



Brasília's Instituto Nacional de Criminalística

Brazil Solves Big Crimes with Microscopic Images

DualBeam™ system plays vital role in providing critical forensic evidence

“We chose FEI equipment for its versatility...we can use low or environmental vacuum without any preparation on uncoated samples.”

— Sara Lais Rahal Lenharo
lab supervisor and crime investigator

The Microscopic Analysis Laboratory in Brasília is part of the Ballistic Service of the National Criminalistic Institute (INC) of the Federal Police Department. As a branch of the Ministry of Justice, INC has jurisdiction over violations of federal crimes in Brazilian territory.

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Brasília's Instituto Nacional de Criminalística (INC/National Criminalistic Institute) Microscopic Analysis Lab is the central crime lab for Brazil's Federal Police Department. The lab is responsible for forensic activities including collection, analysis, and interpretation of crime evidence. The lab's mission is to rapidly characterize evidence found at crime scenes. To help solve crimes at the microscopic level, the lab acquired the FEI Quanta 200 3D DualBeam™ system and micro-X-ray diffraction equipment to:

- Collect, evaluate, and interpret crime scene evidence
- Produce results quickly to protect public safety
- Preserve evidence through non-destructive analysis methods

The Challenge

Before acquiring the Quanta 200 3D system, the lab did not have any SEMs (scanning electron microscopes) at the Federal Police facilities. When special crime cases came their way, the lab was forced to buy outside services to examine samples. “Before the Quanta acquisition, we had to find available equipment and hire it. Sometimes we had to travel to another city. We could not spend a lot of time analyzing detailed aspects. Nowadays, it is the opposite, we collaborate with the federal University of Brasília and federal research institutes analyzing their materials,” says Sara Lais Rahal Lenharo, lab supervisor and crime investigator at the Instituto Nacional de Criminalística of the Polícia Federal.

Why FEI?

The Quanta offered two key features considered essential for evaluating the forensic samples: the low vacuum capability and the combination of a SEM with a FIB (focused ion beam). The Quanta's ultra-low specimen chamber vacuum enables characterization at different humidity levels and temperatures. “We chose FEI equipment because of its versatility. It allows us to work in low and environmental vacuum conditions along with the FIB. We also knew FEI from previous experience. We contacted FEI technicians several times while working at other research institutes. These previous contacts with FEI contributed to our decision,” says Lenharo.

The Solution

The acquisition of the Quanta was made by the Brazilian Federal Police Department based on the nature of forensic evidence samples. Quanta's ability to operate in high, low, and environmental vacuum conditions with energy dispersive spectrometry (EDS), wavelength dispersive spectrometry (WDS) detectors, and FIB technology set it apart from competitors. According to Lenharo, "We apply the Quanta to solve a variety of forensic problems. It allows us to analyze dry material in high vacuum, such as gunshot residue [GSR]; fracture analysis in metals; rocks, soils and minerals analysis; jewel and gemstones; arts; vehicles; and construction paints. In addition, we can examine biological material using low or environmental vacuum without any preparation on uncoated samples."

Forensic analysis should provide rapid answers to enhance public security. "For example, we were given forged letters, allegedly sent from the president of Brazil, containing a wet, green powder presumed to be a chemical or biological weapon. Twenty-five letters were sent to embassies in Brasília. We analyzed samples in the Quanta and in less than 10 minutes, the granular texture and chemical composition was determined [Fig. 1]. The samples showed a harmless chemical composition of sodium, carbon, oxygen, and silicon. We got the news published in the media quickly," says Lenharo.

Another complex forensic analysis the lab performs is apposition chronology. This technique examines the crossing of ink strokes from both typed and handwritten letters inscribed on paper. The Quanta system has been used in several forensic cases to determine the sequence of pen strokes or printed type. Analysis also determines the thickness of the chalcography used in engraving security documents, such as paper currency, official stamps, etc. "Using SEM images with a tilt of 60 degrees, the sequence between the pen stroke and printed letter can be determined," says Lenharo (Fig. 2 and Fig. 3). "The size of the cuts are just a few microns [Fig. 4], causing

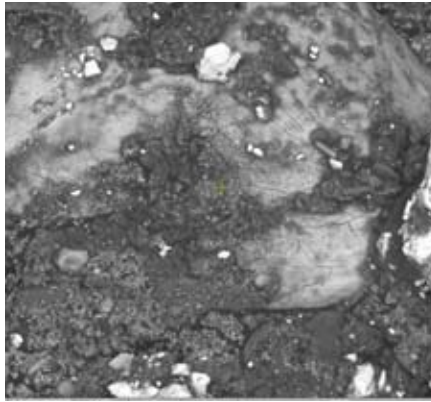


Fig. 1: SEM low vacuum image of green, wet powder with granular texture

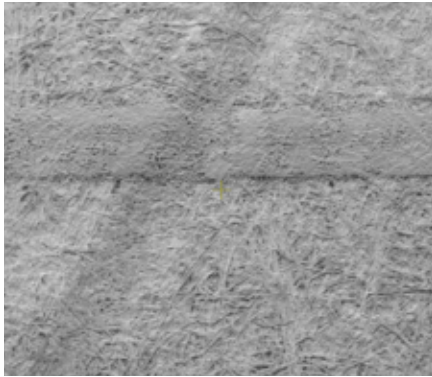


Fig. 3: SEM image with 60° of tilt—blue ink under laser-printed letter

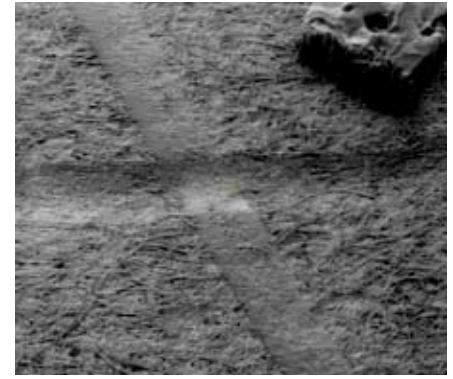


Fig. 2: SEM image with 60° of tilt—red ink over laser-printed letter

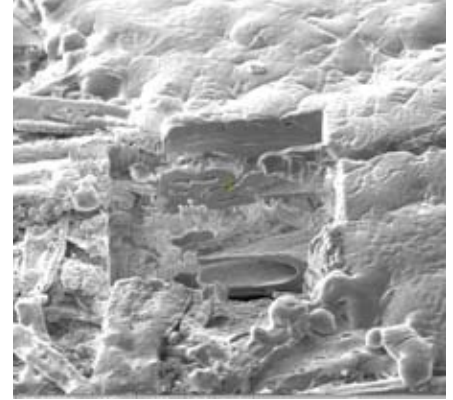


Fig. 4: Cross-section of a laser-printed letter on paper

minimal damage to the material evidence. To set up the conditions for document analysis, we consulted FEI's experts in Brazil, Germany, the Czech Republic, and the Netherlands to try to obtain similar results in their labs. FEI made suggestions about SEM voltage, vacuum conditions, and gas injection before and during the milling process. This was very helpful to us," says Lenharo.

The Result

"Before using the Quanta, we were discarding evidence due to inaccurate results," says Lenharo. "For example, GSR analysis using colorimetric methods was dubious, whereas using SEM analysis is certifiable. Results are produced in few hours. Today, we apply microscopic techniques and build new procedures to produce an accurate answer to forensic problems. More forensic areas benefit from the detailed knowledge of SEM and correlated techniques. The use of these high-tech instruments in forensic analysis has positioned the Brazilian Federal Police as a reference point for all crime labs in South America," concludes Lenharo.

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