Photon etc
A spectrum of solutions

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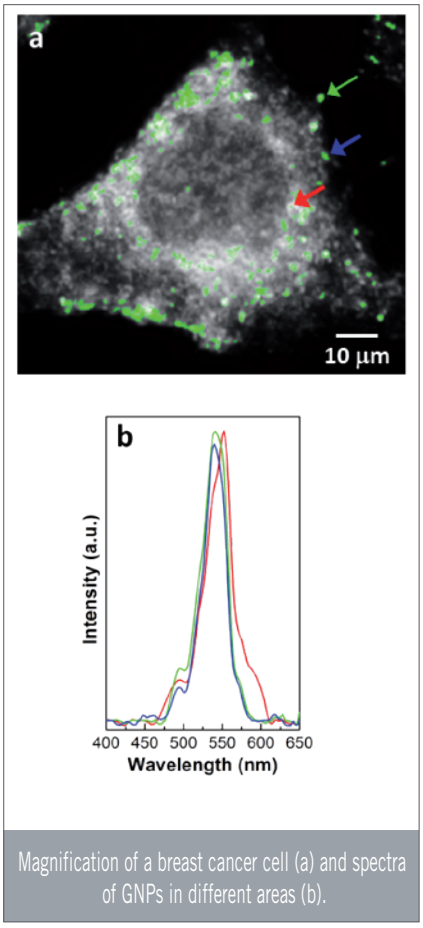
CANADA

IMA™ FLUORESCENCE

Dedicated to life sciences, IMA™ Fluorescence is an integrated hyperspectral fluorescence microscope perfect to study the properties of organic and inorganic samples. With the possible integration of a darkfield illumination module, it becomes an exceptional tool to also detect the composition and the location of nanomaterials embedded in cells.



Magnification of a breast cancer cell (a) and spectra of GNPs in different areas (b).

TECHNICAL SPECIFICATIONS	VIS	IR	DARKFIELD
Spectral Range	400 to 1000 nm	900 to 1700 nm	400 to 1000 nm
Spectral Resolution	< 2.5 nm	< 4 nm	< 2.5 nm
Objectives	20X, 50X, 100X	20X, 60X, 100X	20X, 60X, 100X
Camera*	Front-illuminated interline CCD camera	Photon etc. InGaAs Camera	Front-illuminated interline CCD camera
Epifluorescence Filter	Triple Filter Fluo	Optional	Triple Filter Fluo
Illumination Lamp	HBO or XBO 100	Optional	HBO or XBO 100
Laser*	Optional	808 nm	Optional
Darkfield Module	Optional	Optional	Oil or Dry
Spatial Resolution	Sub-micron		
Microscope	Inverted		
Maximum Sample Format	10 cm x 10 cm		
X, Y Travel Range	76 mm x 52 mm		
Z Stage Resolution	1 µm		
Maximum Scanning Speed	150 ms		
Wavelegth Absolute Accuracy	0.25 nm		
Video Mode	Megapixel camera for sample vizualisation		
Preprocessing	Spatial filtering, statistical tools, spectrum extraction, data normalization, spectral calibration		
Hyperspectral Data Format	FITS, HDF5		
Single Image Data Format	JPG, PNG, TIFF, CSV, PDF, SGV		
Software	Computer with PHySpec™ control and analysis software included		
Dimensions	≈ 102 cm x 76 cm x 76 cm		
Weight	≈ 80 Kg		

UPGRADES*	Back-illuminated camera, EMCCD Additional excitation wavelengths available	High Resolution Module: 900-1700 nm FWHM < 1 nm Additional excitation wavelengths available	Back-Illuminated camera, EMCCD

APPLICATION

IDENTIFICATION OF SINGLE NANOPARTICLES IN CANCER CELLS BY DARK FIELD HYPERSPECTRAL IMAGING

Dark field illumination is commonly used for the analysis of biological samples containing nanomaterials that significantly scatter light. When combined to hyperspectral imaging, it becomes an exceptional tool to also detect the composition and the location of nanomaterials embedded in cells. IMA™, Photon etc.'s hyperspectral imager, can be equipped with a highly efficient dark field condenser and generate high contrast images of biological samples.

The high throughput of Photon etc.'s hyperspectral filter allows the rapid acquisition of spectrally resolved high resolution images. Since the camera captures the whole area in the field of view, it is possible to collect spectral and spatial information in real time, with the possibility of recording spectrally resolved videos to follow the dynamics of cells and luminescent nanoscale components. PHySpec™, Photon etc software, enables principal component analysis (PCA) in order to identify the smallest variations of single and aggregated nanoparticles.

With the purpose of showing the capabilities of IMA™ to analyse nanomaterials in biological systems, a sample of MDA-MB-23 human breast cancer cells has been tagged with 60 nm gold nanoparticles (GNPs) and exposed to a dark field illumination on the entire field of view (Figure 1). With a 60× objective, an area of 150×112 µm was imaged, with a step of 2 nm and an exposition time of 2 s per wavelength. The complete analysis took only a few minutes, for more than one million spectra, each of them covering the whole visible spectrum.

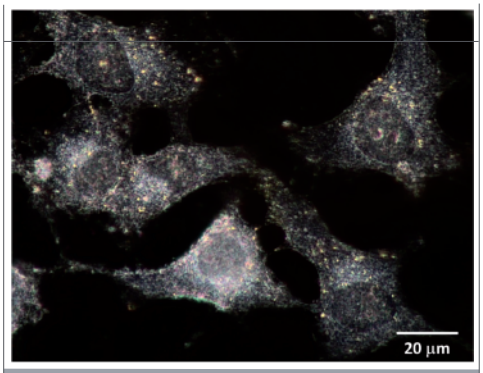


Fig. 1: Dark field image of human breast cancer cells tagged with gold nanoparticles (60 nm size)

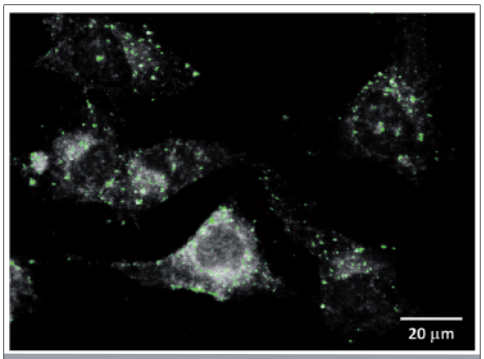


Fig. 2: Monochromatic image at 550 nm. GNPs marked in green after PCA

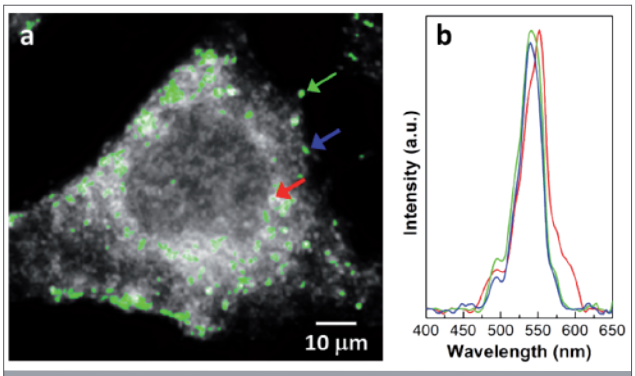


Fig. 3: Magnification of a breast cancer cell (a) and spectra of GNPs in different areas (b).

Cells typically have a flat scattering spectrum, whereas GNPs show a sharp peak around 550 nm. Figure 2 illustrates the 550 nm image extracted from the dark field hyperspectral cube of the breast cancer. The GNPs are marked with a green colouring after PCA software processing. The magnification of a breast cancer cell (Figure 3a) and the spectra of the regions containing GNPs (some examples in Figure 3b) confirmed the presence of single 60 nm NPs (peak at 550 nm) and their aggregates (peaks red-shifted). The hyperspectral camera did not detect any GNPs in the areas between the cells.

Results kindly provided by: David Rioux, Éric Bergeron and Michel Meunier, at École Polytechnique, Canada.