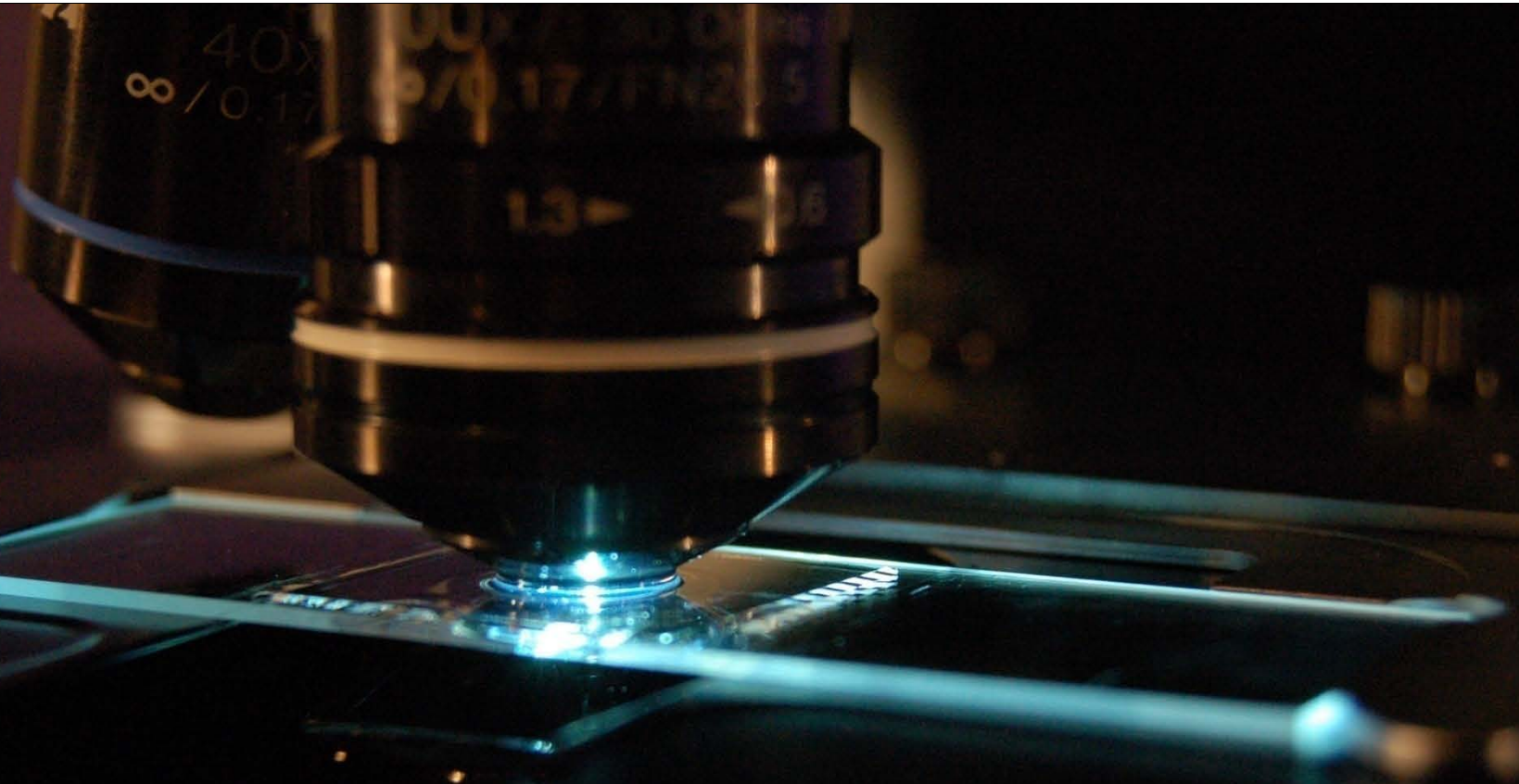




2006 & 2007
Winner

CytoViva®



Optical & Spectral Imaging For Nanoscale Research
Purdue Discovery Park

www.cytoviva.com

- **The Plan**

- **Tech Transfer-Commercialization Process
...finding the money!!**
- **CytoViva spectral microscopy for nano-
biotech research-ACS presentation**

Technology Transfer & Commercialization Process

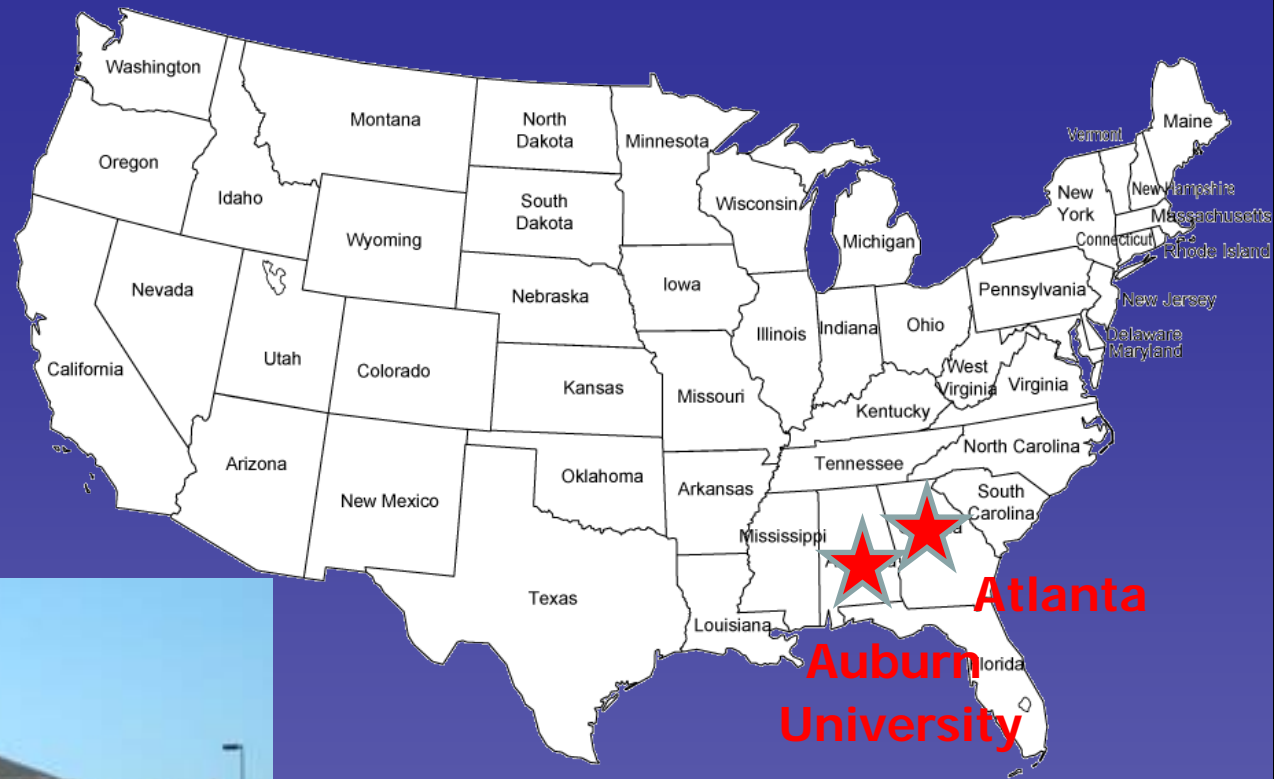
- Invited by Auburn University to review TT Process
- Formed Aetos Technologies-Parent
 - Equity relation w/ Auburn University
 - Review top technologies for commercialization
 - Form subsidiaries to fund, build, grow & sell
- Critical benefit to Auburn
 - Create revenue for Auburn & investors
 - Faculty help W/ tech prep & early stage details
 - Feed development into Auburn incubator

Rice Smalley Center Bucky Ball Gala

The Consortium for Nanomaterials for
Aerospace Commerce and Technology
(CONTACT) part of the Smalley Institute
for Nanotechnology at Rice University



Aetos Technologies, Inc





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CytoViva®

**CytoViva's patented optical technology
was invented by Auburn University
Bio-Physics Professor Vitaly Vodyanoy...**



2006 & 2007 winner



Most Promising Life Science Technology Award
2008 Winner



2007 winner

...the technology has received significant recognition



Microscope stage

CytoViva
Illuminator

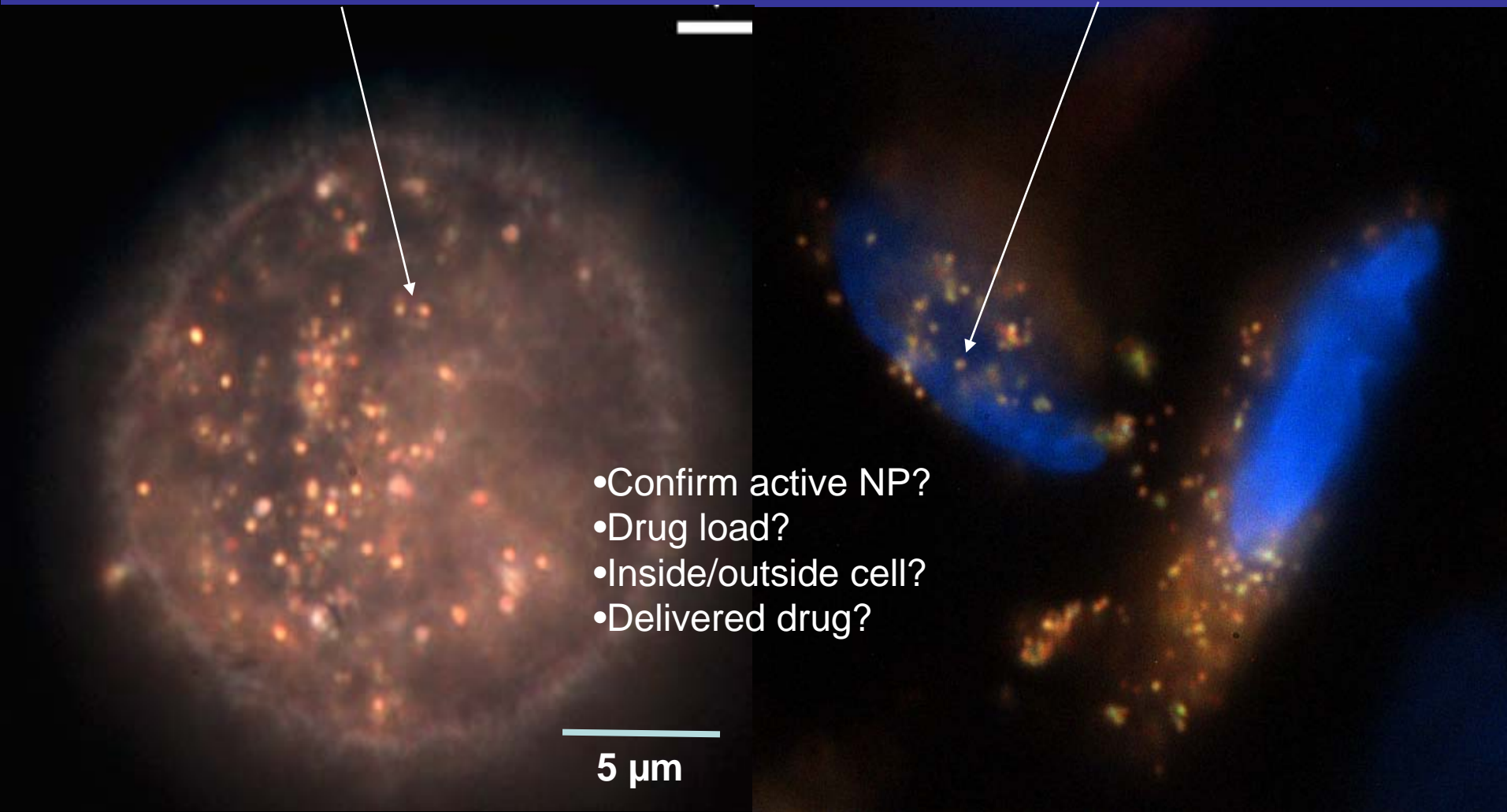
Condenser
Mount

Light Guide

ISSUE: How do we quantify the NP **CytoViva**[®] in cells, tissue or polymers???

Oral Cancer cell with Au NP

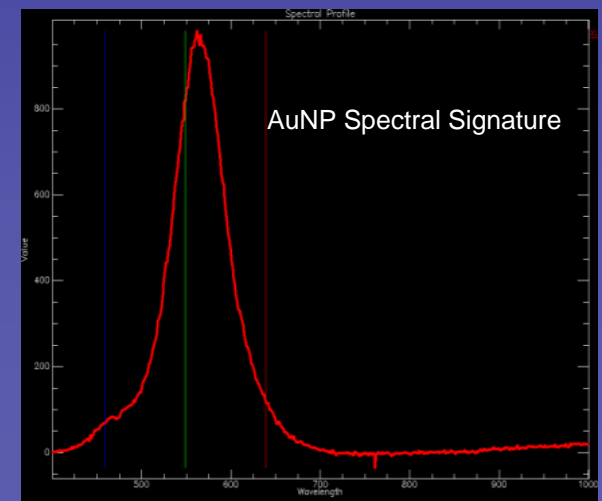
Stained Lung Cancer cell with coated Au NP shells



Hyperspectral Microscopy Primary Components...

- A patented high S/N optical microscope system.
- A VNIR hyperspectral imaging system (HSI) integrated onto the microscope .

...these integrated technologies serve to advance nano-materials research.



Hyperspectral Microscopy System: Footprint



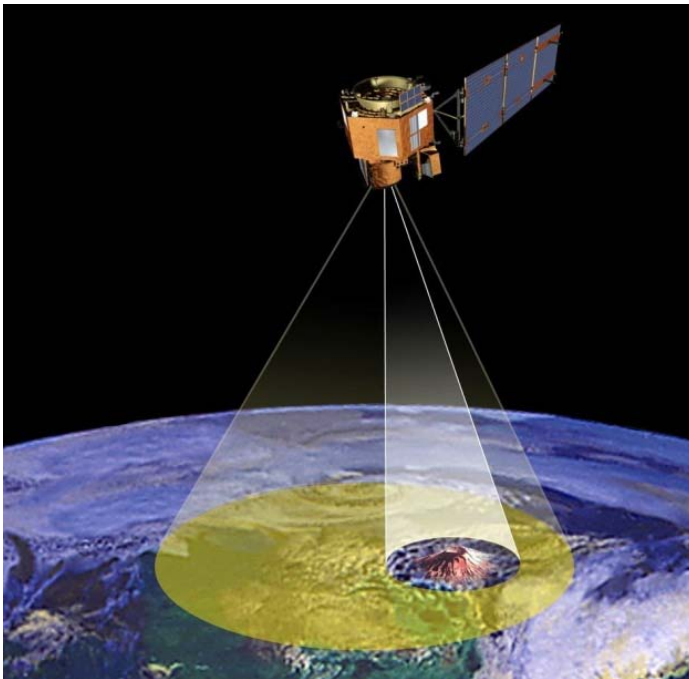
**Figure 1. Polystyrene latex standards 240nm viewed with
a) conventional Darkfield microscopy and b) CytoViva System**



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

Hyperspectral Imaging background

Hyperspectral imaging has been utilized for decades in geospatial image analysis



CytoViva adapted hyperspectral imaging for biomedical imaging applications

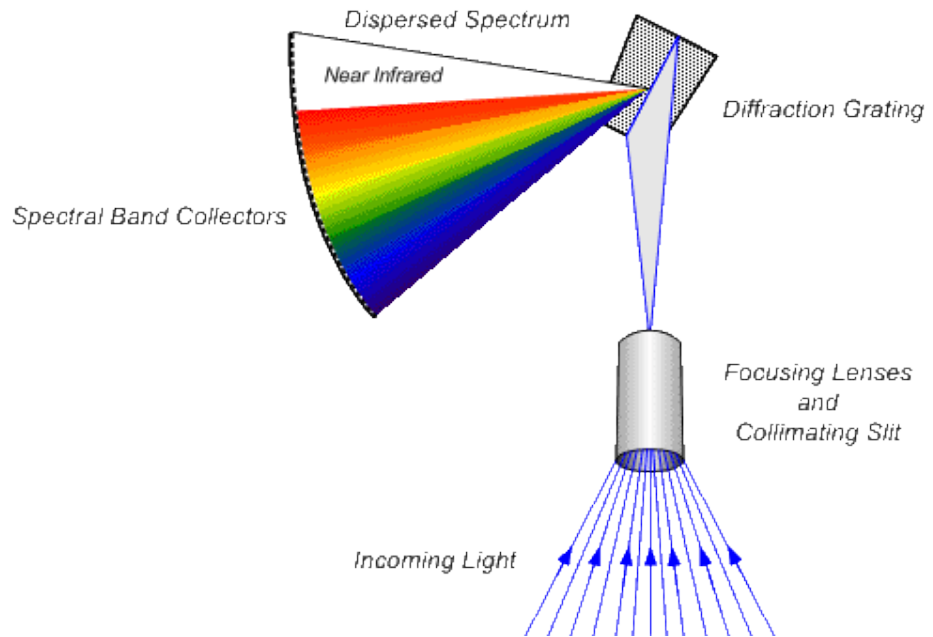




Hyperspectral Imaging System

How It Works

- The Hyperspectral Imager mounts onto the Microscope
- The reflectance spectra of objects from the microscope field of view are captured (VNIR spectrum from 400nm-1,000nm)
- Spectral data is reported in high resolution (down to 2.0nm)
- The complete spectra for each pixel of the CCD detector is captured (pixel size as small as 128nm)
- 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.



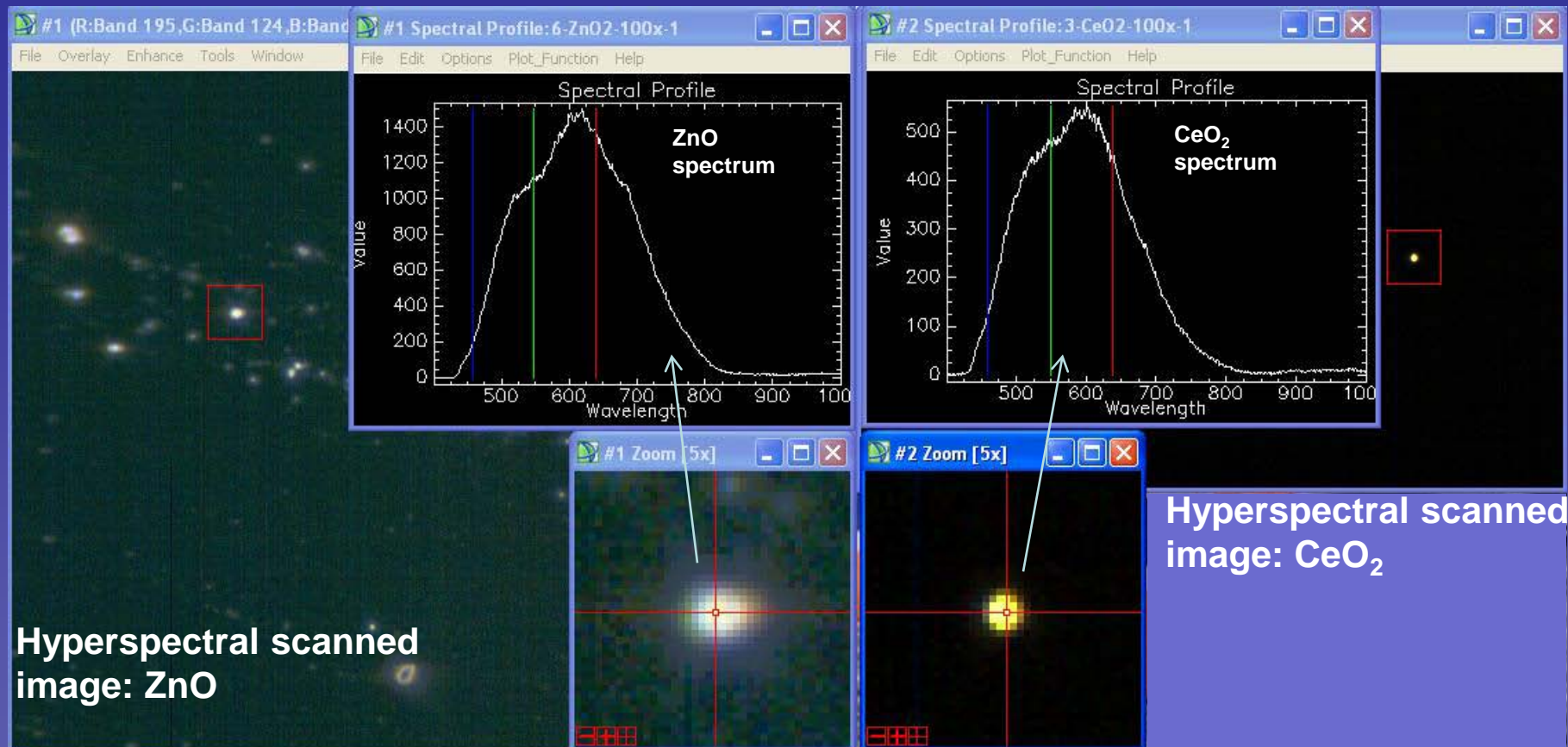
Diffraction Grating Hyperspectral Imaging System



Characterizing Nano-materials

Application Examples

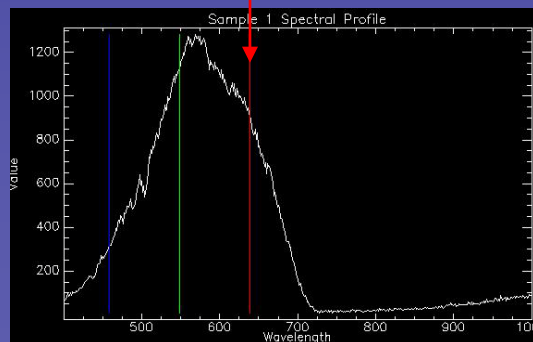
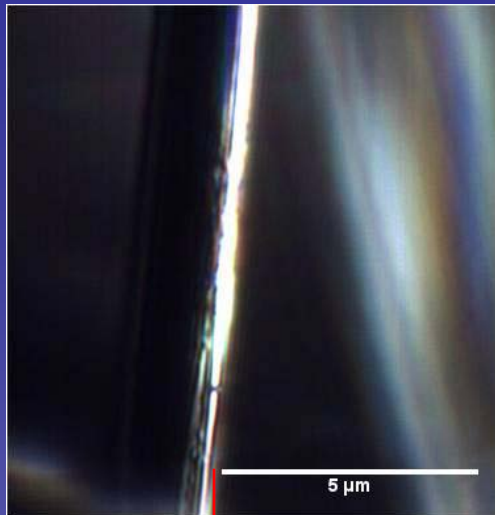
Characterizing spectral differences in metal oxides



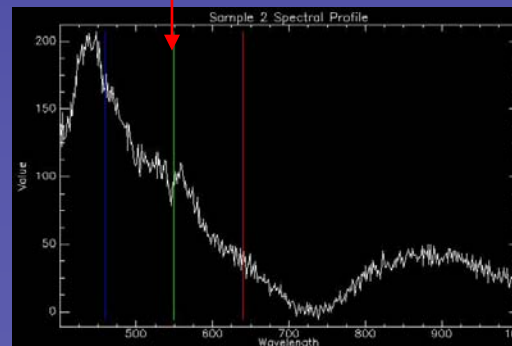
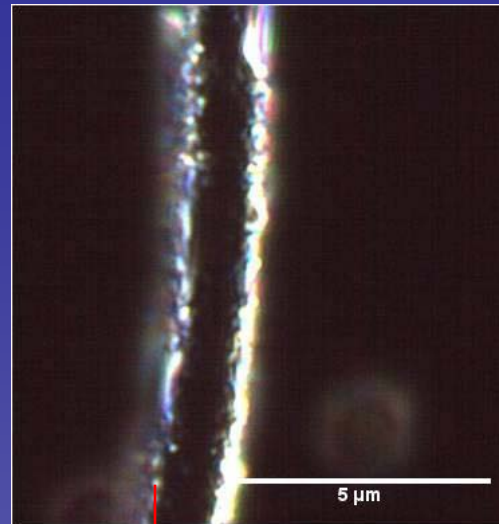
Hyperspectral scanned images of ZnO and CeO₂ (screen shots): Spectral differences in the spectra from each sample is illustrated.

Observing spectral differences in functionalized CNTs

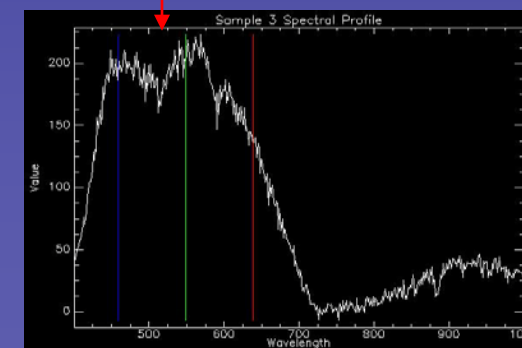
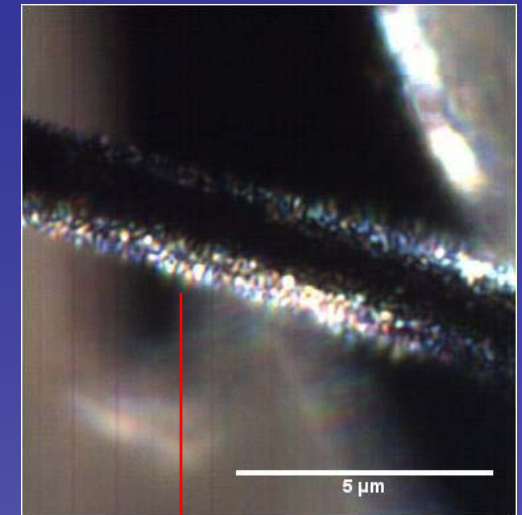
Hyperspectral Scan of
Toray Fiber Sample #1
No CNT Coating



Hyperspectral Scan of
Toray Fiber Sample #2
Raw CNT Coating

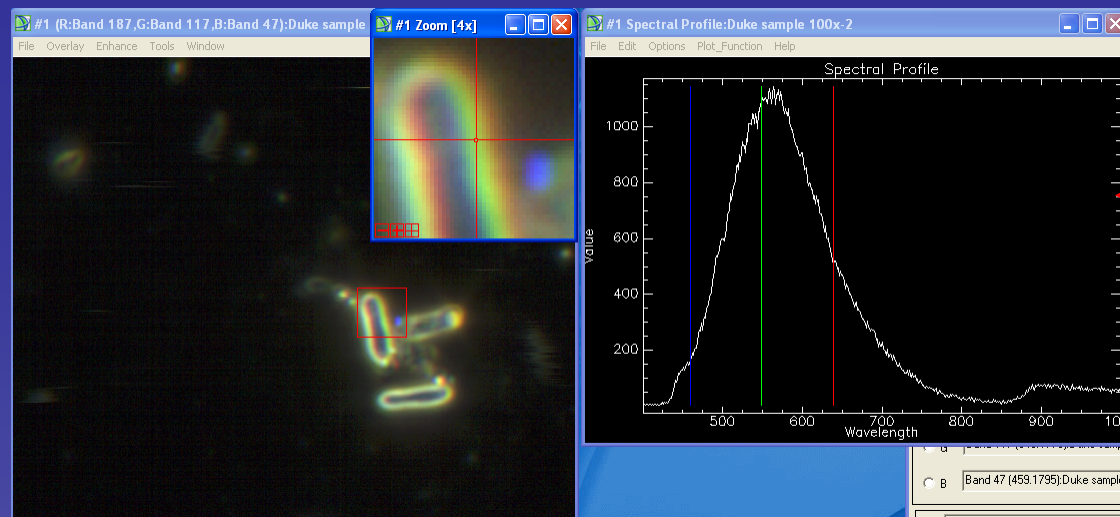


Hyperspectral Scan of
Toray Fiber Sample #3
Specialized GOx CNT Coating

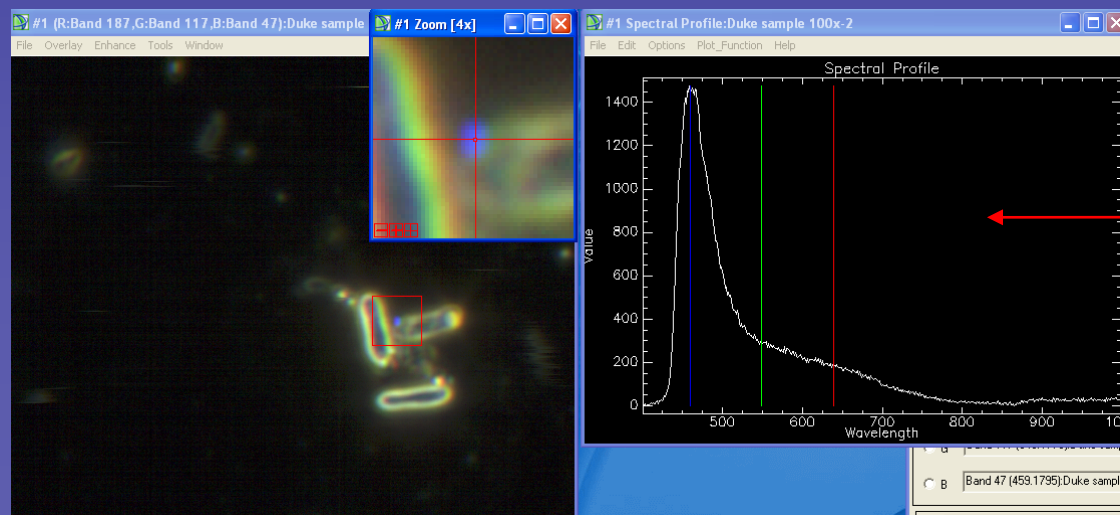


Hyperspectral measurements of single pixel areas from the three different samples confirms different surface chemistry from each sample.

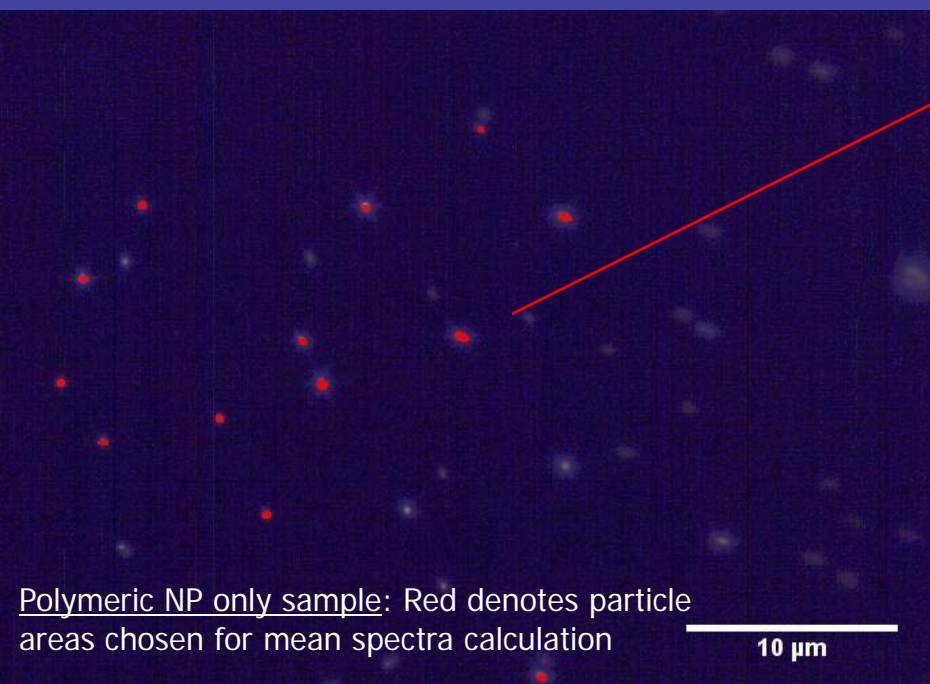
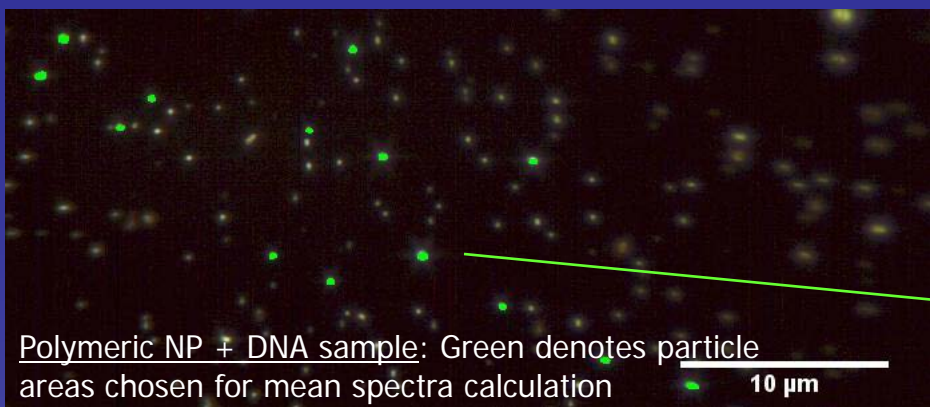
Characterizing spectral differences between cells & AgNPs



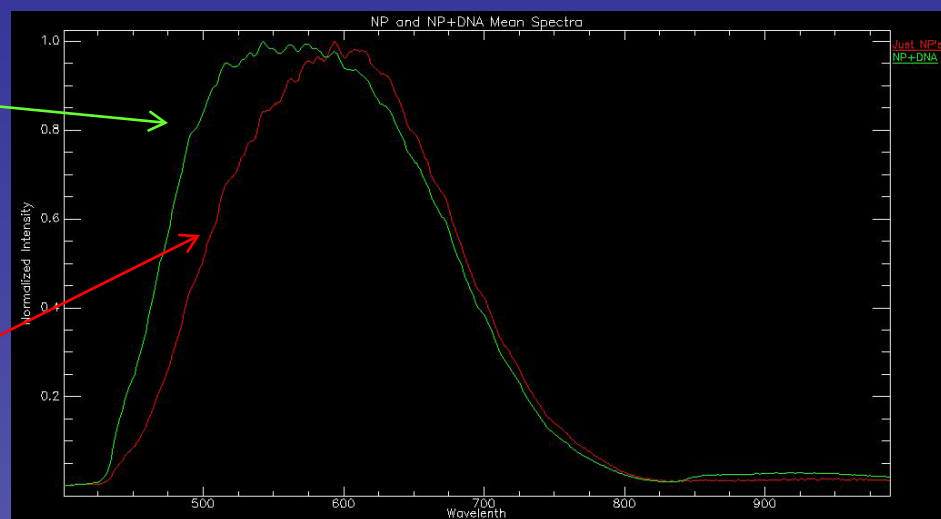
Spectral Signature
E-coli membrane



Spectral Signature
Ag NP



Sample: Polymeric NPs + DNA



Normalized mean spectra of NP + DNA green and NP only red:

The aggregate mean spectra of the two samples are quantitatively different.

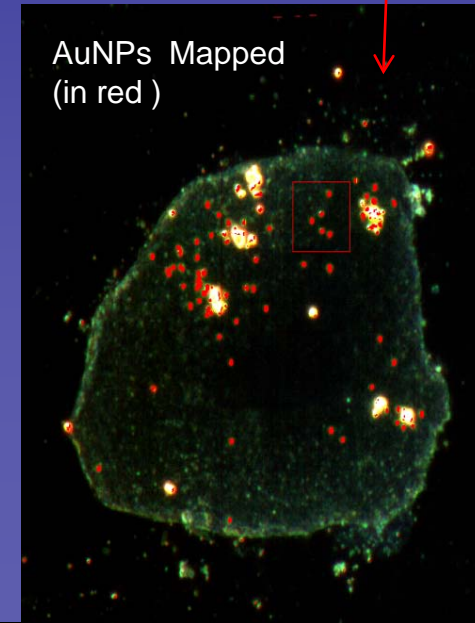
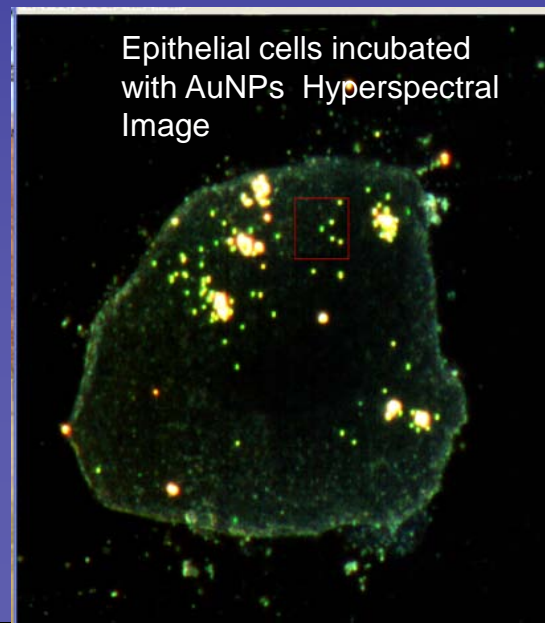
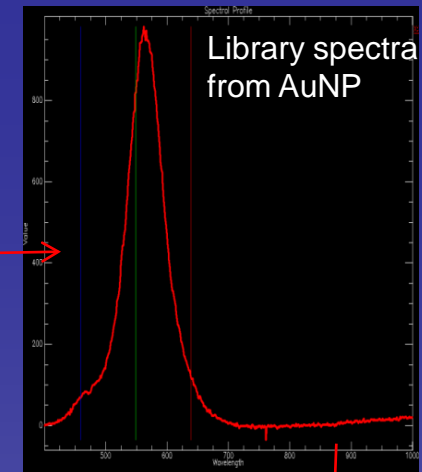
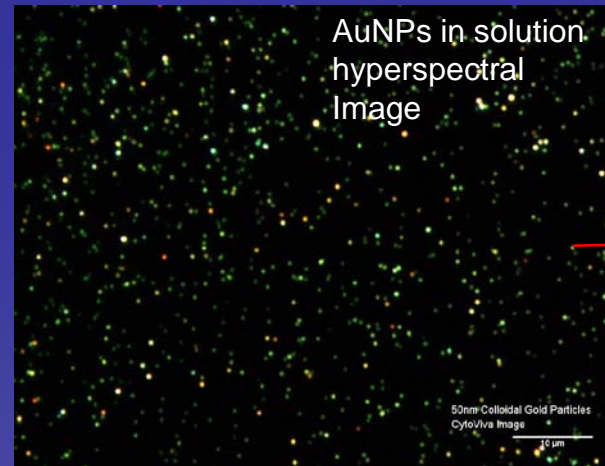


Mapping Nano-materials In-vitro

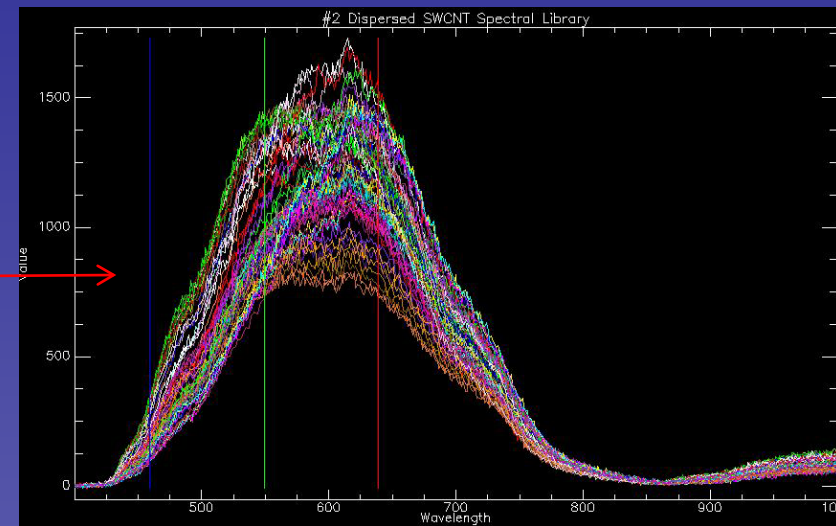
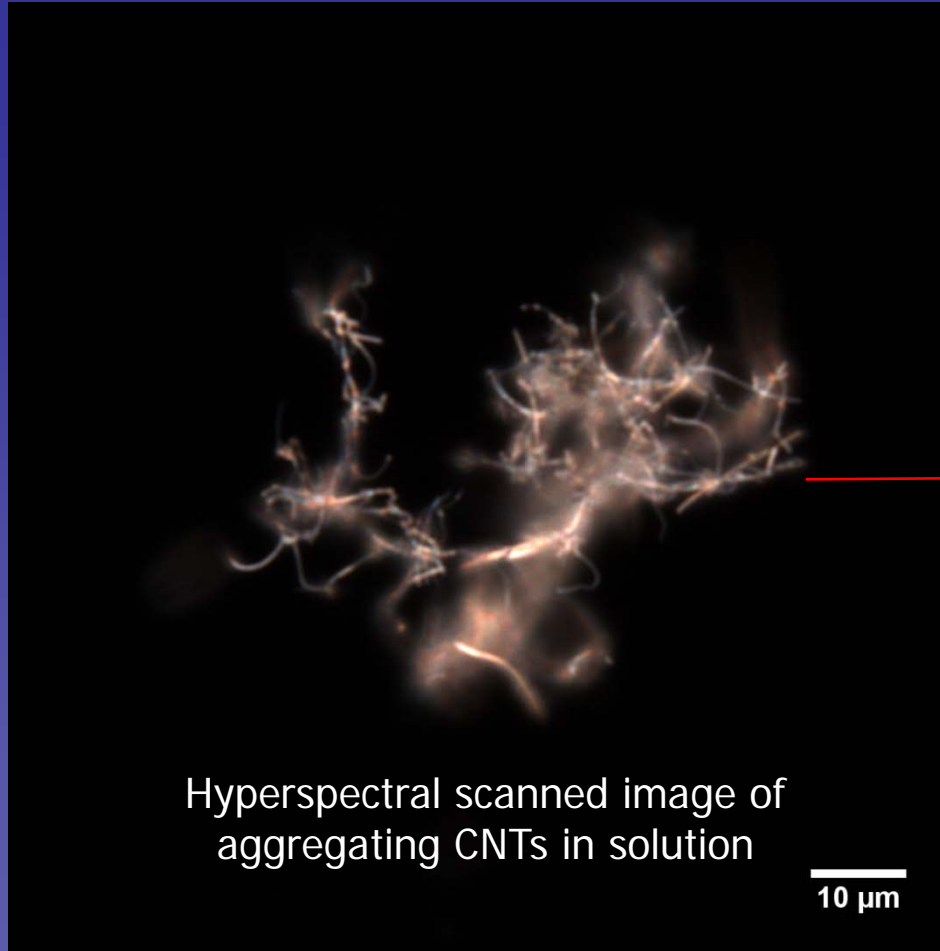
Application Examples

Mapping AuNPs in cell culture

- NP target is scanned.
- Unique spectral signatures of NP is loaded in a library database.
- New sample containing NP is scanned.
- Using NP spectral library, NP is mapped in the new sample.



Mapping CNTS in tissue

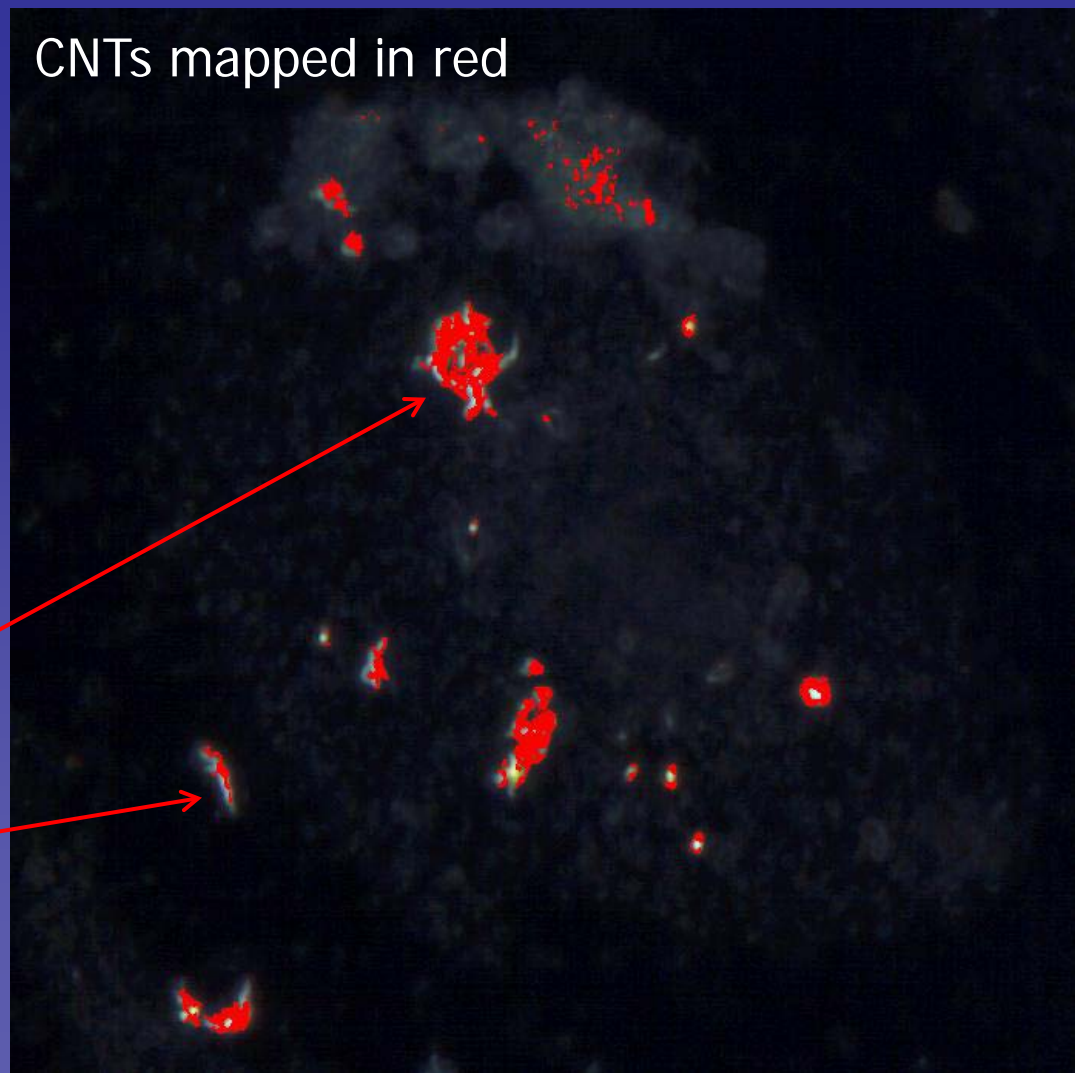
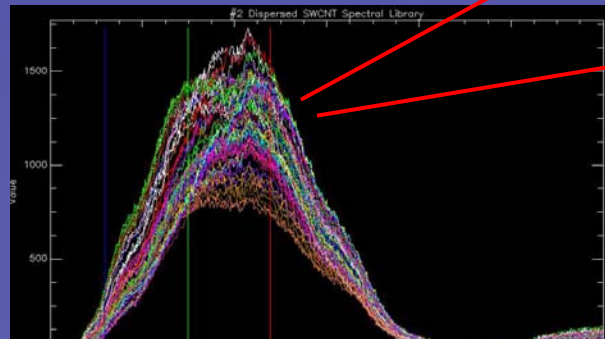


Spectral signatures collected from the CNT sample & loaded into the spectral library

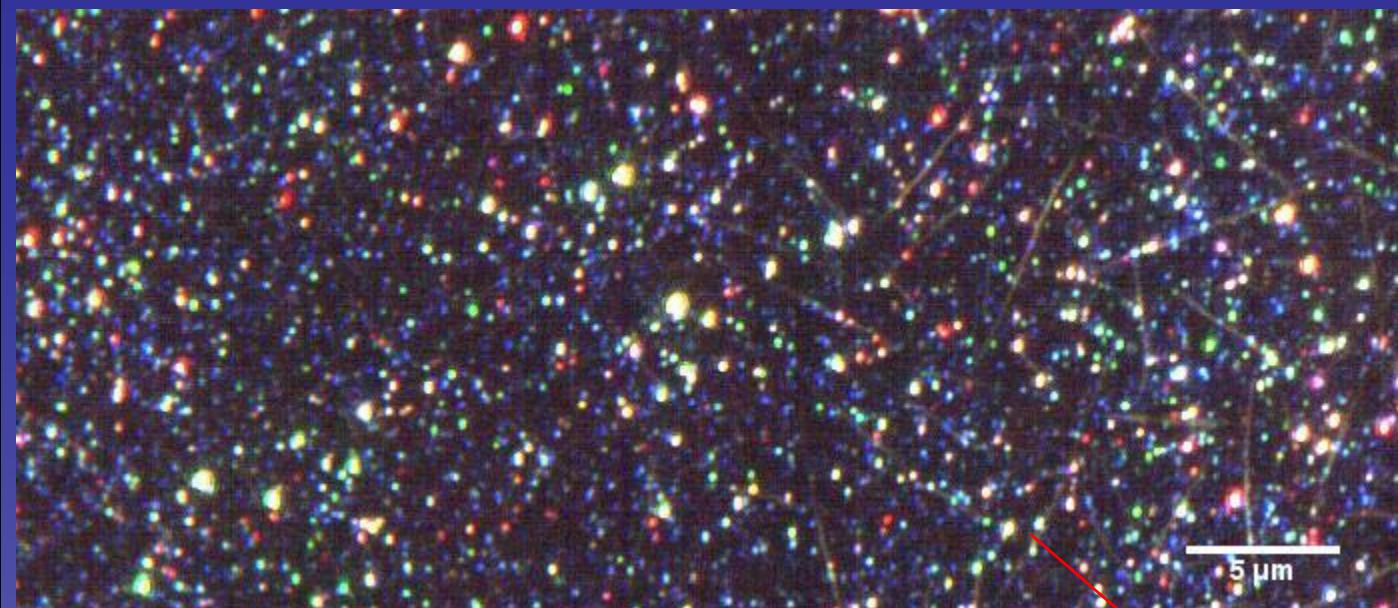
Mapping CNTs in tissue

Hyperspectral
scanned image CNTs
& tissue : 100x

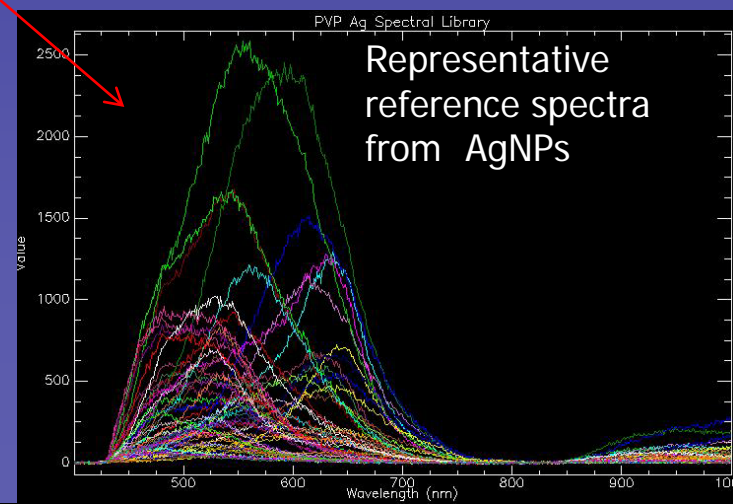
CNTs mapped in red



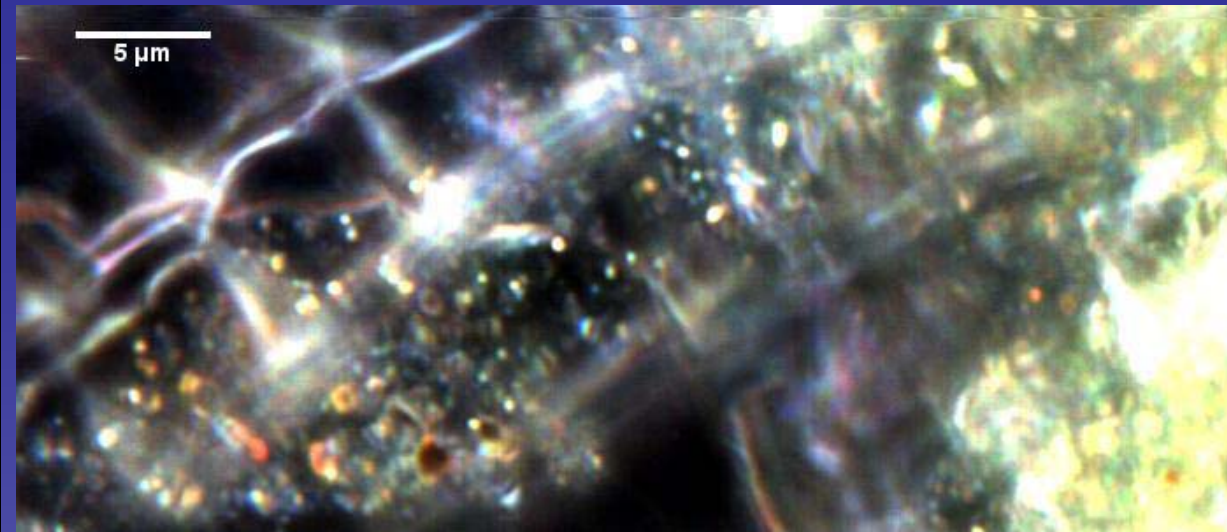
Mapping AgNPs in whole animal organisms



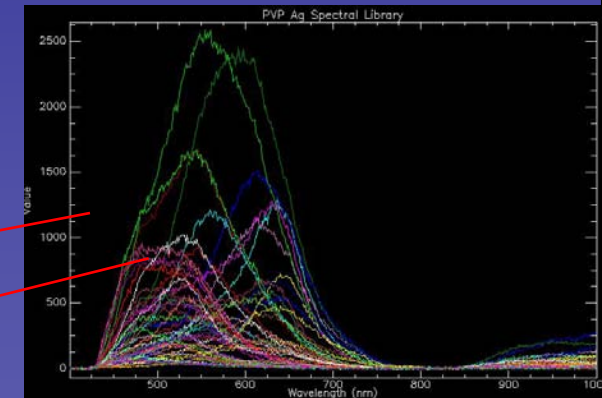
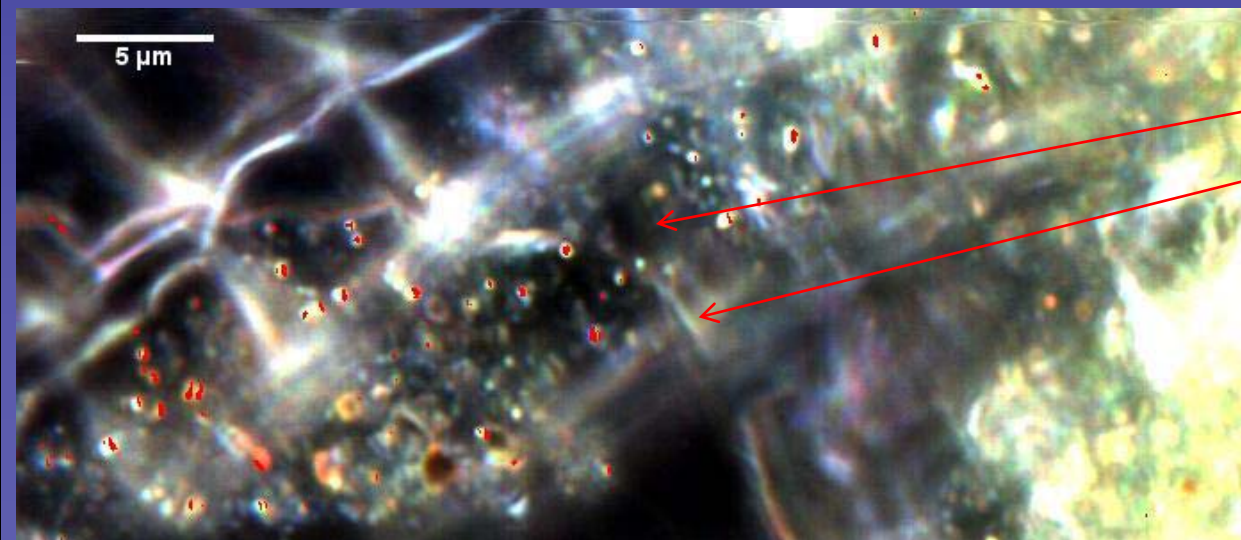
Hyperspectral Scanned Image of AgNPs in solution: 40x



Mapping AgNPs in whole animal organisms

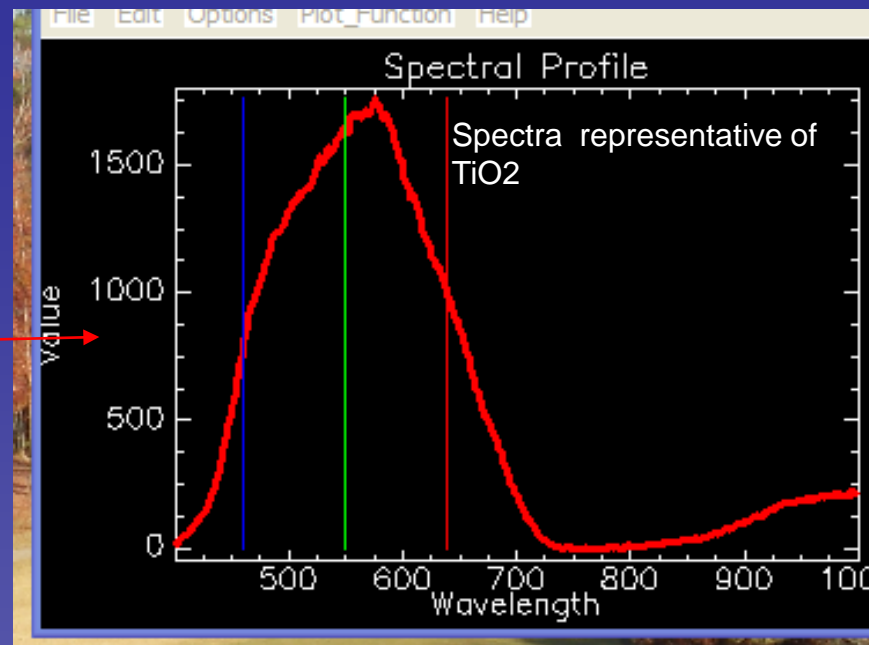
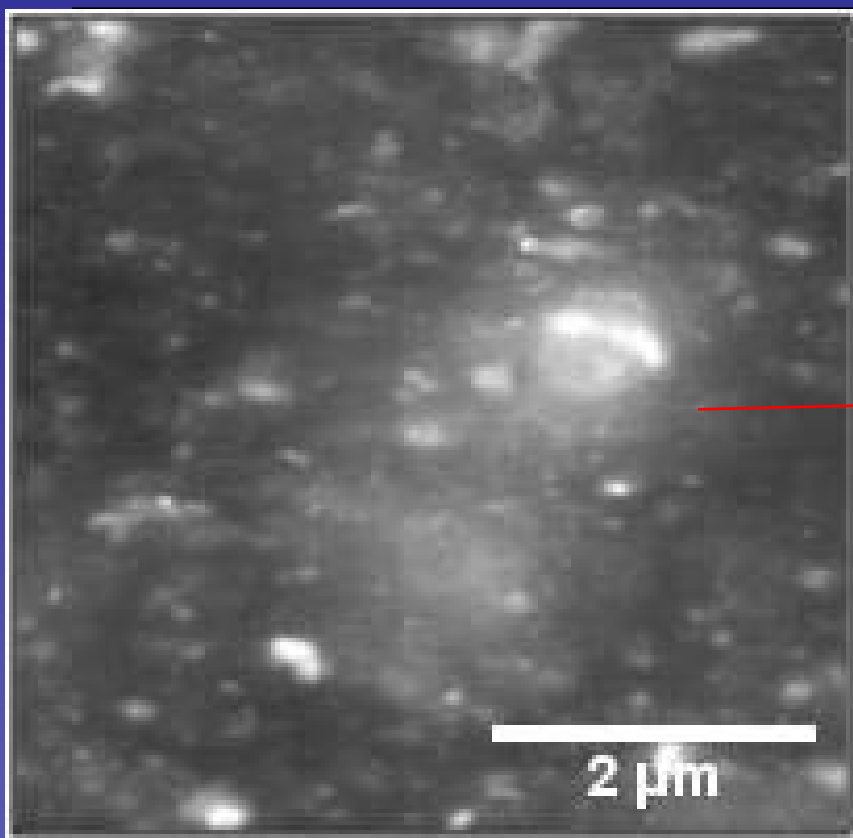


Hyperspectral scanned image of Daphnia and AgNPs



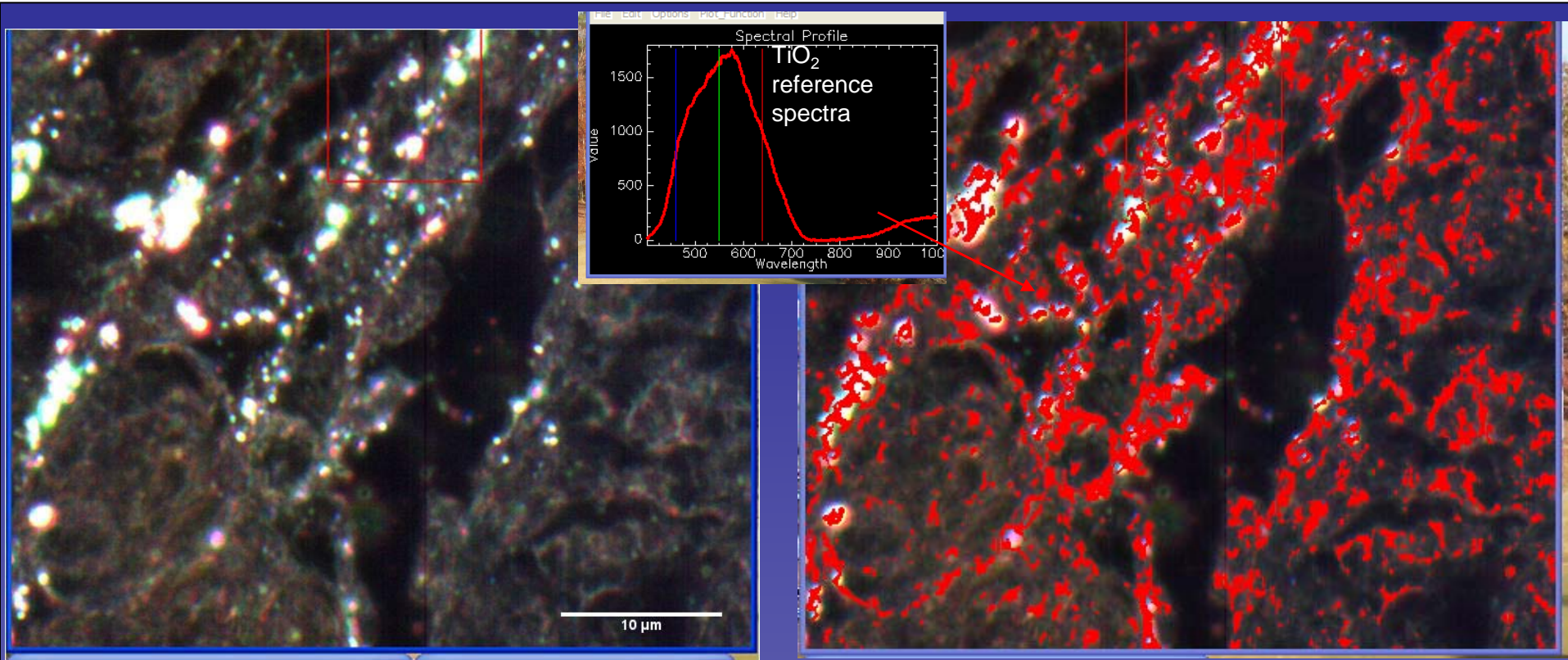
Mapping of the scanned image with each pixel exactly matching the spectra of the AgNPs colored red

Mapping TiO_2 in tissue



Hyperspectral Image Scanned image of TiO_2 aggregating on microscope slide

Mapping TiO_2 in tissue



Skin Tissue Containing TiO_2

Hyperspectral scan of skin tissue sample with TiO_2 particles: Sample imaged at 40x

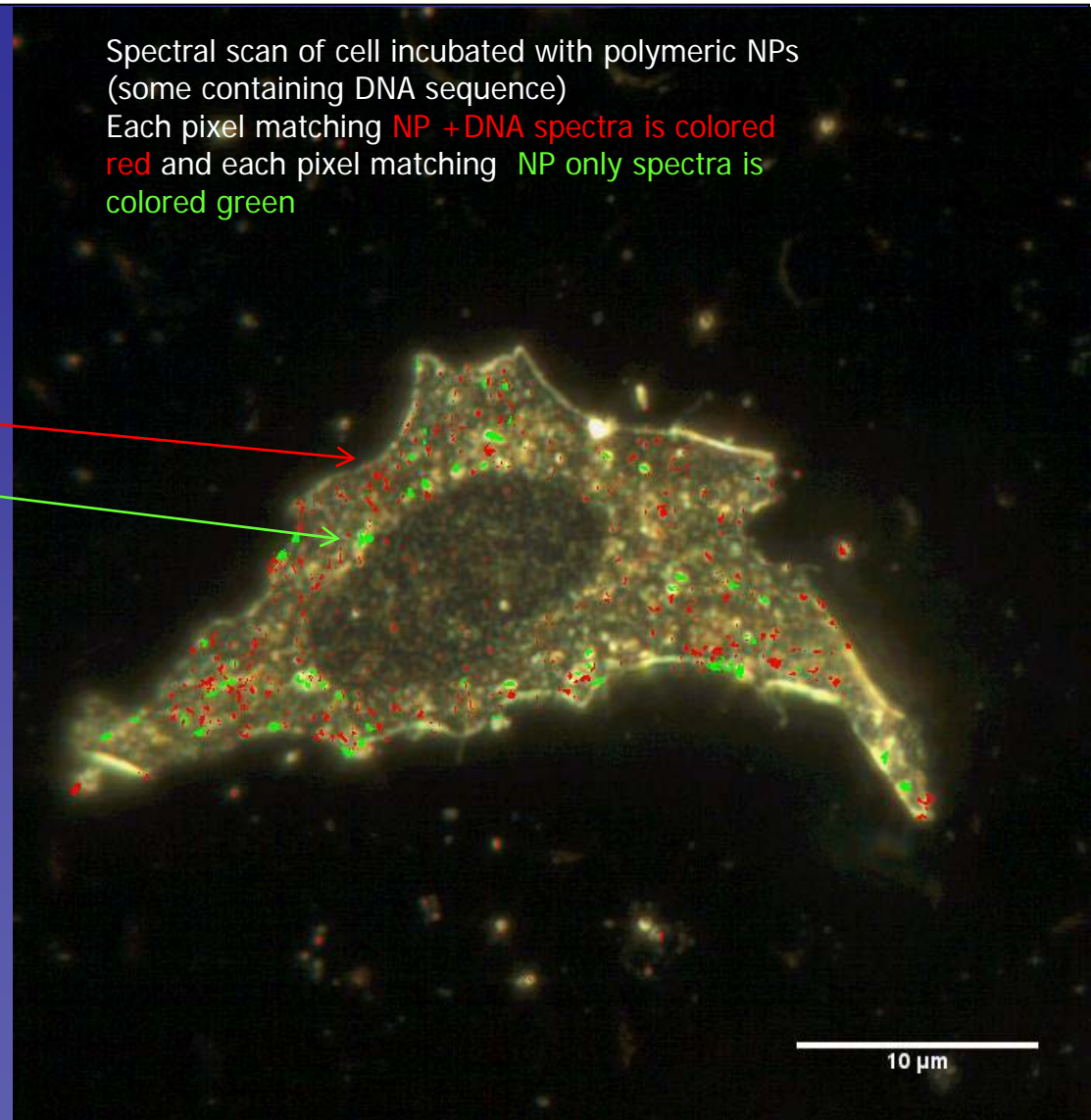
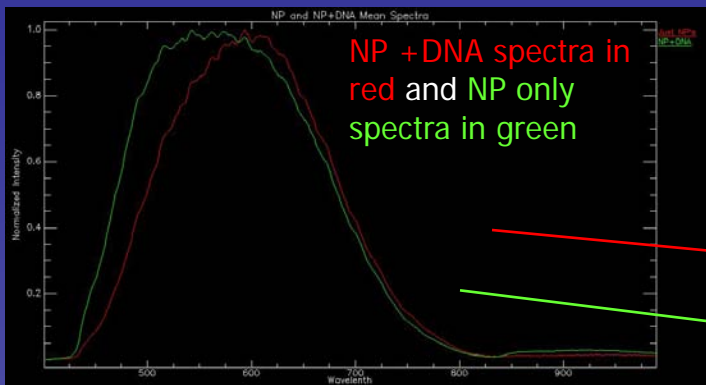
Mapping of TiO_2

Red maps pixels matching TiO_2 spectra in the tissue sample.

Mapping Polymeric particles in cells

Spectral scan of cell incubated with polymeric NPs
(some containing DNA sequence)

Each pixel matching NP + DNA spectra is colored
red and each pixel matching NP only spectra is
colored green





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Example applications and research labs currently utilizing CytoViva



NIST

Nano-fiber cell interactions

FDA

Nano-toxicology

NASA

Nano composites

Argonne Natl. Labs

Nano-particle development

NIH-NCI

Nano-drug characterization

Wright Pat. AFB

Nano-toxicology

Lawrence Berkeley Labs

Bio-fuels development

Johns Hopkins

Nano-particle-cell interactions

Georgia Tech

Nano-medicine

Rice University

Nano-medicine

University of Michigan

Nano-medicine

Duke University

Nano-particle characterization

MD Anderson Cancer Center

Nano-medicine

Methodist Center Ferrari Center

Nano-medicine

Dow Chemical

Nano-particle analysis

Johnson & Johnson

Nano-material composites

Pfizer

Nano-medicine

Schering Plough

Nano-emulsions

Merck

Nano-medicine

Proctor & Gamble

Emulsions & nano-particles

Novozymes Inc.

Bio-fuels development



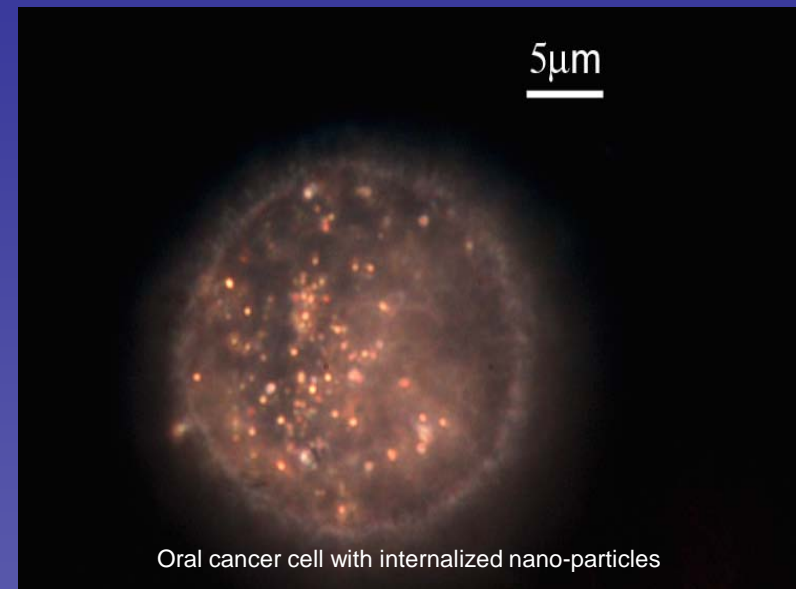
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CytoViva®

CytoViva has over 210 research clients world-wide



CytoViva works with research teams to understand how hyperspectral microscopy can advance their nano-materials research ...



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

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Email: info@cytoviva.com



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