Trace Evidence

A range of systems for the examination and analysis of forensic trace evidence

foster+freeman

Forensic Science Equipment

foster+freeman

Improving the Quality of Forensic Evidence

Foster + Freeman are innovators in the design and manufacture of systems for the examination of questioned documents, latent fingerprints, trace evidence and shoe prints.

Founded in 1978 the company's reputation has been built upon the development of leading edge forensic technology.

Foster + Freeman products are used by all major police forces and forensic science laboratories worldwide as well as government agencies, commercial and private organisations such as homeland security, immigration authorities, security printers, lottery companies, university departments and national libraries.

With offices in the UK and the USA, and a global network of agents and distributors, Foster + Freeman are able to provide customers with a high level of technical support, installation and training.

Foster + Freeman's range of systems for the examination of Trace Evidence was re-shaped in 2011 through the introduction of the ffTA, a unique modular system that provides multiple facilities on a single microscope. This one instrument alone provides the forensic scientist with a range of techniques, both new and old, for the examination and characterisation of trace evidence including:

Glass fragments
Bodily fluids including blood, semen and saliva
Gun shot residues and explosive materials
Drugs and illegal substances
Paint chips, pigments and stains
Organic and synthetic fibres

ffTA

a new concept from Foster + Freeman...

a system that provides a range of analytical facilities on a single microscope

Built around the Leica DM2500 laboratory microscope, the ffTA is a unique modular system that enables the user to add functions to meet specific laboratory requirements. Using an optical multiplexer the operator simply switches the image from one module to another.

ffTA modules are available for the following applications:

GLASS RI MEASUREMENT
Analysis and grouping of glass fragment data

RAMAN SPECTROSCOPY
For the study of paint chips, fibres, inks, drugs and illicit substances

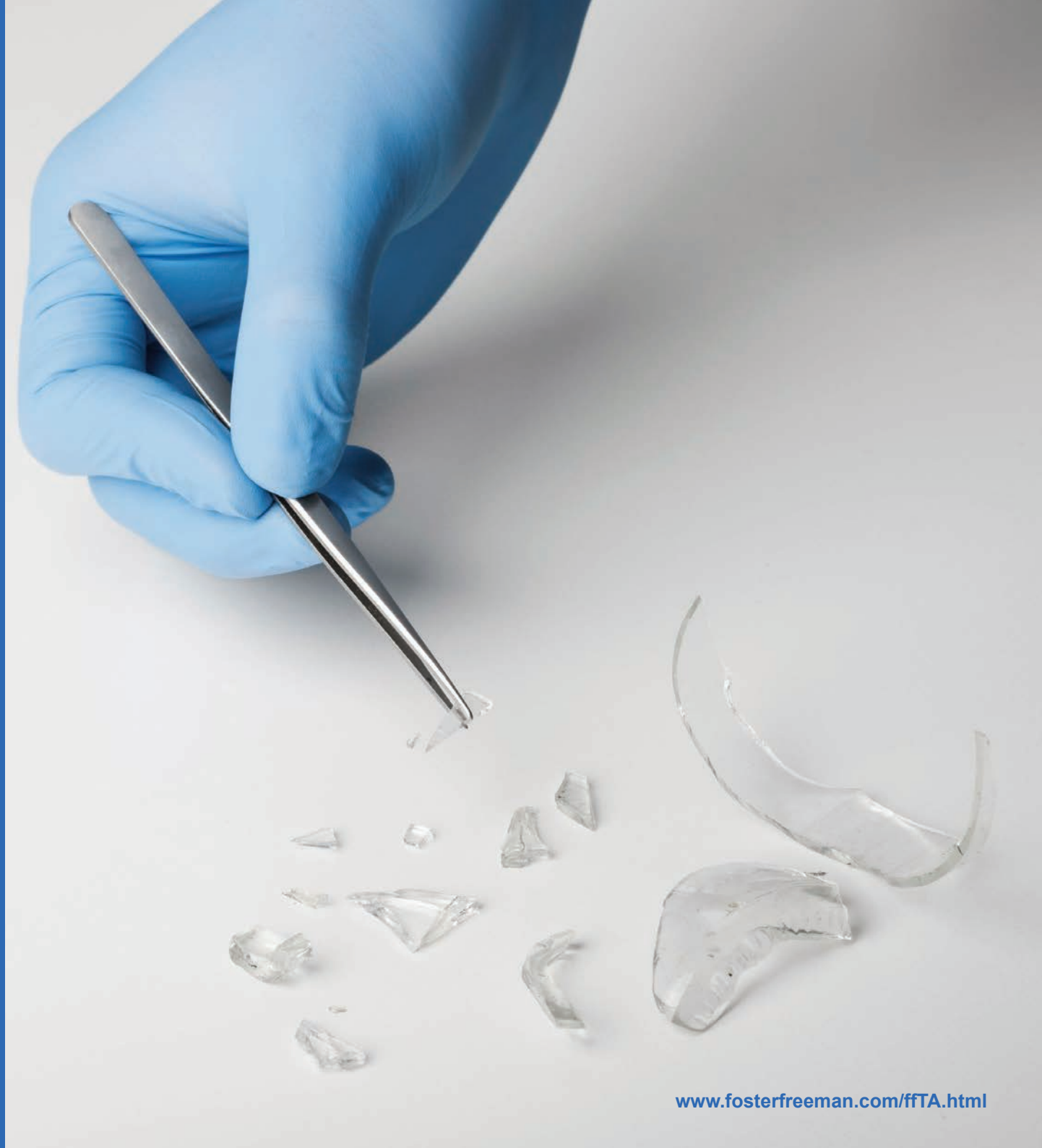
FLUORESCENT IMAGING
Identification of biological samples, chemicals, and illegal substances

IMAGE PROCESSING
Enhancement & comparison of captured digital images

MICRO-SPECTROSCOPY
Analysis of organic compounds including paint and fibres

LIGHT POLARISATION
For the examination and identification of natural and synthetic fibres

The unique design of the ffTA enables new modules to be integrated seamlessly with the user's existing system at any time.



www.fosterfreeman.com/ffTA.html

ffTA

Modular system for trace evidence examination

FORAM X3 Multi-wavelength Raman spectrometer module

Raman spectroscopy is a powerful analytical tool that is widely used in forensic science for the study of paint chips, fibres, inks and controlled substances, as well as residues from explosives, flammables and accelerants.

Specific to molecular structure, Raman spectra provide valuable "signatures" for comparing, and differentiating materials.

By installing the wide range of databases that Foster+Freeman offer, 'unknowns' can be identified, as most substances produce unique Raman spectra.

Equipped with three laser wavelengths 785nm, 638nm and 532nm, the Foram X3 module is a highly versatile device. High levels of sensitivity can be achieved with the 532nm laser, while the 785nm, infrared laser is better able to suppress fluorescence. A highly stable 638nm red laser provides a third option.

GRIM 3 Glass Refractive Index Measurement module

The ffTA GRIM system determines the refractive indices of glass using the standard oil immersion/temperature variation technique.

ffTA GRIM features include:
- Multiple edge measurements
- Calibration
- Enhanced casework documentation
- High level of temperature stability and accuracy

Using GRIM, repeat measurements produce results with a standard deviation of, typically, 0.00002RI over a 5 hour period and 0.00003RI over a 5 day period.

Glass Fragment Analyser
A software module that provides an interpretation tool to assist forensic experts in evaluating the results of glass RI measurements. The software includes two grouping algorithms and two match test options providing the examiner with the flexibility to select the most appropriate approach for their lab's quality requirements.

Micro-spectrometer module

A powerful analytical tool that is widely used in forensic science for the study and comparison of paint chips, fibres and inks.

Spectra in the visible region provide the user with objective measurements of colour and through the examination of ultra-violet and infra-red spectra, users are able to make comparisons between materials that may be indistinguishable to the naked eye.

Statistical analysis software offers the user further tools for discrimination.

The micro-spectrometer is available with three wavelength ranges:

- 240–1000nm; UV through to IR
- 240-830nm: UV to near IR
- 400–1000nm: Visible and IR

Features include:
- Fast non-destructive analysis
- Transmittance and Reflectance micro-spectrometry
- Optional fluorescence spectroscopy using Fluorescence Imaging module

Build a versatile system for trace evidence analysis to meet your laboratory requirements

ffTA

Modular trace evidence examination system

Image Processing module

A comprehensive module for processing images from the scientific grade CCD colour camera.

Functions include:

Image Enhancement
Contrast stretch, Noise Filters, Grey Level Equalization, Fast Fourier Transform, Gamma Correction, and Sharpen.

Image Analysis
Measurement of distance, angle and area with calibrated grids.

Image Annotation
Image annotation, including text, arrows, lines, boxes and circles.

Image Comparison & Transformations
Side-by-side comparison of live and stored images on a vertical or horizontal split screen with user adjustable split position. Superimposition and subtraction of live and stored image (option of red/green rendered images for extra clarity)

Fluorescence Imaging module

A widely used technique for the identification and comparison of trace materials including paint chips, fibres and biological materials.

Equipped with four excitation bandwidths: UV, Violet, Blue and Green, this module provides versatile high resolution imaging as well as a fluorescence imaging option when used with the Micro-spectrometer module.

Forensic Applications
- Identification of illegal substances
- Examination of accelerants (petrol, diesel, kerosene etc.)
- Imaging of biological samples

Additional Applications
- Anatomical pathology, diagnosis through live cell imaging
- Inspection of agricultural material
- Inspection of circuit lead bonds

Light Polarisation module

A module primarily used for the identification of fibres by the measurement of their cross polar birefringence.

In addition the ffTA Polarised Light Module can be used for the identification of chemical crystals (e.g. caffeine) rocks and minerals.

Consisting of a pair of polarisers, a retardation plate, and a 360-degree circular rotating specimen stage with Vernier scales, this module enables birefringence to be measured to an accuracy of 0.1 degree.

Applications include
- Detect fibres, crystals, and soil etc.
- Identify natural and synthetic fibres
- Toxicology and drug analysis

The ffTA's unique modular design allows new facilities to be added to an existing system at any time

ffTA

System and module specifications

ffTA ESSENTIALS

Leica DM2500 Microscope

2-step focusing drive
5 way nose-piece
ErgoStage with ceramic plate
XY stage control standard
Ground plate
Phototube switchable output trinocular
Lamp housing 107/2, 12V 100W, 1-lens

High resolution 5MP CCD camera
400-700nm spectral response
Approximate magnification range of x310-2500 at full resolution (using x5 - x40 objectives)
Fields of view: 1.5mm x 1.2mm to 0.21mm x 0.15mm, using x5 - x40 objectives.

Computer System (minimum specification)
Intel Quad or i5 equivalent
Windows operating system
24" flat panel monitor
Deskjet printer

Optical Multiplexer
1x input from microscope
3x selectable outputs

DM2500 OBJECTIVES

x5, x10, x20, x40

For use with ffTA 5MP camera or Micro-spectrometer

INCIDENT ILLUMINATION

Leica incident illumination package

12V 100W

LIGHT POLARISATION KIT

fixes to DM2500 microscope

52mm mounted linear polariser
Mounted analyser
Waveplate & quarter waveplate
Polarisation rotary stage

RAMAN SPECTROMETER

Lasers
532nm (nominal) solid state laser,
Maximum output 8mW

638nm (nominal) stabilised laser,
Maximum output 9mW

785nm (nominal) stabilised laser,
Maximum output 80mW

Spectrometer
Range, 2300 cm-1 to 4000 cm-1
FWHM resolution, better than 5 cm-1 & 785nm
Low elation CCD detector with Peltier cooling
Peak Quantum efficiency greater than 90%
Line binning and area read out of the detector

Software
Switch between laser wavelengths
Comparison and data processing routines
Automated background/fluorescence algorithms
Label and annotate spectra
Customised spectral library creation tool
Commercial Raman spectra libraries available

Calibration
Inbuilt ASTM automatic calibration standard
Optional NIST calibration standards

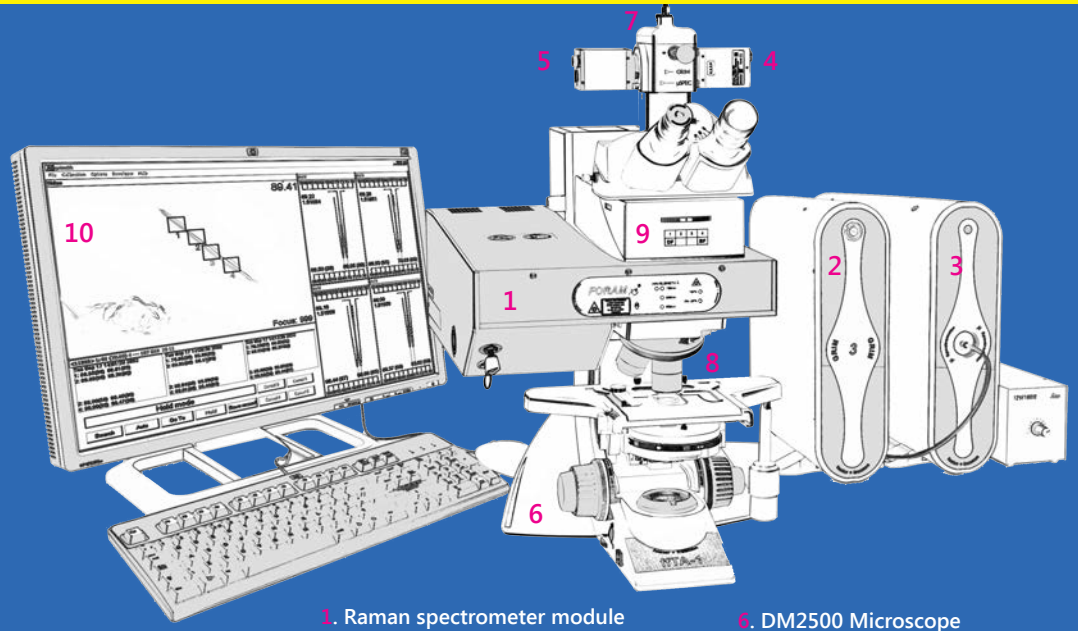
Safety
Class 3B laser instrument
Key switch and remote interlock for 785nm laser

CALIBRATION STANDARDS

Colour measurement
Labsphere SRS-99-010 Spectralon® 99% Diffuse Reflectance White Reference Calibration Standard
Calibrations are traceable to NIST standards

Fluorescence
Calibration standard for DM2500 microscope

NIST
NIST traceable wavelength calibration for use with the Microspectrometer
NIST correction standard for 785nm & 532nm Raman spectrometer lasers.



1. Raman spectrometer module
2. GRIM 3 module
3. Micro-spectrometer module
4. 5MP CCD camera
5. GRIM 3 FireWire video camera
6. DM2500 Microscope
7. Optical multiplexer
8. DM2500 objectives
9. Incident illumination package
10. PC and flat screen monitor

GLASS RI MEASUREMENT

GRIM 3 Processor unit
USB and FireWire connections for hotstage control.
Incorporating improved accuracy and temperature stability.

FireWire Video Camera
AVT Stingray monochrome

Phase ring & Focusing Telescope
Objective - Hi Plane 10x
Focusing telescope

Interference filters
488nm, 589nm and 656nm interference filters (50mm diameter)

Hotstage
Mettler FP82HT hotstage

Reference Oils & Glasses
Set of 19 reference glasses
Set of 3 purified silicon reference oils

UV-VIS-IR SPECTROMETERS

A choice of 3 spectrometer units

240-830nm
Range 240 – 830 nm, pixel resolution ~ 0.6 nm, FWHM resolution better than 1.98 nm

OR

240-1000nm
Range 240 – 1000 nm, pixel resolution 0.77, FWHM resolution better than 2.54 nm

OR

400-1000nm
Range 400-1000nm with a sub-5nm resolution, FWHM resolution better than 3nm

Foram

A range of Raman spectrometers with integral video microscopes for the analysis of forensic trace evidence

Raman spectra exhibit numerous features that are specific to molecular structure and provide valuable "signatures" for comparing and differentiating materials; their examination provides an ideal technique for evaluating trace evidence.

Foram is available with a choice of three laser wavelengths 785nm, 638nm and 532nm. High levels of sensitivity can be achieved with the 532nm laser, while the 785nm, infrared laser is better able to suppress fluorescence. A highly stable 638nm red laser provides a third option.

Instruments have an integral video microscope to assist sample selection, a large XYZ translation stage and dedicated software for analysis and database comparison.

- ***RAMAN SPECTRUM IN UNDER 1 MINUTE***
- ***VIDEO IMAGING WITH X Y TRANSLATION STAGE FOR PRECISE SAMPLE ALIGNMENT***
- ***CHOICE OF 532, 685 AND 785nm LASER WAVELENGTHS***

Foram

Raman Spectrometers

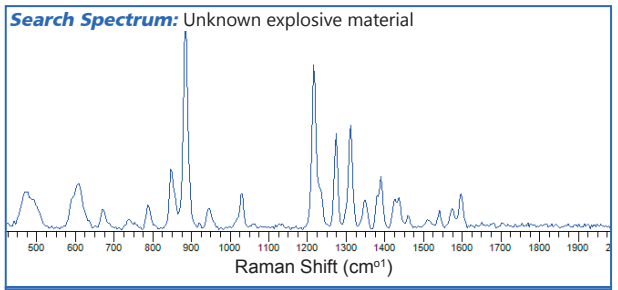
Rapid and accurate analysis and identification

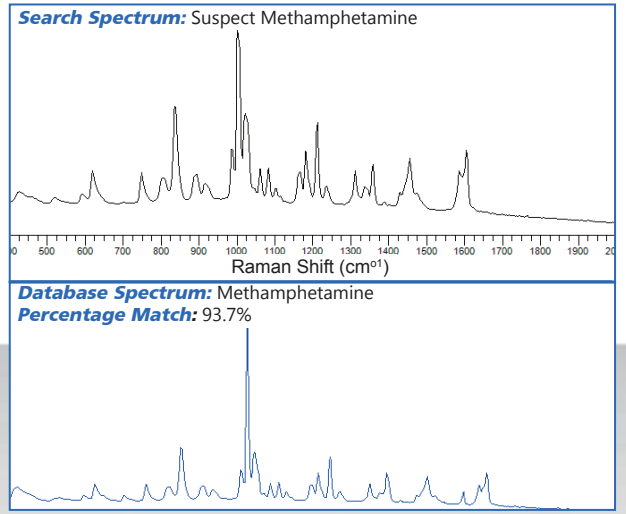
Using an integral video microscope with on-screen magnification of up to x450 on a 22" monitor, operators are able to select and analyse samples as small as 5 microns.

Spectrum comparisons are conducted using an automatic peak-to-peak correlator that determines the significance of a match by providing a simple numeric measure of the degree of similarity. Ideal for comparing large numbers of spectra and for database search and match enquiries.

Technical features

- External cavity laser for maximum stability.
- Low laser power for sample protection.
- Choice of laser wavelengths 532, 685 and 785nm.
- A4 size XY translation stage
- Integral video microscope providing up to x450 magnification.
- Minimum sample size of 5 microns diameter.
- Raman spectra libraries for identification.





Raman Spectra Libraries

Users of the Foster + Freeman Foram and ffTA Raman module can now further enhance the capability of their instruments through the use of Raman databases for the identification of unknown materials and compounds.

A comprehensive collection of libraries has been compiled by S.T. Japan and formatted for use with the Foram and ffTA systems. In total over 9,000 spectra of common and specialist materials are available divided into 20 categories.

Using the Foram software it is possible to search against spectral libraries providing details of the exact composition as well as all additional information such as manufacturer, lot number, appearance, purity, IUPAC name, common name, and other details.

Available Libraries include:

- Forensic compounds
- Pharmaceuticals, Drugs and Antibiotics
- Hazardous and Toxic Chemicals
- Dyes, Pigments, and Stains
- Solvents

ecco

For the elemental analysis of evidence

ECCO is a turnkey system designed for the elemental analysis of paper, glass, metals, paint, fibres, minerals and gunshot residues by laser induced breakdown spectroscopy (LIBS).

The system uses a high intensity pulsed laser focussed on to the sample to create a tiny plasma of vaporised matter which emits an atomic spectrum of the constituent elements. A database of emission lines provides automatic identification and labelling of elements present.

Analysis with ECCO is fast, simple to operate, requires minimal sample preparation, gives immediate results and is sensitive to low parts per million. LIBS offers significant advantages in speed, sensitivity and cost effectiveness over other processes such as XRF, SEM, and mass spectrometry.

- ***AUTOMATIC IDENTIFICATION OF ELEMENTS***
- ***MINIMAL SAMPLE PREPARATION***
- ***COMPARATIVE DISPLAY OF SPECTRA AND PEAK RATIOS***
- ***VIDEO IMAGING SYSTEM AIDS SAMPLE SELECTION***
- ***SAFETY INTERLOCKED SAMPLE CHAMBER***

www.fosterfreeman.com/ecco.html

ecco

Laser Induced Breakdown Spectroscopy

Cost effective elemental analysis

Detects elements XRF is insensitive to

No sample preparation

Minimal user training

Automatically identifies most elements

Gun shot residues

Gun shot residue consisting of particles containing the elements barium, lead and antimony are frequently found on the arms and clothing of a shooter after a firearm discharge. Laser induced breakdown spectroscopy is a rapid method of detecting these elements and is an ideal technique for screening swabs from suspects' hands.

Examination of glass evidence

LIBS can be used to identify many of the elements present in glass as well as minor and trace elements down to concentrations of low PPM. In addition the ratios of the spectral peaks of minor and trace elements to those of the major elements are often effective in discriminating between glasses which cannot be separated by refractive index.

Illicit drug detection

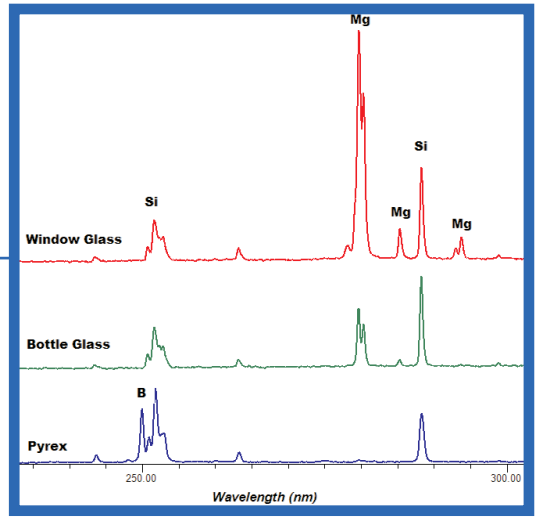
Substances used in the illicit manufacture of methamphetamine, such as lithium, phosphorous and iodine are readily identified with LIBS using ECCO. The identification of chemicals recovered from suspect laboratories can provide useful evidence in proving illicit drug manufacture.

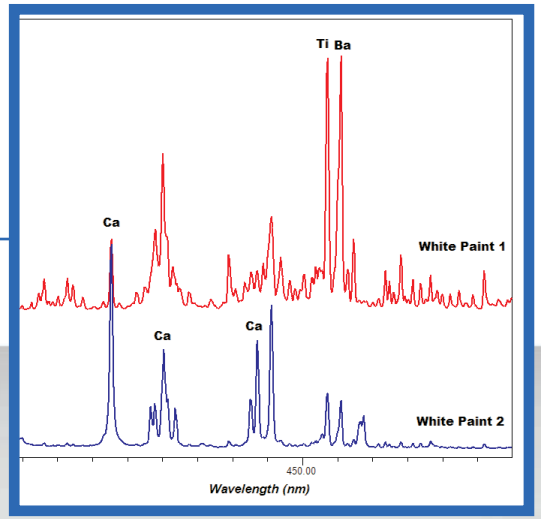
Questioned Document Examination

The ECCO is a fast method of detecting trace elements in paper and can be effective in discriminating between documents.

Paint analysis

Elemental analysis of paint can reveal differences in composition. Differences in the filler used in two white paints are readily apparent in these examples – $CaCO_3$ versus TiO_2 and $BaSO_4$.





Current Detectable Database Elements

Aluminium	Cadmium	Gold	Manganese	Silver
Antimony	Caesium	Indium	Mercury	Sodium
Arsenic	Calcium	Iodine	Nickel	Strontium
Barium	Carbon	Iron	Phosphorous	Thallium
Beryllium	Chromium	Lead	Potassium	Tin
Bismuth	Copper	Lithium	Rubidium	Titanium
Boron	Gallium	Magnesium	Silicon	Zinc

ECCO Specifications

- Air cooled 60 mJ Nd:YAG laser running at 0.5 Hz, at 1064 nm, laser energy stability of +/- 2%.
- Wavelength range of 225–930nm, resolution of 0.14nm
- Spectrometer dynamic range of ~60,000
- CMOS detector with up to 60% Quantum efficiency
- PC driven using bespoke Windows software package
- Integral colour CCD video camera
- Digital zoom and sample measurement
- XYZ sample positioning stage
- Element identification library
- Interlocked sample chamber

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