

Integrated Raman and Hyperspectral Microscopy

HORIBA Scientific and CytoViva® have integrated confocal Raman imaging, hyperspectral imaging and enhanced darkfield imaging onto the same microscope platform. These combined modalities are very important for nanomaterial studies. Combining three different rapid imaging methods allows an easy location characterization and identification on the nanoscale.

This integrated microscope package leverages the proven XploRA Plus Raman microscope from HORIBA Scientific. The system provides for full confocal Raman and PL imaging and the ability to select from single or multiple laser illumination options, including 532 nm, 638 nm or 785 nm. This integrated imaging spectrometer includes four gratings mounted on a motorized turret for full resolution, range and coverage (gratings are 600, 1,200, 1,800, 2,400 gr/mm). It also includes a CCD or EMCCD for enhanced sensitivity.

The XploRA acquisition and analysis is conducted with the user friendly LabSpec6 software package. The KnowItAll Horiba Raman library search software is also available with this technology.

When the microscope is equipped with the CytoViva enhanced darkfield and hyperspectral technology and HORIBA Raman capabilities, it can capture very large area hyperspectral and darkfield images in minutes. The hyperspectral images are created with high spatial and spectral resolution, and closely resemble the sample as observed optically in the microscope eyepiece.

Using the XploRA, Raman spectra and maps of selected sample regions of interest in the identical field of view can be quickly captured. This can be done as a single shot, in a line across the field of view, or in a full Raman map. This allows for cross correlation of the Raman spectra with the broadband hyperspectral signal images, insuring accuracy of data.

See the example above demonstrating the ability to cross correlate hyperspectral imaging with the Raman signal of a multi-walled carbon nanotube in stained tissue.

CytoViva Enhanced Darkfield Hyperspectral – Raman System

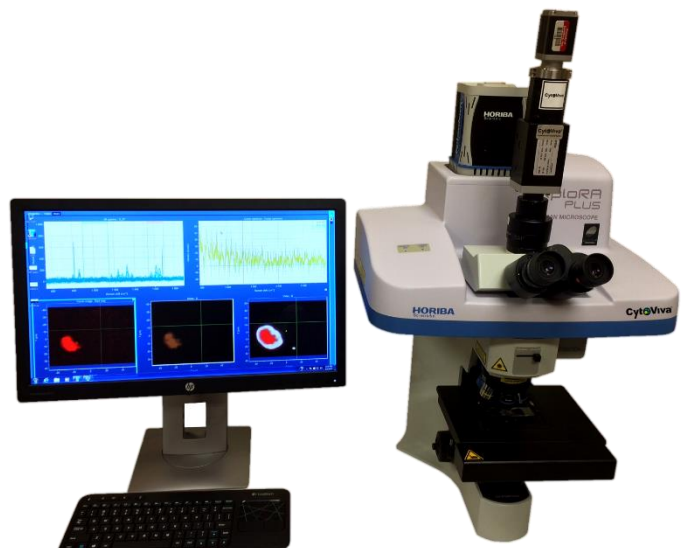
Raman Component Specifications

BASE UNIT	
Laser Options	<ul style="list-style-type: none"> • Integrated up to 3 internally: 532 nm, 638 nm, 785 nm • Other wavelengths and high power options available on request • PC controlled with AutoSwitch option for Raman/white light selection
Spectral Resolution	• 1.4 cm ⁻¹ to 8 cm ⁻¹ depending upon grating, laser and CCD selection
Spectral Range	• 50 cm ⁻¹ to 4000 cm ⁻¹ depending upon grating, laser selection
Spectrograph	<ul style="list-style-type: none"> • Imaging flat field spectrometer for use with larger CCD detectors • High throughput with 4 position grating turret
Confocal Resolution	<ul style="list-style-type: none"> • Fully confocal, adjustable confocal aperture, 500 nm XY resolution • Option for SWIFT™ 10x faster Raman imaging mode
Detector	<ul style="list-style-type: none"> • OE. 1024 x 256 pixel TE deep- air cooled -60° C scientific CCD • 16 bit. Up to 1.48 MHz readout speed
MICROSCOPE OPTIONS	
Upright Scientific Microscope	<ul style="list-style-type: none"> • Includes standard 2 position illuminator with illumination by transmission/reflection • USB image camera • 10x and 100x objectives included
Optical Imaging	<ul style="list-style-type: none"> • Standard epi-illumination • Transmitted enhanced darkfield illumination
Objectives Sampling Optics	<ul style="list-style-type: none"> • 50x long working distance, 100x long working distance options • Macro cuvette cell sampler • Fibre-optic probes
Software	<ul style="list-style-type: none"> • OneClick operation as standard • LabSpec Spectroscopy Suite • Options: database, chemometric, imaging, ParticleFinder
ENVIRONMENT - REQUIREMENTS	
Weight	• 35 kg - 77 lbs
Operating Temperature	• 15 - 28° C (optimal 22° C ± 1° C)
Voltage	• 110/240 VAC, Mains supply
Dimensions (WxDxH)	• 479 x 352 x 661 mm
Note: No water cooling or LN2 supply required	

**All specifications provided by and property of HORIBA Scientific*

CytoViva[®]
Illuminating the Future

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CytoViva's Hyperspectral Imaging technology was specifically designed to provide quantitative spectral analysis of nanoscale materials imaged with the patented CytoViva Enhanced Darkfield Microscopy or with other microscopy modalities. This can include spectral analysis of both biological and materials-based nanoscale samples, which may be isolated or integrated in cells, tissue or other materials-based matrices.

Hyperspectral Microscopy Components

SPECTROPHOTOMETER

Type	Transmission Grating
Spectral Range	400 nm – 1,000 nm
Spectral Resolution	2 nm (with 30µm Slit)
Maximum Spatial Scan Width	896µm @ 10X Magnification

SPECTROPHOTOMETER INTEGRATED CCD

Type	CCD
Pixel Size	6.45µm x 6.45µm
Resolution	1,392 x 1,040
Exposure Time Range	5µs – 60 sec.
Frame Rate (Full Resolution)	7.3 fps @ Full Binning, 13.5 fps @ 2 x 2 Binning
Dynamic Range	14 bit
Camera Control	USB

COMPUTING

Computer	Dell Precision Tower, 8GB RAM
Operating System	Windows 7

LIGHT SOURCE

Lamp Type	Quartz Halogen Aluminum Reflector
Wavelength	400 nm - 2,500 nm
Power	150 watts

IMAGE ANALYSIS

Image Analysis Software	ENVI 4.8 (IDL Available)
Spectral Image Display	Real Time Display of Recreated RGB Image of Spectral Data
Mapping Methods	Spectral Angle Mapper
Spectral Library Data Capture	Single/Multiple Pixel Spectral Libraries
Regions of Interest	Can be Created with up to Five Different Techniques
Spectral Data Statistical Computation	Mean, Min, Max (+) and (-) Standard Deviation

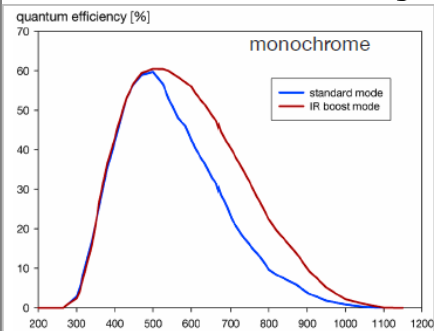
AUTOMATED STAGE

Scan Resolution	10 nm Step Size
Travel Range	114 mm x 75 mm

Application Examples

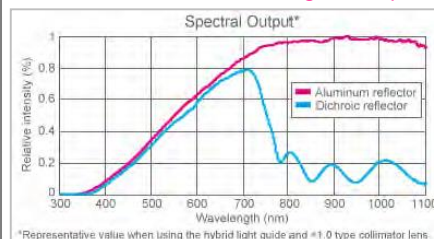
- Nanotoxicology
- Cancer Research
- Nanoparticle Characterization
- Drug Delivery

CCD Detector Quantum Efficiency



Illumination Spectral Output

Aluminum Reflector Halogen Lamp



*Representative value when using the hybrid light guide and #1.0 type collimator lens.



The patented **CytoViva enhanced darkfield illumination system** replaces the standard microscope condenser. The specialized illuminator focuses fixed-geometry, highly collimated light at oblique angles on the sample. This serves to improve signal-to-noise up to seven times over standard darkfield microscopy, optimizing dark field detection capability for non-fluorescing nano-scale samples.

CytoViva Enhanced Darkfield Optical Illumination System Specifications

SYSTEM PERFORMANCE	
Noble Metals & Metal Oxide NPs	Detection ~ 10 nm
SoftNPs (liposomes, polymers, etc.)	Detection ~ 75 nm
ILLUMINATION SYSTEM	
Field of View	~400 μ m
Numerical Aperture	1.2–1.4 N.A.
LIGHT SOURCE	
Standard Light Sources	Solarc, Halogen, Mercury Vapor
Power Supply	100-240Vac, 50/60 Hz, 1.6A max
Light Guide Type	Liquid (5 mm OD, 3 mm ID)
DIMENSIONS	
Height (Max)	98 mm
Minimum Mounting Clearance	51 mm
Weight	0.43 kg (15 oz.)
REQUIREMENT	
Immersion Oil	Type A (nd > 1.515) Cargille Brand
Cover Slip	0.17 mm Thickness
Glass Slide	25 mm x 75 mm x 1 mm
MICROSCOPE COMPATIBILITY	
Upright Research Microscopes	C- and O-shaped, 3-point Condenser Mounts (Diameter and Clearance Requirements of CytoViva Optical Illumination System)
Inverted Research Microscopes	Requires Optional Inverted Adapter
OBJECTIVE COMPATIBILITY	
Low Range Objective	10X Air, 20X Air
Mid Range Objective	40X Air (N.A.= 0.7 Iris Optional), 40X Long Working Distance
High Range Objective	60X and 100X Oil with Iris (N.A.= ~1.4)
WARRANTY	
Warranty	One (1) year from date of purchase

Application Examples

- Nano-Bio Interactions
- Nano-materials Characterization
- Nano-Drug Delivery
- Pathogen and Cell Characterization

CytoViva Optical Illumination System



20nm AgNPs in Solution



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