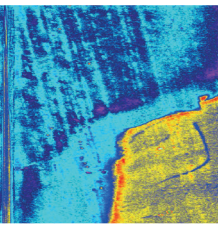
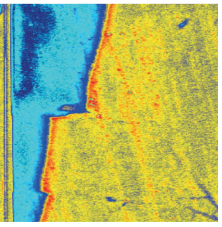
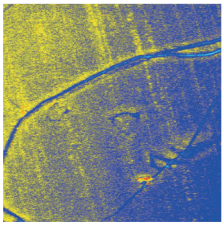
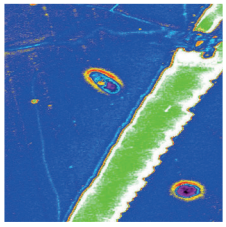
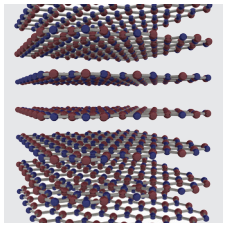
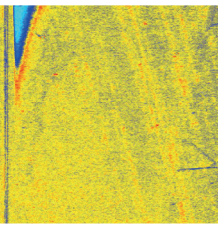
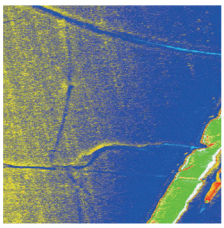
HORIBA
Scientific



# CLue Series

## Universal Extensions for CathodoLuminescence, Photoluminescence and Raman Spectroscopy


Boost your Electron Microscope with Hyperspectral & Imaging Solutions

JOBIN YVON
Technology

# Clue Series

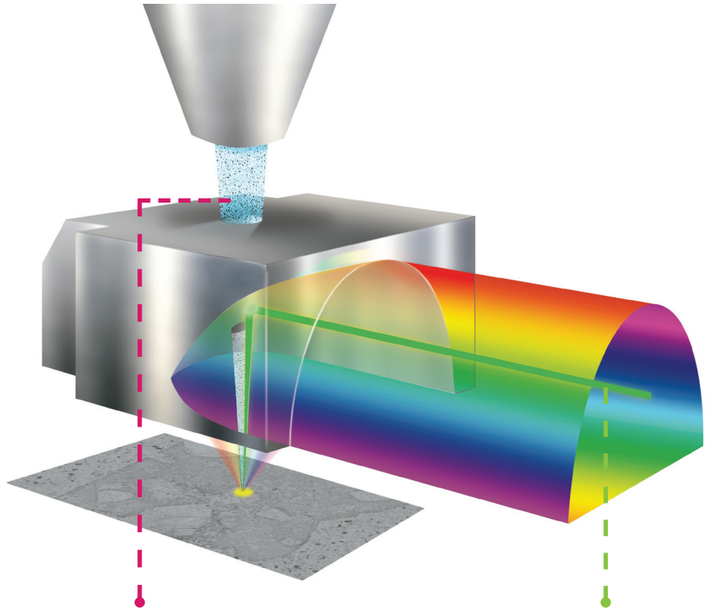
## Add Cathodoluminescence and Raman Capabilities to your Electron Microscope

Nanomaterials | Optoelectronics Semi-conductors | Geology Mineralogy | Photovoltaics

HORIBA Scientific is your partner in spectroscopy with unequalled experience in optics, vacuum and detectors designs.

Based on combined experience in Japan (MP series) and in France (CLUE series), HORIBA Scientific offers a bunch of cathodoluminescence systems for process applications in semi-conductors as well as Research applications in Earth, Life and Material Sciences

With a consistent worldwide installed base and as a leader in diffraction gratings, Raman, PL and VUV spectroscopy, HORIBA Scientific is a global company with application and service support next to you.



### What is SEM-CL Spectroscopy?

CathodoLuminescence (CL) is a non-destructive technique providing maps of optical and electronic properties of many kinds of materials with a nanometric spatial resolution.

Cathodoluminescence is similar to Photoluminescence (PL) technique, but the excitation by high energy electron beam can produce all the transitions to the higher energy excitation states and induce light emission from DUV to NIR.

CL technique is particularly suitable for analysis of particles, group IV semiconductors, thin films and nanostructures, novel photonics materials, oxides and minerals.

### What is SEM-Raman Spectroscopy?

Raman spectroscopy is based upon the interaction of monochromatic light such like a laser with the molecules within a material.

This technique typically provides information about chemical structure, phase and polymorphy, crystallinity, and molecular orientation.

Raman analysis can be applied to any kind of organic (biological, polymers…) and inorganic (minerals, semi-conductors, glasses, oxides…) materials, except pure metals.

## Gain unique insight into the chemical and electronic properties of materials with nanoscale resolution!

Measuring CL and Raman / PL photons inside the electron microscope* specimen chamber, in a SameSpot™ configuration, permits to measure the following parameters in the same conditions of pressure and temperature as other EM measurements (EDX, XRF, EBSD, Auger…).

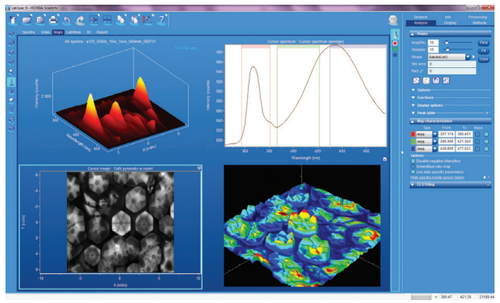
*Compatible with SEM and FIB/SEM microscopes

### Cathodoluminescence

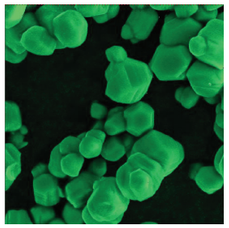
- Electrical and compositional properties
- Quality control and failure analysis
- Defects, impurities, dopants, vacancies
- Contaminations and inclusions
- Zoning analysis in zircons

### Raman Spectroscopy

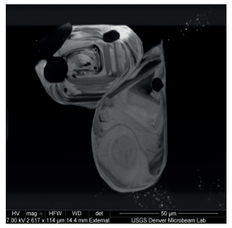
- Compounds molecular identification
- Functional groups analysis
- Crystallinity, lattice modes
- Strain & Stress
- Free carrier concentration



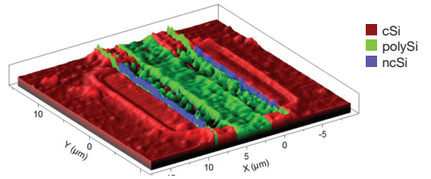
*GaN pyramidal nanostructures*



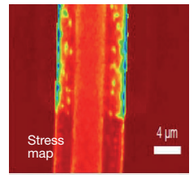
*CL image of phosphor powder*

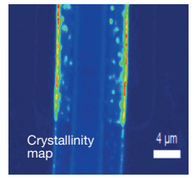


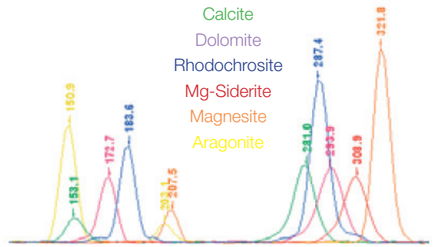
*Zoning mosaic image of Zircons (400x400µm)*




*2D and 3D Raman fast map of Si peak bandwidth, showing various crystallinity*



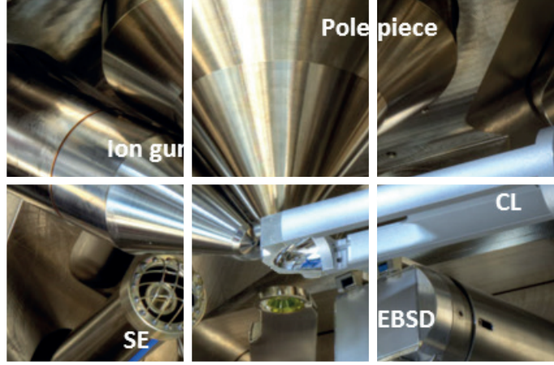




*Raman spectra of different types of carbonate crystals*

# CLUE Just Fits IN whatever your SEM!

## Add-on Detectors Portfolio




### An ultra-compact scalable solution to fit any request and budget

From i-CLUE affordable CL panchromatic imaging controlled by the electron microscope software, to F-CLUE fiber coupled ruggedized configurations and H-CLUE laboratory solutions featuring high performance direct coupling; HORIBA Scientific offers a cathodoluminescence solution to every customer and every sample.

In addition, our special product team can develop a custom solution to meet your specific requirements.

### Keep the original configuration of your electron microscope

Because it is fully retractable, HORIBA CLUE series offers the possibility to add CL or Raman spectroscopy as a field upgrade on any famous brand of Electron Microscope*, without any restriction on microscope performance!

* Need a free horizontal port and technical compatibility validation

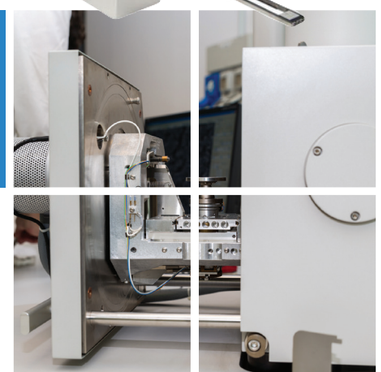
*Affordable • Compact • Fast*

### i-CLUE

### Fast Imaging CL

Best price-to-performance ratio for a plug-and-play fast CL imaging module features:

- Ultra-compact panchromatic CL detection
- Manually retractable mirror
- Large field of view ellipsoidal mirror collection
- Driven by EM software
- Imaging touch-screen controller



### F-CLUE

### Compact Hyperspectral CL

Flexible solution to fit any kind of environment, featuring:

- Imaging and/or hyperspectral CL
- Rugged optical fiber interface
- Selection of ellipsoidal or parabolic retractable mirror to fit all sample types and applications
- Powered by LabSpec 6™ Software
- Fully motorized spectrometer
- Optional RGB filters



*Modular • High Performance • Field Upgradeable*

### H-CLUE

### Versatile Hyperspectral CL

Free space optical coupling for the highest performance over the widest CL spectral range

- Fully automated control
- Motorized RPM with fine adjustment
- No chromatic shift
- Customized configurations: angle-resolved CL, time-resolved CL, polarization, filter wheels
- Imaging and spectroscopy from DUV to NIR with up to 5 detectors
- Long focal length spectrometers



### R-CLUE

### Raman PL & CL

All-in-one fully automated solution for high-end Research labs, featuring:

- Fiber coupled interface
- Colocalized laser and e-beam excitations
- Fully computer controlled
- Multi-wavelengths Raman lasers
- Injection-rejection Raman filters
- Field upgradeable
- Built-in video camera

# Ultimate User Experience
## with LabSpec 6 Software

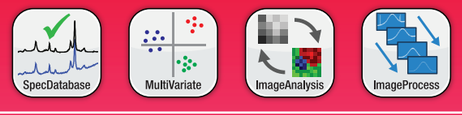
The core of the CLUE series is LabSpec 6™ software, concentrating the power of advanced spectrum analysis, the best imaging and automation and unrivaled ease of use.
LabSpec 6™ stands at the forefront of mosaic visualization, 2D & 3D hyperspectral imaging with built-in multivariate analysis, automated Particle analysis, multi-units (eV, nm, $cm^{-1}$…), spectral and intensity calibration.

## 3 Steps Workflow for Publication-Ready Results

### Ease-of-Use


Start with AutoCal to ensure your system is spectrally and intensity calibrated; then insert your collection mirror in OneClick™ and navigate in your low and high magnification sample image with the unique EasyNav™ app, get your particle size and shape distribution and automate their spectral analysis.

### Powerful Image Analysis




Easily identify present compounds by comparing unknown spectra with Raman spectral database, load spectra to create your multivariate analysis map and overlay the spectral image with SE image.

Automate processing of multiple images and runaway!

### Working Together


Because SEM is a multi-detector and multi-user instrument, our fully validated software allows to create multiple user accounts (administrator/operator), personalized hardware and software configurations. It includes as well templates for readily editable test reports.

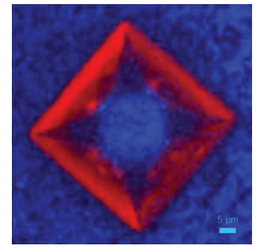
# The Best of Spectral Analysis
## For High Resolution Cathodoluminescence Images

Unveil every detail of minerals and zircons with high resolution CL images.
Map opto-electronic properties with nanometric scale resolution and reveal the true nature of ceramics, photonic nanomaterials, LED or photovoltaics thin-films, 2D heterostructures…

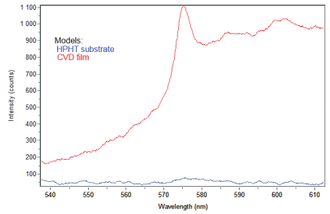
« H-CLUE unique achromatic design allows to measure easily CL signals even in the DUV, such like synthetic diamonds emissions. Its mirror is fully retractable; original configuration, performances and vacuum of SEM were not affected by the CL upgrade »

Dr A. Tallaire – CNRS - LSPM

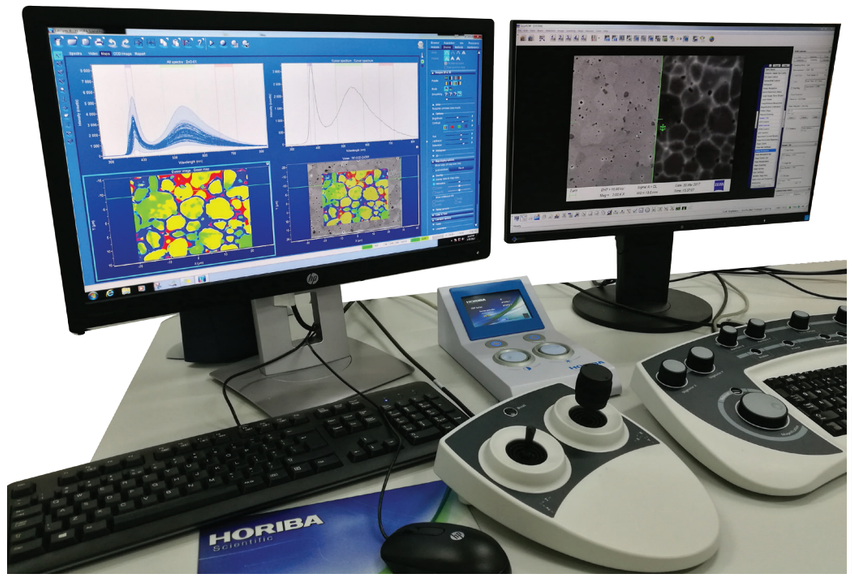
**Application note CL29*




*Classical Least Square fitting using multivariate analysis allowing the identification of the substrate and CVD layer region from their emission spectrum**




*Luminescence spectra corresponding to the central HPHT substrate region (blue) and to the lateral CVD film region (red). Bright emission from NV centers at 575 nm is detected.**




*Al doped ZnO ceramics hyperspectral CL image*
*Samples courtesy of Materials Genome Institute, Shanghai University, Professor Hui Gu*

HORIBA Scientific

Find out more at www.horiba.com/cathodoluminescence

| | Imaging CL | CL Imaging and Spectroscopy | | | Raman, CL and PL imaging and spectroscopy |
|---|---|---|---|---|---|
| | i-CLUE-e | F-CLUE-e | F-CLUE-p | H-CLUE-p | R-CLUE-p |
| Spectral range | Panchromatic CL | UV-VIS or VIS-NIR fiber dependent | | UV - VIS - NIR Free space achromatic coupling | UV-VIS or VIS-NIR fiber dependent |
| Diamond turned collection mirror | -ellipsoidal mirror short & long working distances | | -parabolic mirror short & long working distances | | |
| 200 mm retractable interface | Manual fine adjustment under vacuum | | Motorized with fine adjustment under vacuum | | |
| CL imaging detector | Panchromatic CL with ambient PMT | Standard: Panchromatic and monochromatic CL with ambient PMT Options: Cooled PMT, IGA monochannel, photon counting PMT, time resolved PMT, RGB filters | | | |
| CL spectrometer type | N/A Option upgrade to F-CLUE-e | microHR (180mm) or iHR 320 (320 mm focal length), up to 3 grating turret, up to 2-entrance / 2 exit | | iHR 320, iHR 550 (320 to 550 mm focal length), up to 3 grating turret, 2-entrance/2exit | |
| Upgrade available | Upgrade to F-CLUE-e | Upgrade from PL, MicOS systems | | | Upgrade from LabRAM HR Series |
| Electron beam control | SEM software | CL-LINK for multiple acquisition processing (Analog, pulse mode, SE), Mapping linescan, point measurement, Synchronization with spectroscopic detection, Control by external scan input of Electron Microscope | | | |
| Software | SEM software | Spectroscopy and imaging powered by LabSpec 6™ | | | |
| Remote Controller | Included | Optional | | | |
| CLUE Accessories | N/A | Polarization, ND filter, camera, EMCCD etc | | | |
| SEM Accessories | N/A | LN2, He cryo-stages, EBIC detector and many other accessories to complement our CLUE Series add-on detectors | | | |

λ = 325-1064nm P ≤ 500mW
VISIBLE AND/OR INVISIBLE LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 3B LASER PRODUCT

CE

JOBIN YVON Technology



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