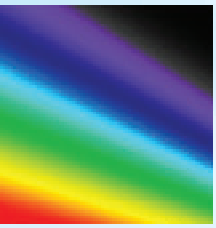
HORIBA Scientific



iHR550

Imaging Spectrometer

OSD-IS-01

ELEMENTAL ANALYSIS
FLUORESCENCE
GRATINGS & OEM SPECTROMETERS
OPTICAL COMPONENTS
FORENSICS
PARTICLE CHARACTERIZATION
RAMAN
SPECTROSCOPIC ELLIPSOMETRY
SPR IMAGING

Simply the Best Imaging Spectrometer with No Compromise

The iHR550 imaging spectrometer from HORIBA Scientific is simply the most versatile spectrometer on the market with no compromise among imaging, spectroscopy, and adaptability. The iHR550 utilizes a unique patented asymmetric design, which provides superior image quality and minimizes unwanted optical aberrations common to symmetric and crossed-Czerny Turner designs. For unrestricted flexibility, the iHR550 allows the user to take full advantage of the instrument by having two entrance and two exit ports for enhanced measurement capabilities.

The iHR550 is the most suitable imaging spectrometer solution for:

- **Multi-track spectroscopy with tens of fibers imaged at once**
- **Direct coupling for microscopy and 2D imaging**
- **Hyperspectral imaging for Raman and luminescence applications**
- **UV-Vis, near-IR and mid-IR spectroscopy with multiple array or single-channel detectors**

Virtually No Astigmatism

When spatial resolution is needed, optical aberrations and—more precisely—astigmatism limits the imaging capabilities of the spectrometer. In a multi-track spectroscopy setup, where high spatial resolution is needed, astigmatism leads to a "bow-tie" effect, in which the image of each fiber blurs in the vertical direction towards the edge of the CCD. The iHR550 spectrometer minimizes astigmatism and delivers a sharp image of each fiber across the entire focal plane, as shown in Figure 1.

Negligible Crosstalk

To assess the degree of crosstalk between fibers, it is necessary to perform a horizontal bin of the full image. In a poorly designed spectrometer with a high degree of astigmatism, the signal between fibers begins to overlap, preventing clear separation between the fibers. The design of the iHR550 minimizes crosstalk between channels and improves contrast ratio. Figure 2 (next page) shows that the iHR550 image quality provides distinct peak separation.

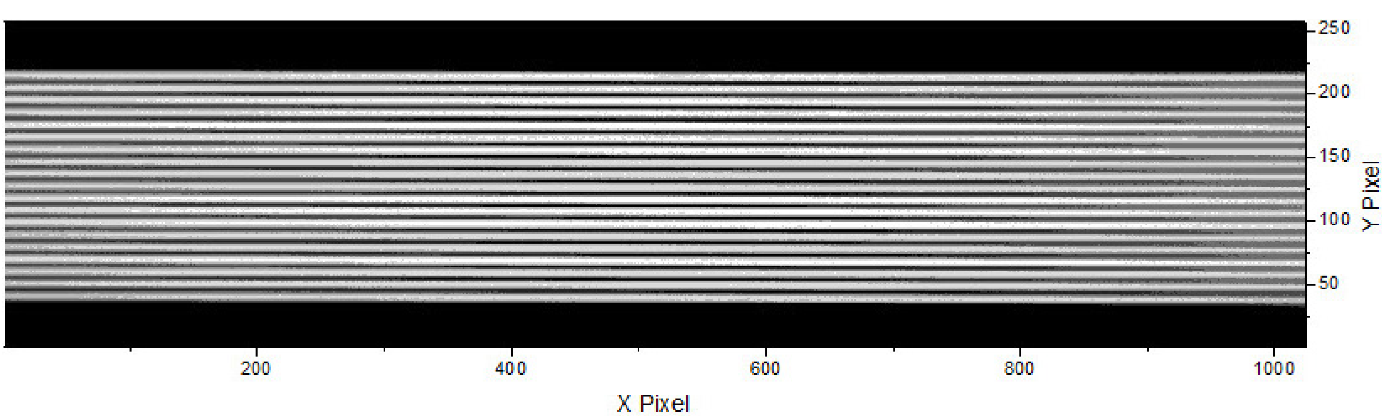


Figure 1. Image of a broadband quartz tungsten-halogen spectrum recorded with nineteen 200 µm fibers using the 1× imaging adapter with an iHR550 spectrometer, 1200 gr/mm grating blazed at 500 nm, and 1024×256 open-electrode CCD.

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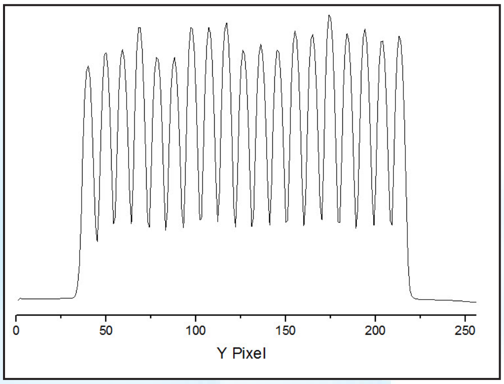


Figure 2: Horizontally binned results from Figure 1 showing minimal crosstalk between fibers.

Preservation of the focal plane image

Figure 3 shows the image of each fiber as it is moved across the focal plane. Again, the effect of astigmatism is minimal, allowing a sharp image across the 30 × 12 mm focal plane.

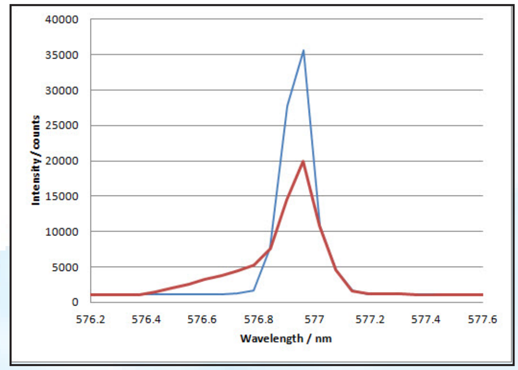


Figure 5: Spectral line from a mercury calibration lamp measured with an iHR550 and 1024×256 open-electrode CCD (blue), compared with a simulation showing effects of coma (red).

Fully Coma Corrected

In addition to effects that arise from astigmatism, spectra and images can also be affected by coma. Figure 5 shows a spectrum measured with an iHR550 spectrometer (blue) and a simulated spectrum (red) with coma effects included. The recorded spectrum shows a higher peak intensity and narrower line width corresponding to a better signal-to-noise ratio and higher resolution. By correcting coma aberrations, the iHR550 collects light more efficiently, increasing the level of useful signal collected.

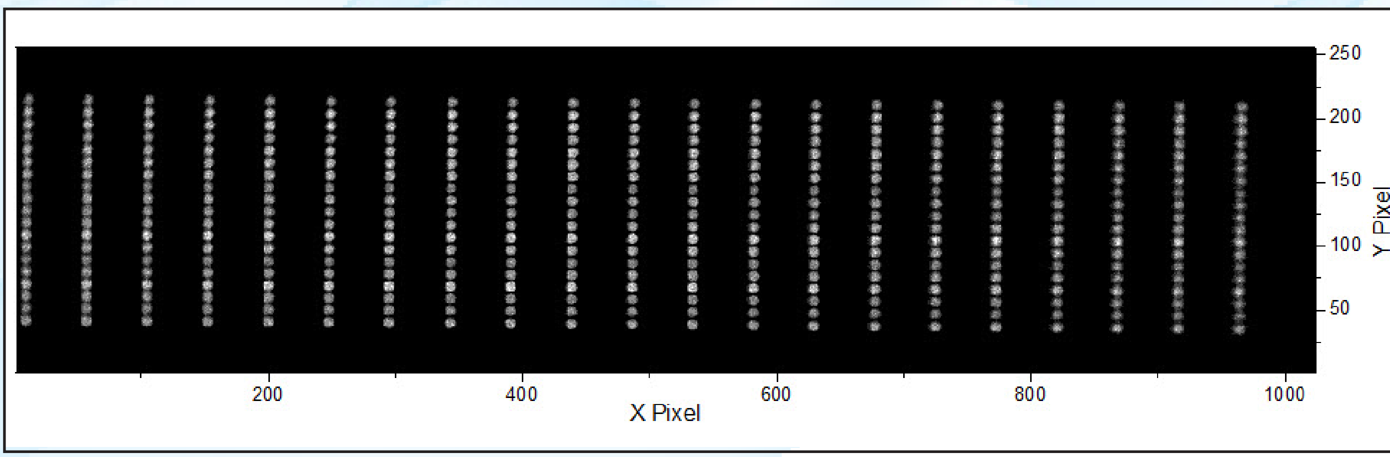


Figure 3: Image of a 633 nm laser moved across the focal plane through nineteen 200 µm fibers. The 1× imaging adapter was used with an iHR550 spectrometer, 1200 gr/mm grating blazed at 500 nm, and 1024×256 open-electrode CCD.

Preservation of spectral intensity

Vertical binning of the full image shows that the intensity is preserved across the chip. As shown in Figure 4, the iHR550 produces sharp spectral lines and constant intensity across the entire focal plane. Only 3.5% variation in intensity is observed between the center of the sensor and the edges.

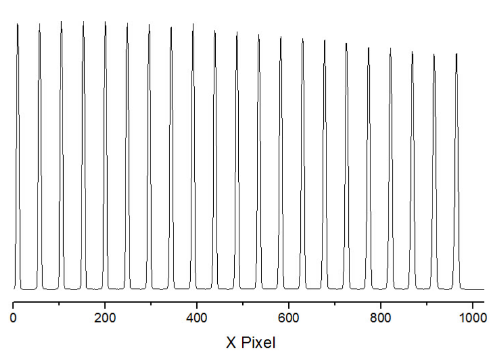


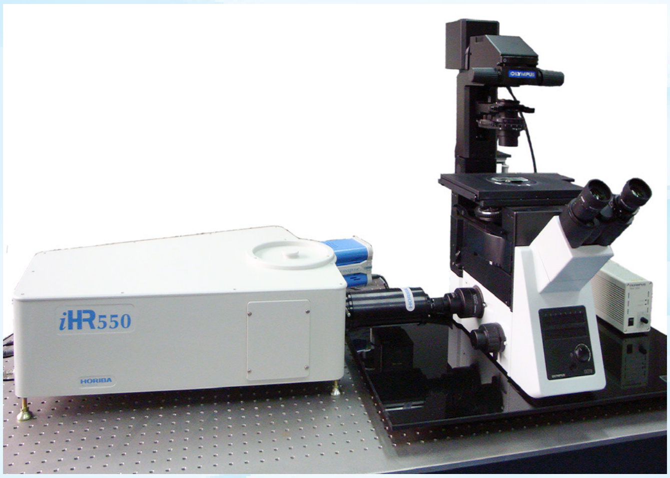
Figure 4: Vertically binned results from Figure 3 show preservation of intensity across the focal plane.

Flexible Design

The iHR550 can be configured with multiple entrance and exit ports, and has the capability to mount multiple detectors, including two array detectors at once. This is the ideal scenario for the user who would like to expand wavelength-sensitivity beyond the visible. Our InGaAs linear arrays and Si CCDs can be mounted simultaneously to give a total range of sensitivity from 200 nm to 2200 nm. In addition, wavelength sensitivity can be extended even further through the use of various single-channel detectors up to 20 µm. If experimental requirements change in the future, the iHR550 can adapt with a wide variety of available options for input coupling and large catalog of detectors.

Microspectroscopy

In addition to being the most suitable spectrometer for spectroscopy applications, the iHR550 imaging spectrometer offers outstanding performance when used for microspectroscopy. The iHR550 interfaces seamlessly with most commercially available microscopes as depicted in Figure 6 (top) on an inverted microscope for Raman spectroscopy.



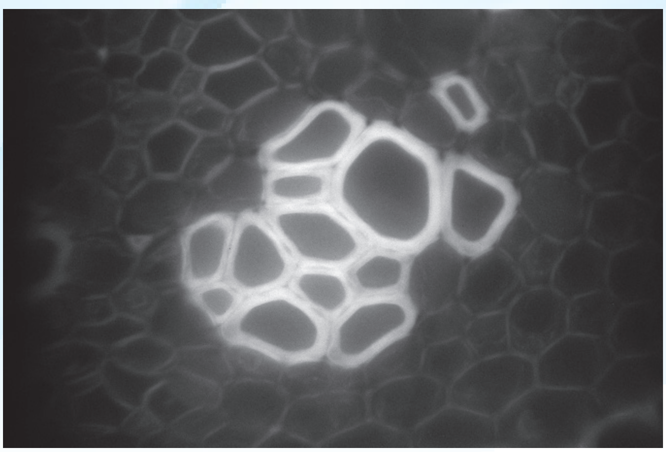


Figure 6: iHR550 spectrometer directly coupled to an inverted microscope (top). Image of Convallaria *cells (bottom).*

Imaging of the sample may be recorded with the microscope's witness camera or through the spectrometer itself, eliminating the need for an additional camera. Figure 6 (bottom) shows the image of *Convallaria* cells recorded with a grating tuned to zero-order in the iHR550. The resulting image is crisp and clear, showing the capillary structure within the cells.

Selected accessories for iHR:

AFW-IHR-UVIS	iHR550 Internal Filter Wheel, 6 × 25.4 mm (1″) filter positions
AFW-C6PM	External Filter Wheel, 6 × 25.4 mm (1″) filter positions
22-FSA	Filter Slide, 3 × 25.4 mm (1″) filter positions
ACH-C	Optical chopper for use with IR detectors and lock-in amplifiers
AFO-XY	*xy*-adjustable Fiber-Optic Adapter for 10 mm and ¼″ ferrules
220F	Lens-based fiber-optic interface
ASC-VIS	SampleMax Sample Compartment
ASC-UV	SampleMax Sample Compartment optimized for UV
DPM-HW	UV-VIS Photomultiplier Tube and Housing
DSS Detectors	Solid-state detectors including Si, Ge, InGaAs, PbS, PbSe, and HgCdTe
1427C	Solid-State Detector Interface
CSW-SYNERJY	Data-acquisition software
Multichannel detectors	CCD cameras available in a large variety of formats and linear InGaAs arrays
220M	Direct-coupled lens-based microscope interface
LSH	Lamp Source Housings, quartz tungsten-halogen and deuterium
FL-1039A	450 W Xe light source

iHR550 Features

- Up to four ports (two entrance and two exit)
- Kinematic turret with easy access hatch
- High-speed USB and additional hub port
- Purge port for UV and near-IR
- Easy CCD focus and alignment with external locking mechanism
- Choice of CCD or exit slit on either exit port
- Fast scanning capability: up to 160 nm/s
- Powerful SynerJY™ software for Windows®
- Optional internal filter wheel
- Choice of 2 mm slits for high resolution or 7 mm slits for high throughput

iHR550 Specifications

Focal length (mm)		550 mm
Aperture		*f*/6.4
Grating size		76 mm × 76 mm
Number of gratings		three, on-axis
Flat field size		30 mm × 12 mm
Resolution[1]		0.025 nm
Wavelength accuracy[1]		±0.20 nm
Repeatability[1]		±0.075 nm
Spectral dispersion[1]		1.34 nm/mm
Magnification		1.1
Stray light[2]		1×10^{-5}
Scan range[1]		0 – 1500 nm
Step size[1]		0.002 nm
Dimensions	**Length**	648 mm
	Width	460 mm
	Height	193 mm
	Optical axis	98 mm
	Nominal weight	28 kg
Computer interface		High-speed USB

[1]All specifications given for 1200 gr/mm grating at 435 nm and subject to change without notice.
[2]Stray light measured at 1 nm from 514 nm laser with HORIBA Scientific holographic gratings.

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