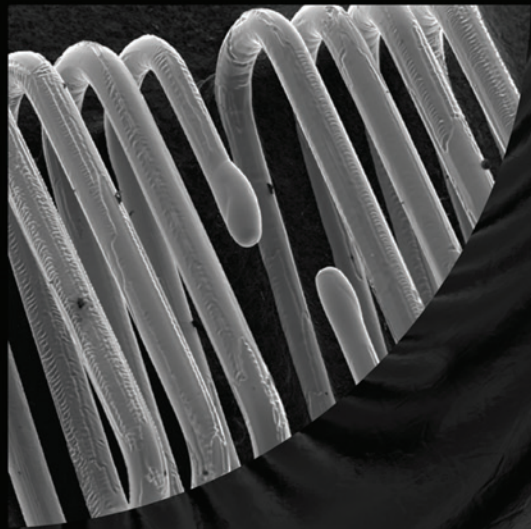
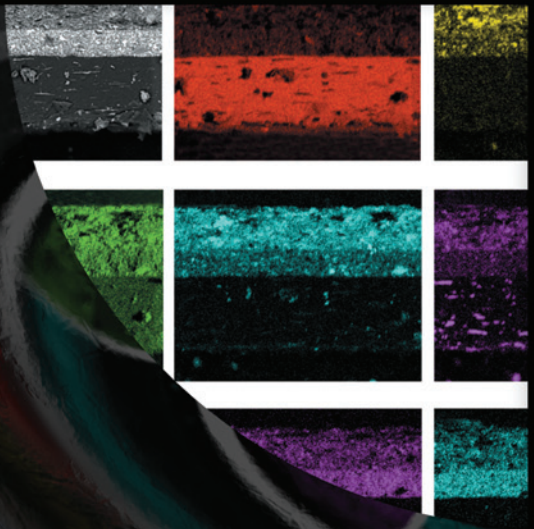
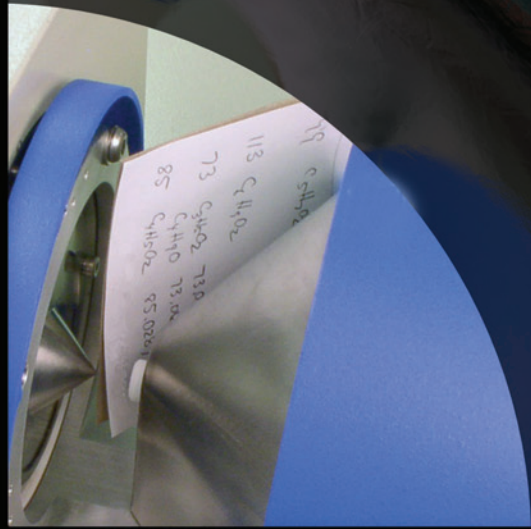
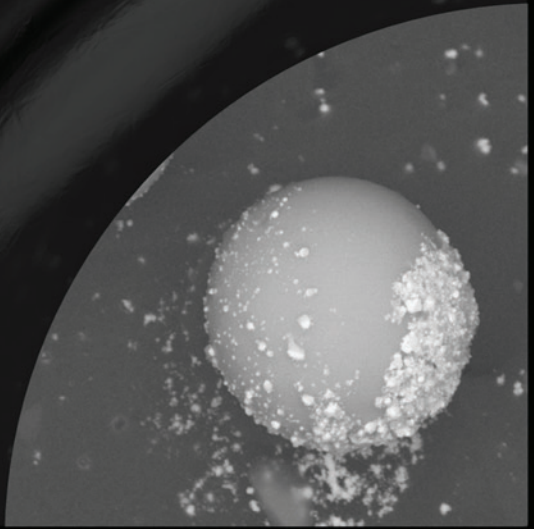


# Forensic Analysis

Scanning Electron Microscopy  
Mass Spectrometry



# JEOL

# Forensic SEMs

*JEOL, a world leader in SEM technology for six decades, offers scanning electron microscopes that enable imaging and analysis of the smallest details in forensic microscopy. JEOL SEMs are used for crime scene investigation, accident reconstruction, ballistics, explosives detection, toxicology, arson investigation, automated gun shot residue analysis, trace evidence, and failure analysis. The imaging and analytical ability of JEOL SEMs reveal physical and chemical evidence that might otherwise be easily overlooked.*



*JSM-6610LV  
scanning electron microscope*

## A Closer Look

The JEOL JSM-6610LV SEM is a highly flexible, high performance SEM uniquely suited to the investigative needs of crime laboratories and forensic science centers. The JSM-6610LV is ideal for forensic microscopy of trace evidence and automated GSR. Investigators can calculate 3D measurements from stereo images, contrast and compare fine details, and determine elemental composition. With its large specimen chamber and automated eucentric stage, the JSM-6610LV can accommodate large pieces of evidence in their native state for both imaging and chemical analysis.

### Focus on the Evidence

- Wide magnification range of 5X – 300,000X (at 4 x 5” print size)
- Smart settings for point and shoot imaging
- Large field of view
- Superior resolution at the analytical working distance
- Automatically tilt, translate, and rotate objects

### Preserve the Evidence

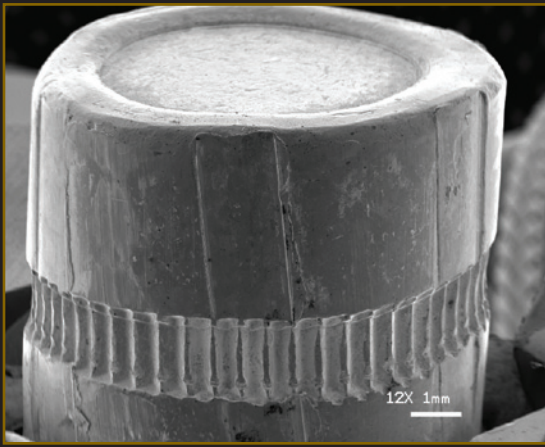
- Largest available chamber accommodates samples up to 12” in length and allows complete view of samples up to 200mm in diameter
- Robust, motorized/automated computer eucentric stage allows placement of objects directly under lens
- Non-destructive analysis – view and analyze nonconductive and wet specimens without coating or cutting

### Investigate and Compare

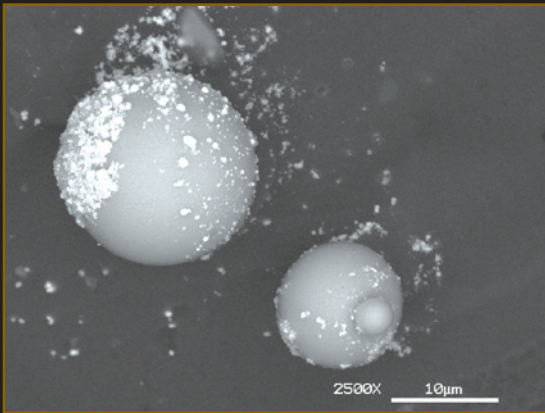
- Store and recall multiple image locations (stage coordinates) in memory
- Optional EDS and WDS (energy dispersive and wavelength dispersive X-ray analysis) for elemental analysis
- Dual live image display
- 3D imaging and metrology
- Live color image for point and shoot navigation

### Analyze with Ease

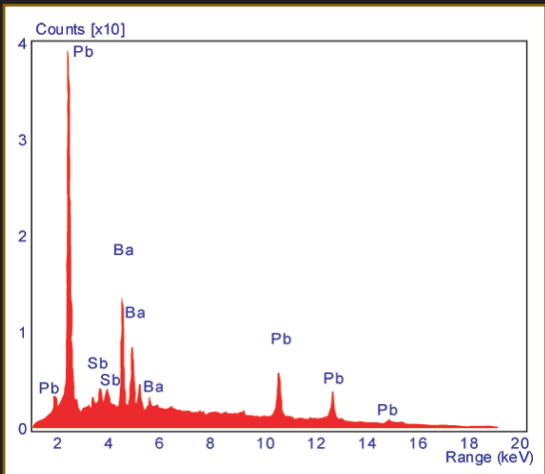
- Intuitive operation with graphical user interface
- Customized setup for multiple users
- Database storage, search, retrieval, and output of data



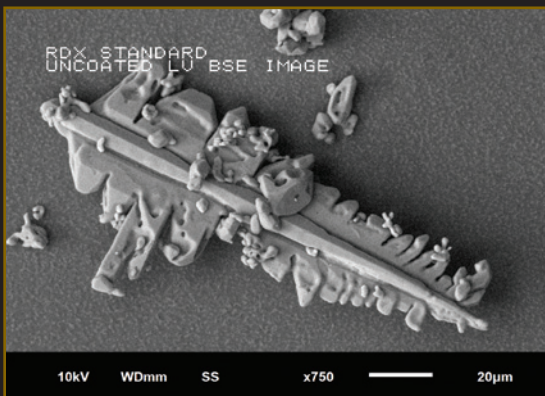
*Cartridge cases at low magnification*



*Gunshot residue*



*EDS spectrum of gunshot residue indicates presence of lead, barium, and antimony.*



*Explosive RDX*

## Ballistics Investigations

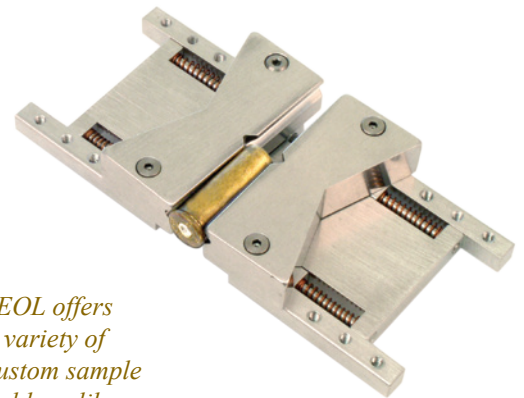
Firing pins, extractors, ejectors, and breech marks all leave what are known as “mechanical fingerprints” on the bullets and cartridge cases passing through the case-hardened action of a firearm. A forensic microscopist can locate, examine, and categorize and compare these marks using both the magnification and depth of field of an SEM.

The JSM-6610LV can also be used at extremely low magnification, allowing the microscopist to easily compare two reference images with a live image that can be rotated 360° until he finds a match. The SEM’s eucentric stage can be automatically tilted and rotated in five axes without losing image focus. The stage navigation software makes it easy to examine the sample at all magnifications and navigate to specific locations.

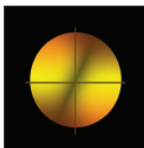
## Automated GSR

Forensic analysts identify gunshot residue (GSR) based on a combination of unique size, shape, and chemical composition. With the JEOL SEM, GSR samples can be analyzed, counted, and sorted in a completely automated procedure, freeing up the analyst to perform other tasks in the lab simultaneously.

The JSM-6610LV is configured with a new high-speed automated stage (for unattended overnight operation), a solid-state backscatter detector (to show atomic number contrast), and a combination EDS and WDS (wavelength dispersive X-ray) to identify elemental composition and allow sorting of particles into predefined classifications.



*JEOL offers a variety of custom sample holders, like this one for bullet casings.*

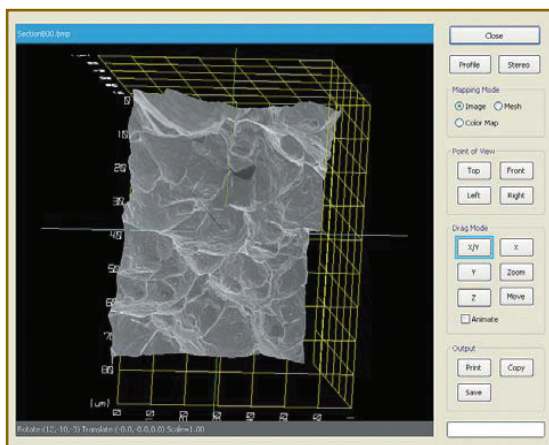


## Accident Reconstruction

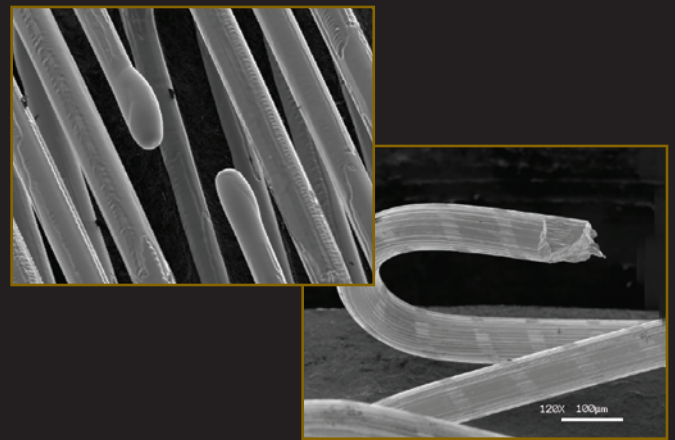
Were the vehicle's headlights off or on when the accident occurred? An SEM image of a headlight filament will reveal the truth. A cold, or sharp break in the filament indicates the lights were off. A hot break, where the ends of the filament are melted, indicates the lights were on. These details can easily be discovered through scanning electron microscopy. Microscopic details on seatbelts, odd shaped pieces of metal or plastic, and fabrics help piece together the evidence from a vehicular accident.

## Paint Chip Analysis

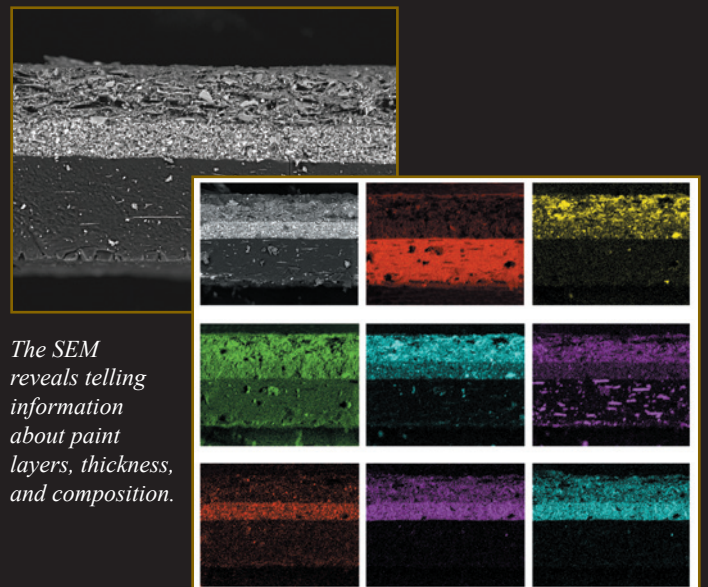
Paint chips are often used as evidence in a crime, for they have characteristics such as pigments, texture, thickness, number, and chemical composition of the paint layers that SEM imaging reveals. In addition to imaging the layers for comparison, the forensic microscopist can use the EDS to analyze the chemical composition of the paint. Composition is unique to the paint color and also to the manufacturer, which can confirm findings. Automotive paint can be compared to more than 40,000 samples in the National Automotive Paint File, helping identify color, make, model and year of an automobile.



*3D Sight software constructs a bird's eye view image from a pair of stereo images. You can measure height of surface morphology from this view.*

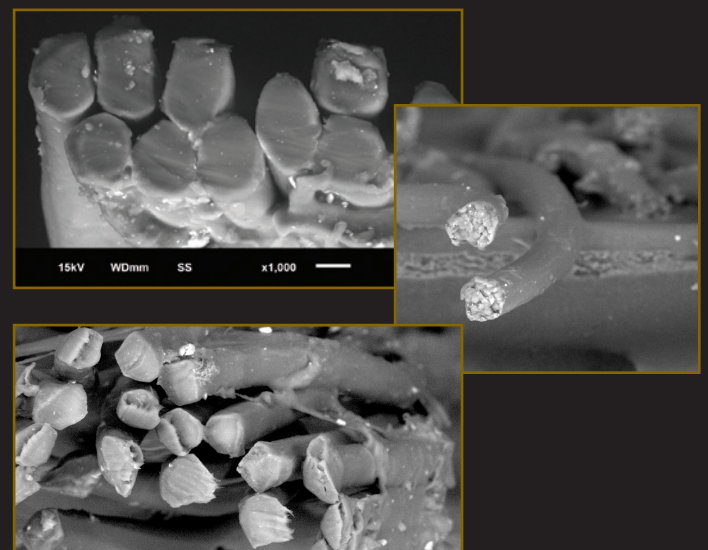


*The melted ends of a hot filament break indicate that the headlights were on when an accident occurred. Sharp ends indicate the headlights were off when the break occurred.*

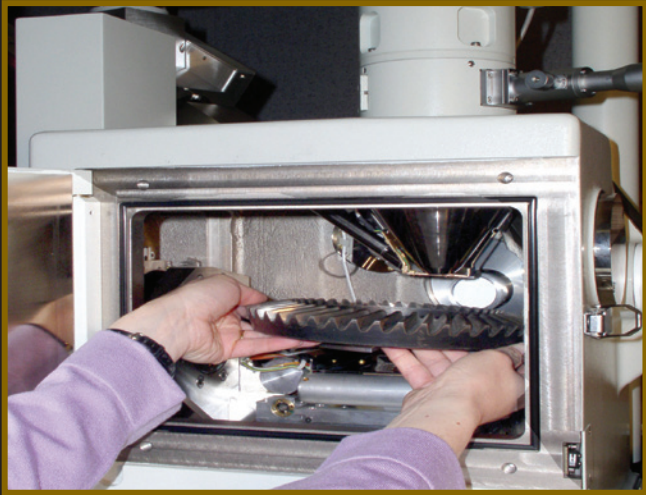


*The SEM reveals telling information about paint layers, thickness, and composition.*

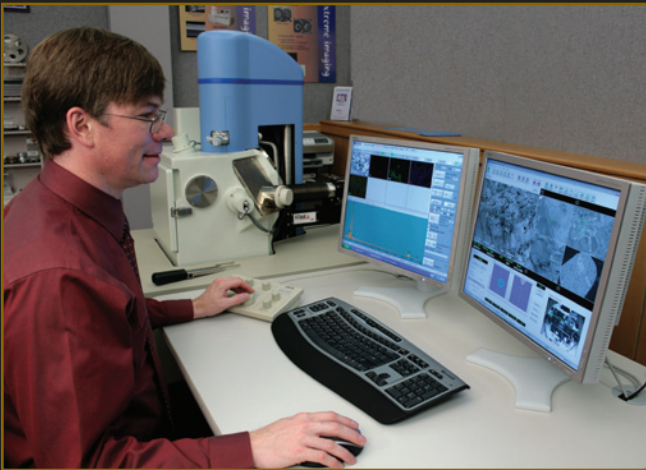
*EDS digital x-ray dot maps show chemical composition and elemental distribution.*



*Close inspection of fibers shows ends that were cut with a scalpel, torn, or cut with scissors.*



*The JSM-6610LV specimen chamber accommodates large pieces of evidence or entire machined pieces. The rear differential gear from a two-ton pickup truck is shown on the sample stage.*



*Graphical user interface is intuitive and allows simultaneous display of live images, reference images for stage navigation or comparison, and operation conditions.*



*The CarryScope SEM was installed in a mobile lab that was featured in a BBC television program.*

## Select the Right SEM for the Application

There's a good reason why crime labs and forensic examiners specify JEOL when they are looking for an SEM. It's the right instrument for the job. JEOL offers three SEMs that are ideal for forensic investigations:

The **JSM-6610LV** is designed to make examination of the evidence simple and operation of the instrument intuitive. Large, odd-shaped specimens are placed directly on the stage under the lens, giving the operator immediate visual confirmation of the area to be scanned. Tiny fibers or samples of soil or gunshot residue can be placed in specially-designed holders that are easily manipulated.

The **CarryScope** is a smaller, mobile SEM that can easily be transported from lab to lab. It plugs into a 110 volt wall outlet and requires no water.

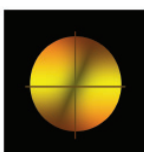
The **NeoScope** is a point-and-shoot benchtop SEM for trace evidence imaging. It features a high depth of field at up to 20,000X magnification and selectable low and high vacuum settings.



*The NeoScope tabletop SEM for up to 20,000X magnifications at large depth of field.*



*The CarryScope mobile SEM is self-contained in one cabinet for easy transport between labs.*



# Mass Spectrometry

*White powders, traces of unknown explosives, illicit drugs, inks and dyes, fingerprints, and bodily fluids all have unique chemical compositions that provide clues to their identity when analyzed by mass spectrometry. JEOL offers a unique solution for real time analysis that frees the investigator from typical sample preparation and provides instant results.*



## **Instantly Analyze Time-Critical Samples**

With the AccuTOF-DART™, the analyst can rapidly and unambiguously detect a wide variety of analytes under ambient conditions. The high resolution, time-of-flight AccuTOF mass spectrometer, combined with the Direct Analysis in Real Time (DART) open air ionization source, allows instant detection of trace levels of unknown substances directly from surfaces, liquids, and vapors with minimal or no sample preparation.

## **Direct Analysis in Real Time (DART)**

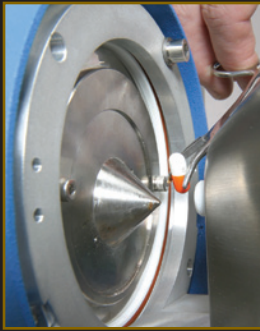
- Instant detection directly from the evidence without sample preparation
- Clean, easily interpreted mass spectra free of artifacts

## **Identify Unknown Substances**

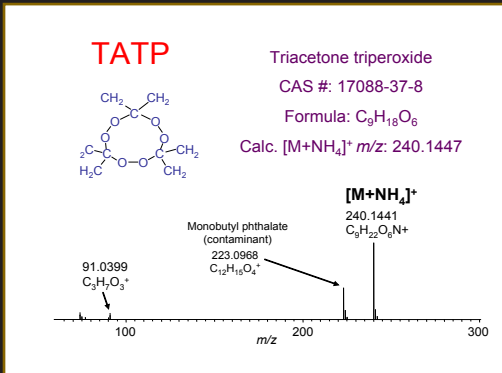
- Exact mass measurement reduces occurrence of false positives
- Searchable library of mass spectra confirms analysis



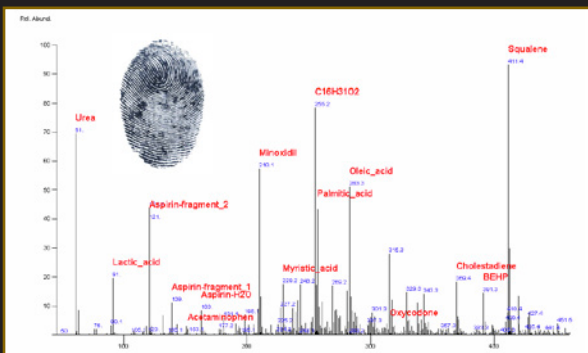
*AccuTOF-DART mass spectrometer*



Drugs can be identified directly from the pill or capsule without alteration.



Recent world events have highlighted the use of triacetone triperoxide (TATP), a peroxide-based explosive (above), and melamine (below). Both have been analyzed with AccuTOF-DART.



Fingerprint analysis directly from a surface detects contact information.

## Drugs

The AccuTOF-DART instantly detects drug residues on surfaces such as currency, clothing, and facial tissue. Dozens of licit and illicit drugs have been successfully analyzed, including steroids, amphetamines, opiates, cocaine, LSD, tranquilizers, and narcotic analgesics. AccuTOF-DART accurately identified GHB from a drinking glass, and cocaine and Ritalin from dollar bills.

## Fingerprints and Bodily Fluids

Direct analysis combined with exact mass measurement detects trace amounts of chemicals transferred from a fingertip to a secondary material. In one test, the AccuTOF-DART detected the presence of TNT after the 52nd fingerprint in a series taken after handling the substance. AccuTOF-DART can also rapidly screen large numbers of body fluid samples for expected and unexpected substances.

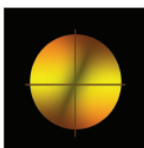
## Explosives, Chemical Warfare Agents, and Arson Accelerants

No explosive has yet been found that AccuTOF-DART has not rapidly detected, including the military compounds RDX and HMX which have very low vapor pressures. Additionally, the AccuTOF-DART has detected peroxide-based explosives, HMTD, TATP, and TNT, which was detected directly from the tie a man was wearing when he walked past a blasting site. The chemical warfare agent VX was detected in a concrete sample long after exposure at a test site. Accelerants absorbed into substrates such as carpeting have produced clean mass spectra with nearly invisible background peaks.

## Questioned Documents - Inks, Dyes, Adhesives

As a method of identifying inks on paper, the DART eliminates all sample preparation. The analyst need only place the holograph in front of the ion source to produce a mass spectrum for the manufacturer's formulation. Currency-pack dyes can easily be detected directly from clothing or fingerprints.

Applications notes and a bibliography of relevant papers are available online at [www.jeolusa.com/ForensicDART](http://www.jeolusa.com/ForensicDART).



## Customer Commitment

Since 1949, the JEOL legacy has been one of dedication to supporting its customers and innovation in developing leading-edge analytical instruments. JEOL produces a broad line of mass spectrometers, NMR spectrometers, scanning probe microscopes, and electron microscopes for research applications, as well as tools used in the production and research of semiconductor devices. An ISO 9001-registered company with more than 50 years of manufacturing excellence, JEOL provides sales support and award-winning service through its wholly-owned U.S. subsidiary headquartered in Peabody, Massachusetts. Peabody is also the center for the JEOL Training Institute, where we ensure that users of our instruments are fully trained in all aspects of operation. We have two full-time demonstration/applications support facilities: one in Peabody and one in Pleasanton, California.

JEOL is committed to the support of your instrument for as long as you own it. We make service and support as easy as possible to obtain. Applications chemists and microscopists are available to answer your questions or to provide help either by phone or by the Internet. We feel that customer support is one of the major reasons we have been in business for 60 years.

# JEOL

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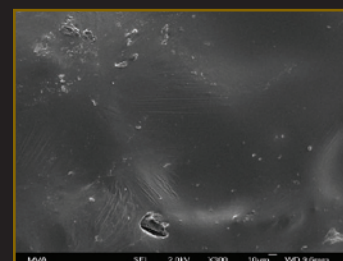
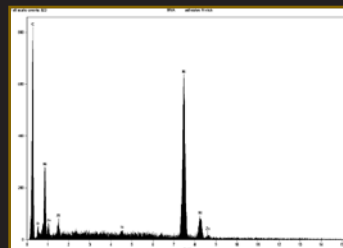
[www.jeolusa.com](http://www.jeolusa.com)

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## JEOL on the Case

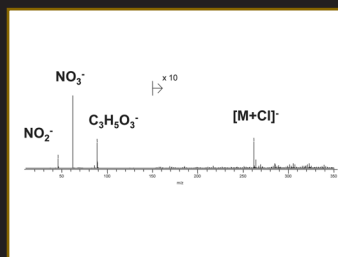


### SEM



*Metal particles from duct tape analyzed by MVA Scientific Consultants helped close the Shannon Melendi case ten years after the murder. See the full story at [www.jeolusa.com/realab](http://www.jeolusa.com/realab).*

### Mass Spec



*Direct analysis of tie worn by a pedestrian who walked past a blasting site confirmed the presence of TNT in the area. Read the applications note at [www.jeolusa.com/ForensicDART](http://www.jeolusa.com/ForensicDART).*