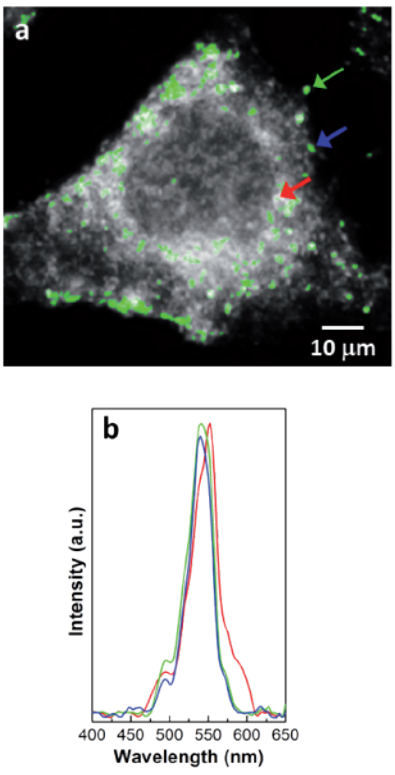
Photon etc
A spectrum of solutions

5795 DE GASPE AVENUE, #222
MONTREAL, QUEBEC, H2S 2X3
CANADA

THE HYPERCUBE™

The HyperCube will transform your microscope into a high resolution spectral imaging system, opening new research perspectives in biological imaging. Designed to fit commercial microscopes, cameras and a vast variety of excitation modules, The HyperCube gives access to the detailed composition of your sample.



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

TECHNICAL SPECIFICATIONS

Spectral Range	400-700 nm
Spectral Resolution	< 2.5 nm
Spatial Resolution	Sub-micron
Microscope	Inverted (provided by customer)
Objectives	Provided by customer
Camera	Provided by customer
Epifluorescence Filter	Provided by customer
Illumination Lamp	HBO or XBO 100 (provided by customer)
Darkfield Module	Provided by customer
Maximum Scanning Speed	150 ms
Wavelegth Absolute Accuracy	0.25 nm
Video Mode	Filtered and non-filtered visualization
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	PHySpec™ control and analysis software included
Dimensions	≈ 55 cm (adjustable) x 30 cm x 45 cm
Weight	≈ 18.5 Kg
*Options	
Special Range Extension	400-1000 nm

APPLICATIONS

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.

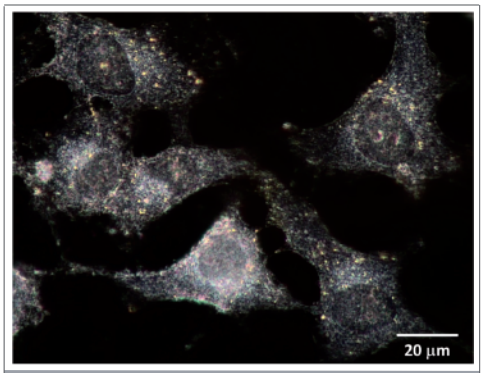


Fig. 1: Dark field image of human breast cancer cells tagged with gold nanoparticles (60 nm size)

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.

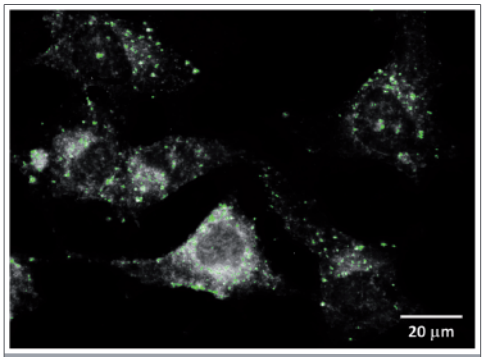


Fig. 2: Monochromatic image at 550 nm. GNPs marked in green after PCA

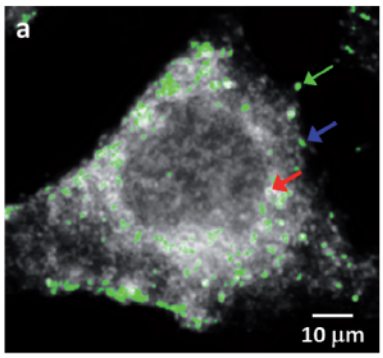


Fig. 3: Magnification of a breast cancer cell (a) and spectra of GNPs in different areas (b).

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.

LUMINESCENCE IMAGING OF EXTENDED DEFECTS IN SiC VIA HYPERSPECTRAL IMAGING

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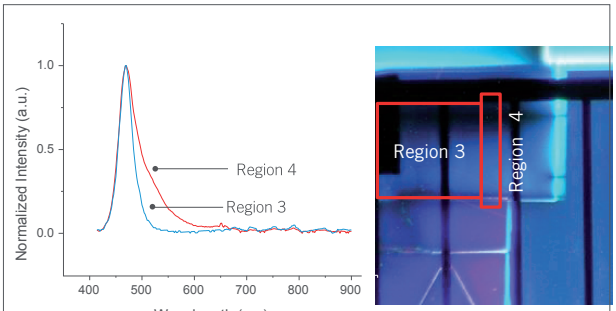
Over the past decade, improvements in silicon carbide growth and materials has led to the development of commercialized unipolar devices such as Schottky diodes and MOSFETs, however, much work remains to realizing the goal of wide-scale commercialization of both unipolar and bipolar devices such as pin diodes or IGBTs, for high applications requiring high powers, operating in elevated temperatures or radiation environments or for many fast switching applications.

Here we report on hyperspectral imaging of electroluminescence (EL) from SiC pin diodes, whereby a stack of luminescence images are collected over a wide spectral range (400-900 nm), thereby providing the ability to both image distinct features and identify their corresponding spectral properties. This process is also equally applicable to collecting either photo- or electroluminescence from other materials or devices emitting in either the UV-Vis or NIR, as well as to reflectance, transmission or other imaging techniques.

EL was induced via driving ~28A/cm^2 through 0.93x0.93 mm pin diode. EL was collected 20x 0.4 NA objective. A series of reflecting mirrors focused the EL onto the entrance slit of the hyperspectral imaging filter. By rotating the two volume Bragg gratings with respect to the incident, the output from the filter was narrowed to 2 nm, with the center wavelength of this pass-band varied from 400-900 nm. This output was focused onto a TE cooled CCD detector. Images were collected in 2 nm increments for 30s each. The collection of images were stacked and a rectification process was performed that enables a spectrum from any given feature within the structure to be obtained, thereby providing direct correlation between given structural features and their corresponding spectra within a single acquisition set.



IN-GROWN STACKING FAULTS: INFLUENCE OF PN JUNCTION