Nano-scale Hyperspectral Microscope System

www.cytoviva.com
CytoViva provides...

- A patented high S/N optical microscope system, specifically designed for imaging nano-scale samples.

- A proprietary VNIR hyperspectral imaging system (HSI) integrated onto the microscope system, enabling pixel level spectral quantification of the sample being imaged.
CytoViva Technology Originated in Auburn University Biophysics Lab

- Developed to support basic research of Nano-technology and infectious disease related studies

CytoViva Commercial Success To Date

- Over 165 system installations in laboratories worldwide since 2005 market introduction
Example U.S. CytoViva Clients and Applications...

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The Complete CytoViva Microscope -HSI System

High S/N Optical Nanoscale Microscope System
- Observe nanoscale materials <50nm.
- Observe live cells interacting with nano-materials.

VNIR Spectrophotometer
- Operates from 400nm-1000nm
- Provide spectral resolution down to 1.5nm
- Pixel size 25nm @100x objective

Image collection & analysis software
- Collects the complete spectra within each individual pixel
- Builds a library of spectral data
- Compares cataloged spectral data against new samples

The CytoViva Nanoscale Microscope capability can be acquired separately from the HSI system.
Patented darkfield-based illumination system enables observation of nanoscale materials & biologicals ...

Functionality Enabling Improved Optical Performance

1. **Pre-aligned Koehler illumination**: Precisely focuses the source light onto the entrance slit of the annular condenser.

2. **Main feature of critical illumination**: Focuses the light precisely on the same plane of the sample as focal point objective. Achievable as a result of pre-aligned Koehler configuration.

*Annular illumination produces an improved point spread function. Through design enhancements in the alignment and focus of annular illumination, CytoViva produces significantly improved optical performance over other comparable techniques including standard darkfield (annular) illumination.

Figure 1. Polystyrene latex standards 240nm viewed with a) conventional Darkfield microscopy and b) CytoViva System
**CytoViva Live Cell Environmental Chamber**

- Closed bath design
- Specifically designed to operate on the CytoViva microscope system
- Control of:
  - Fluids, pharma or reactants
  - Thermal range to 37c-80c
  - Gas blankets
- Applications include:
  - Live cell/tissue studies
  - Pharma/tox exposures
  - Micro-fluidics functionality

The CytoViva environmental chamber enables long-term, live cell studies at high resolution.
Hyperspectral imaging has been utilized for decades in geospatial image analysis.

CytoViva has adapted hyperspectral imaging for microscopy applications.

CytoViva has integrated proven hardware and software technology onto the hyperspectral microscope platform.

Hyperspectral Spectrophotometers

Hyperspectral Image Analysis Software
How It Works

• The CytoViva Hyperspectral Imager mounts onto the CytoViva Nano-scale Microscope

• It captures the unique reflectance spectra of objects from the microscope field of view (VNIR spectrum from 400nm-1,000nm)

• Spectral data is reported in high resolution (down to 1.5nm)

• The complete spectra for each pixel of the CCD detector is captured (pixel size as small as 25nm)

• The data is presented as a spectral curve & as a RGB image

• Detailed quantitative analysis of each object in the field of view can be performed.
Advantages

• No fluorescence tagging is necessary

• 25nm pixel size provides true nano-scale verification

• Quantifies & classifies the presence & location of multiple objects within the field of view

• Highly accurate identification of both biological and material samples
CytoViva-Hyperspectral Imaging (HSI) confirms the presence, location and amount of nanoscale elements by... 

- Collecting all VNIR spectral data within each pixel of the scanned area.

- Storing the unique spectral signatures of selected elements in a library database.

- Classifying and mapping spectral signatures in newly scanned samples against the library database.
CytoViva Hyperspectral Imaging
Quantifying CNT coating on fibers

Toray® Fiber Sample without CNT coating
Spectral Signature of Fiber Sample without CNT coating

Toray Fiber® Sample w/ GOx CNT coating
Spectral Signature of Fiber Sample with GOx CNT coating
CytoViva Hyperspectral Imaging
Quantifying CNT coating on fibers

Hyperspectral Image Scan

Reference Spectra of GOx coated CNTs

Derived from previously scanned pure GOx coated CNT sample

CNTs Mapped in Sample

Overlay image illustrating all areas in red containing the selected spectral profile and location of the GOx coated CNTs

Scanned image and Zoom illustrating GOx coated CNTs adhering to fiber
Hyperspectral Scan at 100X

Sample: Clostridium

Spectral signatures collected from the Clostridium sample & loaded into the spectral library
Sample: Clostridium in Plant Tissue

The red areas are the pixels matching the Clostridium spectral profiles within the spectral library.
Hyperspectral Scan of Fullerenes in solution

Spectral signatures collected from the Fullerene sample & loaded into the spectral library
CytoViva Hyperspectral Imaging
Mapping fullerenes plant tissue

Plant tissue with internalized fullerenes

Red maps of all areas in the scanned tissue matching the fullerene reference spectra
CytoViva Hyperspectral Imaging
Mapping polymeric nano-particles in cell culture

Polymeric nano-particles aggregating on slide

Hyperspectral Scan image:

Spectral Profiles collected from polymeric nano-particles
(aggregation of materials create different spectral curves)
Epithelial cell incubated with polymeric nano-particles and scanned with CytoViva HSI

Red maps of all areas in the scanned cell culture matching the polymeric NP spectral signature within the spectral library.
Sample: Au Nano-particles in solution

Hyperspectral Scanned Image of aggregating Au NPs in solution (samples red shift when aggregated)

Reference spectral signatures collected from multiple pixels in Au nano-particle sample
CytoViva Hyperspectral Imaging
Mapping Au nano-particles in cell culture

Hyperspectral Scanned Image of HaCat Cells with internalized aggregating Au Nano-particles

Red maps of all areas in the scanned cell culture matching the Au spectral signature within the spectral library
Let CytoViva help you understand how it’s nano-scale microscope & hyperspectral imaging can advance your research...

...This can include scanning your samples and providing a comprehensive report of the results.

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