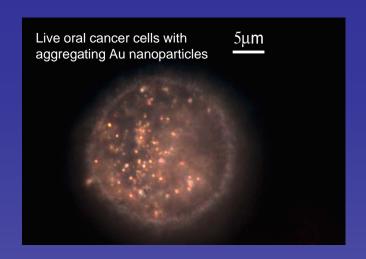




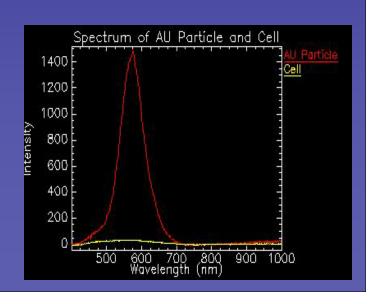


CytoViva provides...

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



 A proprietary <u>VNIR hyperspectral imaging</u> 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







Most Promising Life Science Technology Award 2008 Winner



2007 winner



Example U.S. CytoViva Clients and Applications...



NIST

Nano-fiber cell interactions

FDA

Nano-toxicology

NASA

Biological agents

Argonne Natl. Labs

Nano-particle development

NIH-NCI

Nano-toxicology

Wright Patt AFB

Nano-toxicology

USDA

Infectious Plant Agents

Johns Hopkins

Nano-particle-cell interactions

Mayo Clinic

Calcified Nano-particles

Rice University

Nano-Toxicology

Purdue University

Nano-biosensors

Duke University

Nano-particle Characterization

MD Anderson

Nano-cancer drug delivery

Univ. TX Health Science

Nano-Medicine

Dow Chemical

Nano-particle analysis

Johnson & Johnson

Nano-particle composites

Pfizer

Nano-medicine

Schering Plough

Nano-emulsions

Merck

Nano-medicine

Proctor & Gamble

Nano-Emulsions & Particles

Novozymes Inc.

Biofuels development





High S/N Optical Nanoscale Microscope System

- Observe nanoscale materials <50nm.
- Observe live cells interacting with nano-materials.

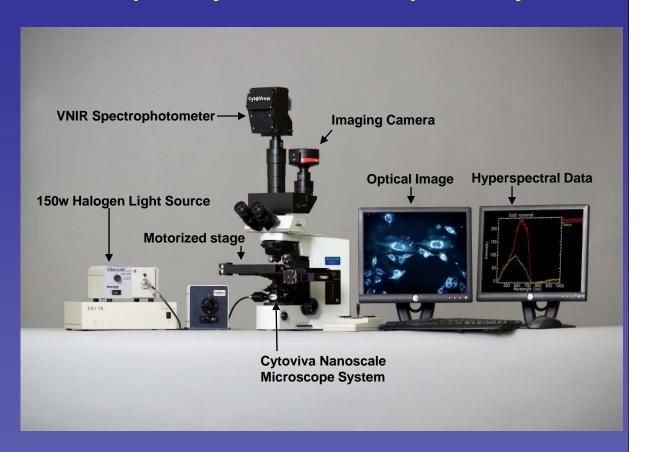
VNIR Spectrophotometer

- 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 Complete CytoViva Microscope -HSI System



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. <u>Pre-aligned Koehler illumination:</u> Precisely focuses the source light onto the entrance slit of the annular condenser.
- 2. <u>Main feature of critical illumination</u>: Focuses the light precisely on the same plane of the sample as focal point objective. Achievable as a result of pre-aligned Koehler configuration.



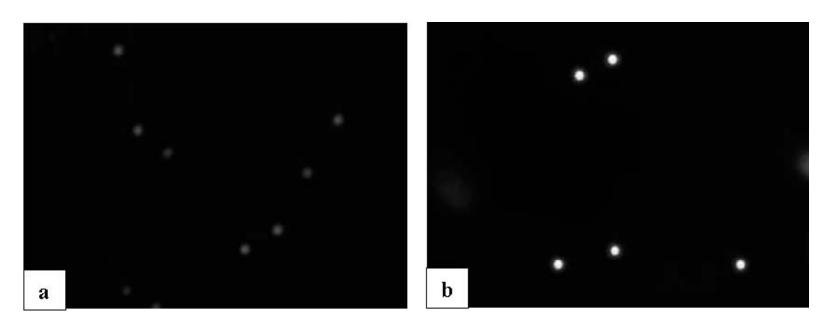


* Annular illumination produces an improved point spread function. Through design enhancements in the alignment and focus of annular Illumination, CytoViva produces significantly improved optical performance over other comparable techniques including standard darkfield (annular) illumination.





Figure 1. Polystyrene latex standards 240nm viewed with a) conventional Darkfield microscopy and b) CytoViva System



Imaging of Submicron Particulate in an Optical Flow Cell
The Dow Chemical Company, Analytical Sciences, 1897 Building, Midland, MI 48667
D.R. Rothe, S.P. Wood, W.A. Heeschen





CytoViva Live Cell **Environmental Chamber**

- Closed bath design
- Specifically designed to operate on the CytoViva microscope system
- o 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





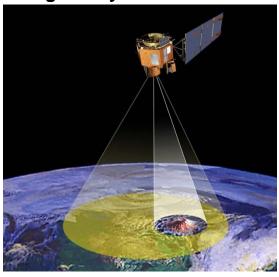
The CytoViva environmental chamber enables long-term, live cell studies at high resolution





Cytoviva Hyperspectral Imaging

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.









Cytoviva Hyperspectral Imaging System

How It Works

- The CytoViva Hyperspectral Imager <u>mounts onto</u> <u>the CytoViva Nano-scale Microscope</u>
- It captures the <u>unique reflectance spectra</u>
 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 <u>complete spectra for each pixel</u> of the CCD detector is captured (pixel size as small as 25nm)
- The data is presented as a spectral curve & as a RGB image
- <u>Detailed quantitative analysis</u> of each object in the field of view can be performed.

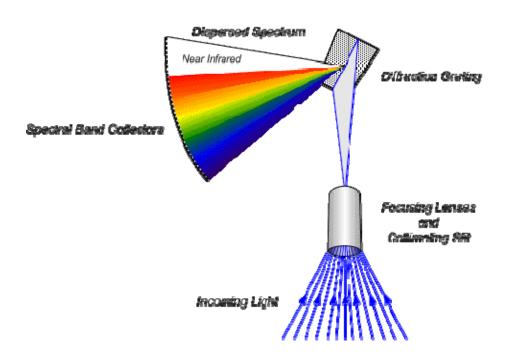


Diagram of Diffraction Grating Hyperspectral Imaging System





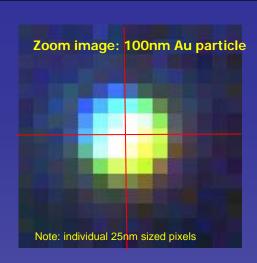
Cytoviva Hyperspectral Imaging System

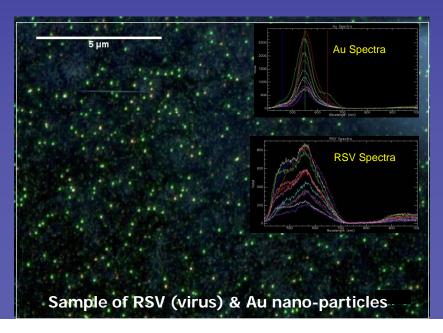
Advantages

- No fluorescence tagging is necessary
- 25nm pixel size provides true nanoscale verification

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

 Highly accurate identification of both biological and material samples





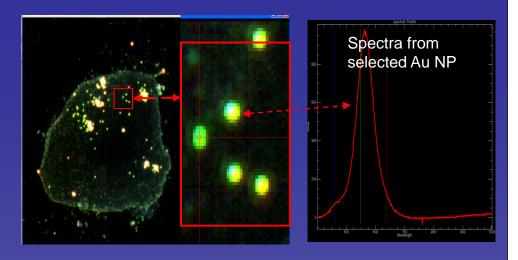


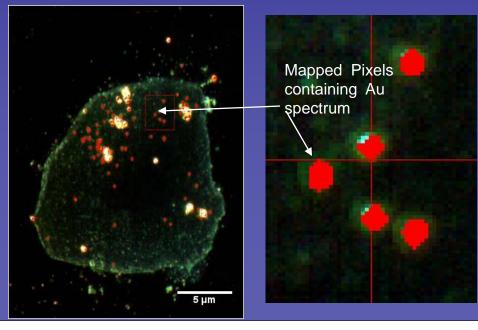


CytoViva Hyperspectral Imaging

CytoViva-Hyperspectral Imaging (HSI) confirms the presence, location and amount of nanoscale elements by...

- Collecting all VNIR spectral data within <u>each pixel</u> 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.





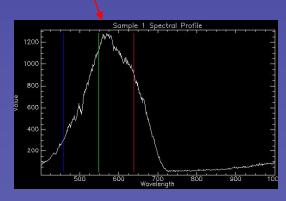






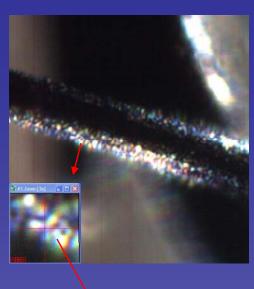
Toray® Fiber Sample without CNT coating

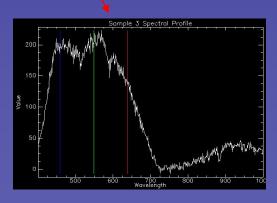




Spectral Signature of Fiber Sample without CNT coating

Toray Fiber® Sample w/ GOx CNT coating





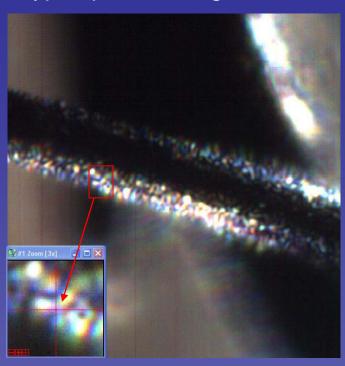
Spectral Signature of Fiber Sample with GOx CNT coating



CytoViva Hyperspectral Imaging Quantifying CNT coating on fibers

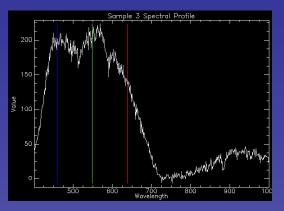


Hyperspectral Image Scan



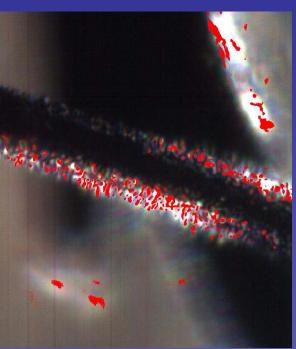
Scanned image and Zoom illustrating GOx coated CNTs adhering to fiber

Reference Spectra of GOx coated CNTs



Derived from previously scanned pure GOx coated CNT sample

CNTs Mapped in Sample



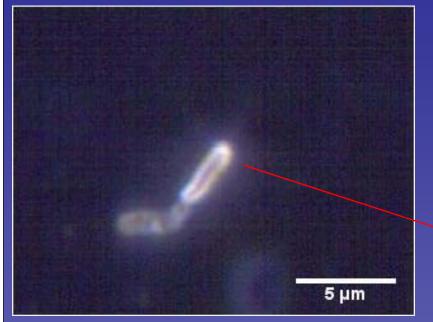
Overlay image illustrating all areas in red containing the selected spectral profile and location of the GOx coated CNTs



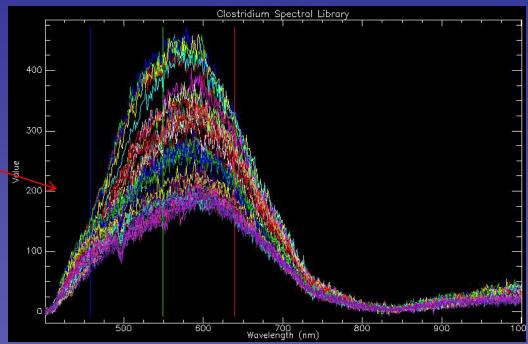




Hyperspectral Scan at 100X



Sample: Clostridium

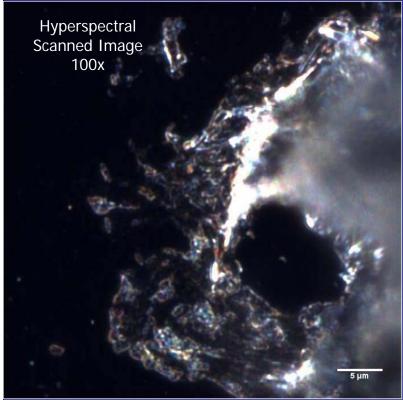


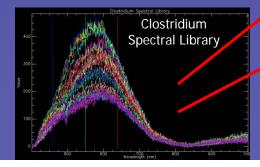
Spectral signatures collected from the Clostridium sample & loaded into the spectral library



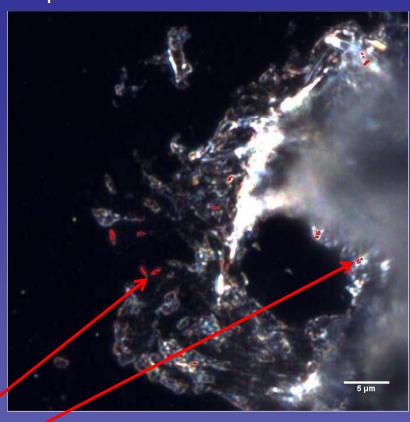


CytoViva Hyperspectral Imaging Characterizing bacteria in plant tissue





Sample: Clostridium in Plant Tissue

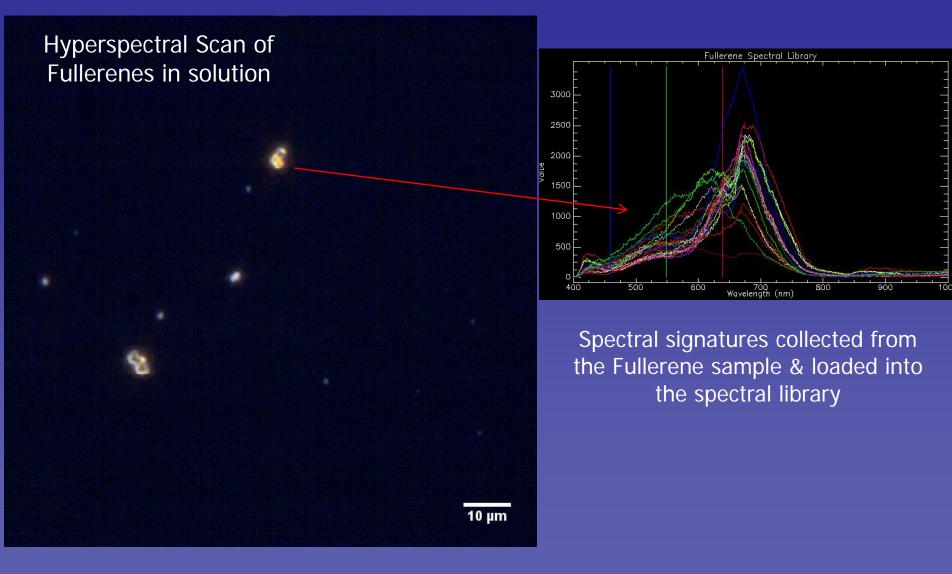


The <u>red</u> areas are the pixels matching the Clostridium spectral profiles within the spectral library.



CytoViva Hyperspectral Imaging Mapping fullerenes plant tissue





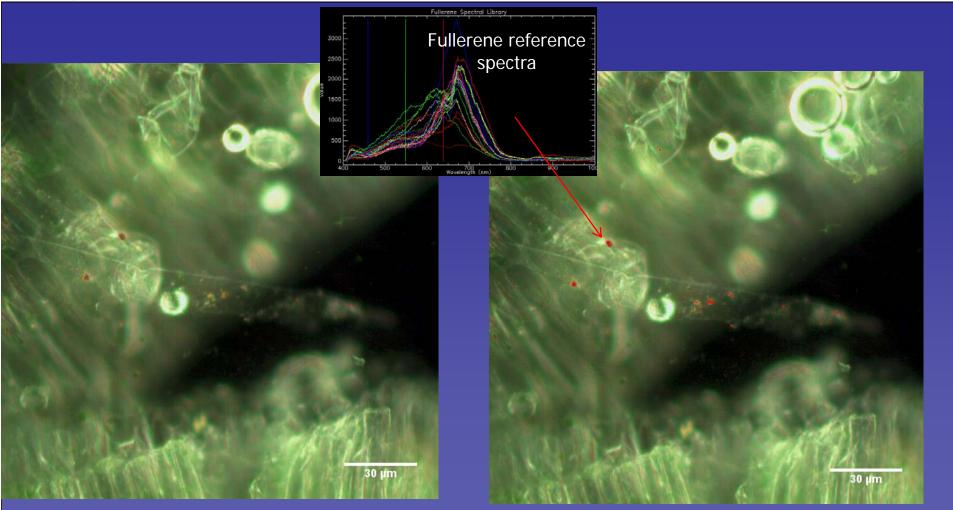




Plant tissue with internalized fullerenes



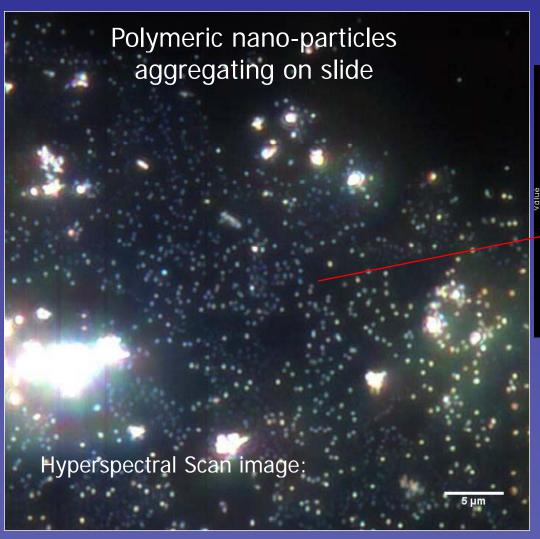
Red maps of all areas in the scanned tissue matching the fullerene reference spectra

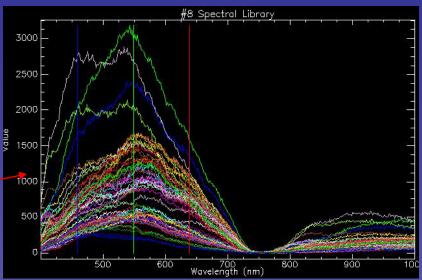




CytoViva Hyperspectral Imaging Mapping polymeric nano-particles in cell culture







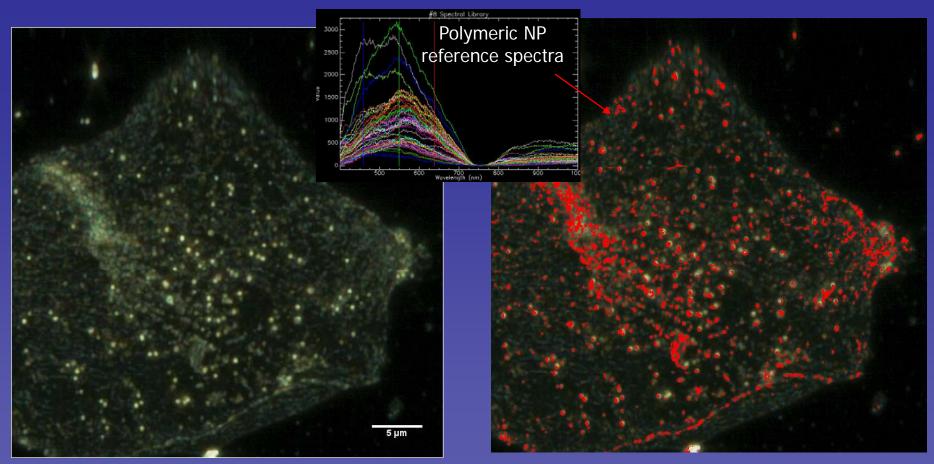
Spectral Profiles collected from polymeric nano-particles

(aggregation of materials create different spectral curves)



CytoViva Hyperspectral Imaging Mapping polymeric nano-particles in cell culture





Epithelial cell incubated with polymeric nano-particles and scanned with CytoViva HSI

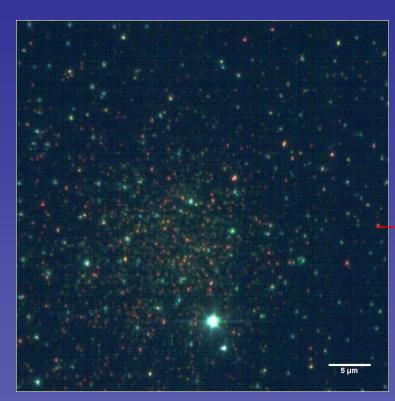
Red maps of all areas in the scanned cell culture matching the polymeric NP spectral signature within the spectral library



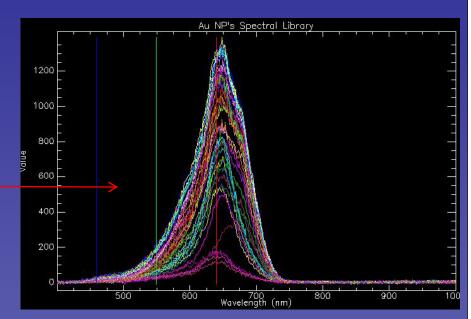




Sample: Au Nano-particles in solution



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



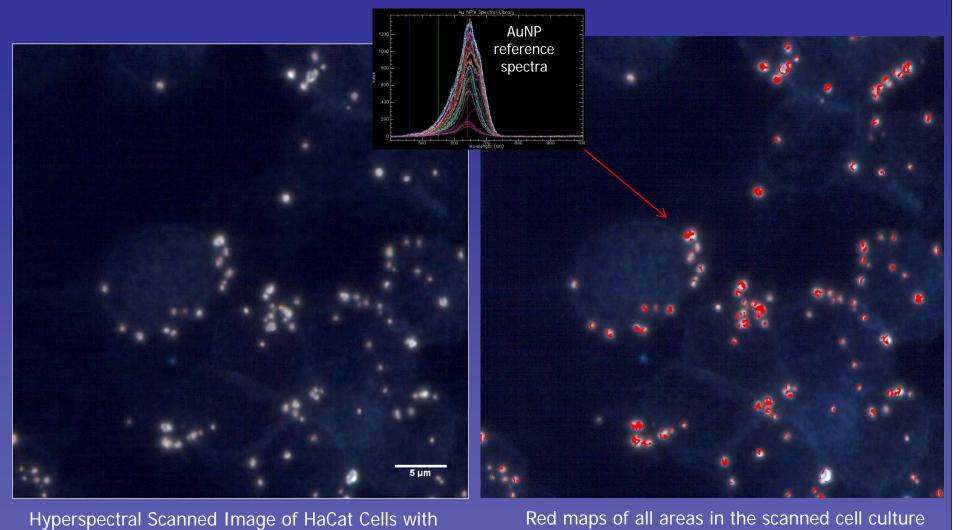


matching the Au spectral signature within the

spectral library

CytoViva Hyperspectral Imaging Mapping Au nano-particles in cell culture

internalized aggregating Au Nano-particles



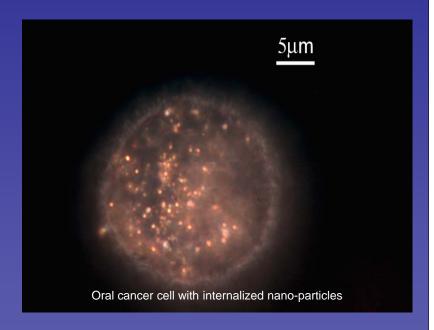




Hyperspectral Microscope System

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.

Web: www.cytoviva.com Email: info@cytoviva.com