full micro-analytical functions in a simple and cost effective way. Compatible with the latest generation of automated software and mapping accessories, routine Raman ´chemical´ maps , PL plots, and laser induced fluorescence images can be produced to characterize material composition and distribution. The low level entry optics on the fiber-microscope enable easy fibre or direct coupling to both spectrometer and laser sources. When combined with longer focal length spectrometers the potential for high resolution Raman and photo luminescence (PL) microscopy is impressive.

Features

- Multiple Laser operation
- Confocal discrimination
- Fibre-optic or direct coupling
- Digital image capture
- Rugged construction
- Automated mapping operation

iHR550 Imaging Spectrometer

The iHR550 spectrometer offers a unique combination of spectral quality, flexibility, robustness, and ease of use that makes it the ideal general-purpose spectrometer for performing spectral measurements with quality results.

With a focal length of 0.55 m, the iHR550 is designed to deliver superb image quality for spectral measurements, and offers the ability to perform multi-track experiments with up to 20 fiber inputs. Incorrect and re-diffracted spectra are eliminated using an asymmetric Czerny-Turner design, in conjunction with our patented on-axis grating drive system. The iHR550 has two entrance and two exit ports available. Each exit port can be configured for use with either an Array detector, such as a CCD, or with a slit for use with a PMT.

Specifications

Focal Length		550 mm
Aperture		f/6.4
Spectral Range		150 to 1500 nm with 1200 g/mm grating 150 nm to 40 mm with appropriate gratings
Grating Size		76 mm x 76 mm
Number of Gratings on Turret		3
Flat Field Size		30 mm x 12 mm
Resolution with Exit Slit and PMT		0.025 nm
Wavelength Accuracy		± 0.20 nm
Repeatability		± 0.075 nm
Spectral Dispersion		1.34 nm/mm
Magnification		1.1
Stray Light		1×10^{-5}
Scan Speed		160 nm/sec
Step Size		0.002 nm
Computer Interface		USB 2.0 (USB 1.1 compatible)
Dimensions	**Length**	648 mm (25.51 in)

CCD Detector

CCD is the complete solution for modern spectroscopic measurements from simple absorbance to the most difficult Raman or photoluminescence measurements. This compact CCD detector is designed to interface with all HORIBA Jobin Yvon spectrometers and provide highly sensitive detection for any experiment.

Features

- **High Sensitivity & Low Noise**
  The Synapse CCD is the next generation in detection electronics, offering unparalleled sensitivity and extremely low noise. The low-noise amplifiers are located next to the CCD sensor to minimize any noise from the external environment.
- **Signal Linearity**
  The Synapse's electronics are specifically designed to provide excellent signal linearity over the entire dynamic range. This allows for more accurate data and better results over a wide variety of signal levels. To ensure such high performance, each Synapse CCD is tested for linearity, full well capacity and read noise values.
- **Thermoelectric Cooling**
  Dark current reduction is the primary reason for cooling a CCD detector. The Synapse

uses thermoelectric cooling to -70^{o}C, which reduces dark current levels to a minimum without the hassles of liquid nitrogen. The CCD sensor is placed in a hermetically-sealed, single window vacuum chamber for maximum cooling performance and a maintenance-free lifetime.

- **Auxiliary Signal Input**
  The Synapse CCD brings the flexibility of spectroscopic data acquisition to the next level by providing an input for a separate voltage or current signal, such as a PMT, silicon photodiode, or InGaAs solid state detector. This additional input can be used for a multitude of purposes including as an automatic reference detector for reference power correction or to extend the wavelength range of your spectrometer by using an InGaAs or Germanium photodiode. In the reference mode, the auxiliary input records data at the same time as the CCD exposure. As a separate data acquisition channel, this input can be used to scan the spectrometer past the usable wavelength range of silicon into the NIR.
- **USB 2.0 Interface**
  The Synapse CCD uses a high-speed USB 2.0 interface which allows for a fast, simple computer connection. It quickly connects to our powerful SynerJY® software for easy detector and spectrometer control and data acquisition. For more customized experiments, the Synapse CCD can also be used with our Software Development Kit (SDK) or LabVIEW® VIs to provide full control over every aspect of the detector and measurements.
- **Flexible Triggering**
  The Synapse CCD has a set of programmable TTL edge triggers for experimental interactions. The input trigger is used to start an acquisition while the output trigger is programmable to act as an exposure monitor or a readout monitor.
- **Built-In Shutter Driver**
  As a spectroscopic CCD, the Synapse uses a shutter to control exposure time and to perform dark subtraction for correct spectral acquisitions. Unlike other CCD cameras that require an extra module, the Synapse CCD has a shutter drive circuit built in for quick connection to a shutter and correct data collection from the first acquisition.

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