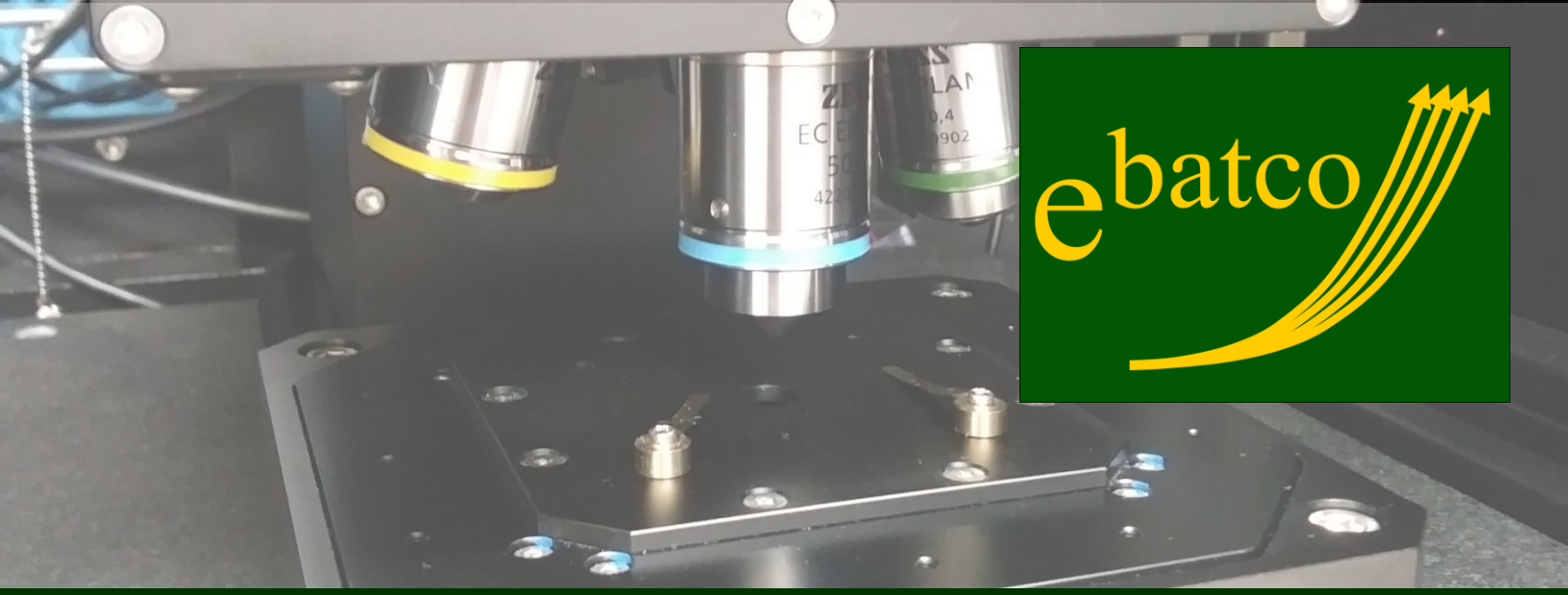

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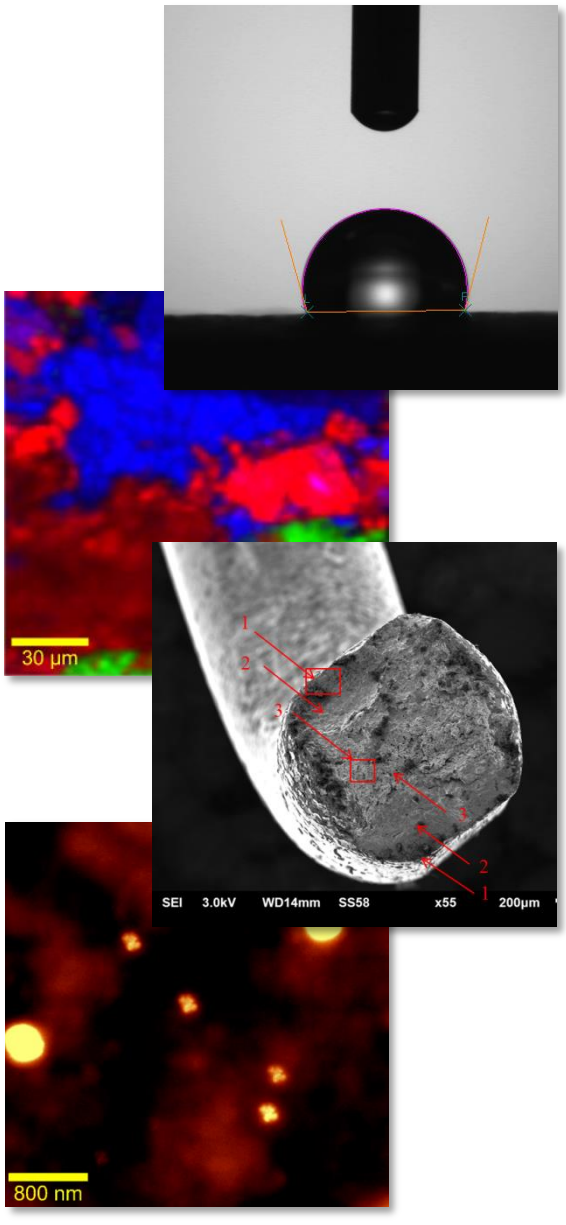

Analytical Lab Services for Litigation and Investigation

Tel: +1 (844) 332-2826, Fax: +1 (952) 746-8086, Email: natlab@ebatco.com

Introduction

When handling insurance claims, investigating accidents, or analyzing materials, it is imperative that you have a quality, certified testing lab at your disposal to ensure you can respond timely and accurately to both the expected and unpredictable demands of the investigative and litigation process. Having assisted the legal community for over 10 years, Ebatco is your choice to streamline your client support process. In addition to achieving ISO 17025 certification, we consistently strive to improve the quality of our offerings through the acquisition of instruments, standards, and novel analysis methods.

There are five prominent areas in which Ebatco serves the insurance community, running the gamut from investigative support to litigation assistance: insurance claims, accident reconstruction and failure analysis, proof and verification, investigation support, , and intellectual property. The following document explains some common situations that have arisen in the past associated with each testing area to provide you with an illustration of the type of work we do as it relates to the insurance and legal community.

Insurance Claims and Material Testing

Outside insurance companies often require independent analysis labs to determine liability. Through our expansive and accurate testing services Ebatco offers five distinct suites of tests to help assist liability claims: Surface Analysis, Chemical Analysis, Mechanical Analysis, Thermal Analysis, and Particulate Characterization. The suites and the associated tools are described in Table 1.

The Chemical Analysis suite offers powerful and rapid analysis of surface contamination, coatings analysis, grain size and arrangement, paint identification, residue characterization, active pharmaceutical ingredient (API) and excipient characterization, failure analysis, and a host of others.

As the only ISO-certified nano indentation analysis lab in the USA, Ebatco's mechanical analysis offerings are uniquely situation to deliver top-quality and high resolution characterization data, providing you with information regarding material hardness, failure analysis, elasticity, fatigue, and toughness.

The Thermal Analysis suite provides customers with compositional analysis, moisture content, contamination, humidity effects, and water loss analysis.

Our Particle Analysis offerings are vital to examining particle runoff, evaluating sanitation protocols, contamination, particle and grain analysis, and failure analysis.

Table 1 The Full Suite of Ebatco Analysis Tools and Analytical Tests

Suite	Tools and Tests
Mechanical Analysis	Nanoindentation, Microindentation, DMA, TMA, Young's modulus, glass transitions, coefficient of thermal expansion (CTE),
Chemical Analysis	FTIR microscopy, Raman microscopy, SEM/EDX, TGA/DSC, XRD, AFM
Surface/Interface Analysis	Microcontact Angle, surface free energy, surface tension, interfacial tension, reciprocating wear, pore sizing, Zeta potential, scratch testing, friction, high-load scratch, nanoscratch, microscratch,
Thermal Analysis	Thermogravimetric Analysis (TGA), glass transitions, Differential Scanning Calorimetry (DSC), enthalpy of melting, mass loss, evaporation kinetics
Particle Analysis	Dynamic Light Scattering (DLS), Particle Counting, laser diffraction, Zeta potential,

Accident Reconstruction Support and Failure Analysis

Ebatco can support your reconstruction efforts by analyzing samples taken from the scene and processing components of failures. Because of Ebatco's unique combination of mechanical, chemical, and thermal analysis characterization instrumentation, we are well-suited and experienced to characterize samples to support your reconstructions and failures. The cases below outline crack progression and failure analysis situations.

Case Study #1

Optical profilometry is one of the top choices for surface inspection at the nano and micro scale. The Wyko NT3300 Optical Profiler equipped at Ebatco's Nano Analytical and Testing Laboratory (NAT Lab) uses both vertical scanning interferometry and phase shift interferometry to characterize surface features. Sub-nanometer resolution in phase shift interferometry allows for precise surface feature and roughness analysis of smooth surfaces, while vertical scanning interferometry permits millimeter-sized object profiling and contouring. An obvious advantage of non-contact profilometry is its ability to make non-destructive and rapid analyses on specimen surfaces in contrast to contact based stylus measurements that are slow and that have to be in contact with the analysis surface.

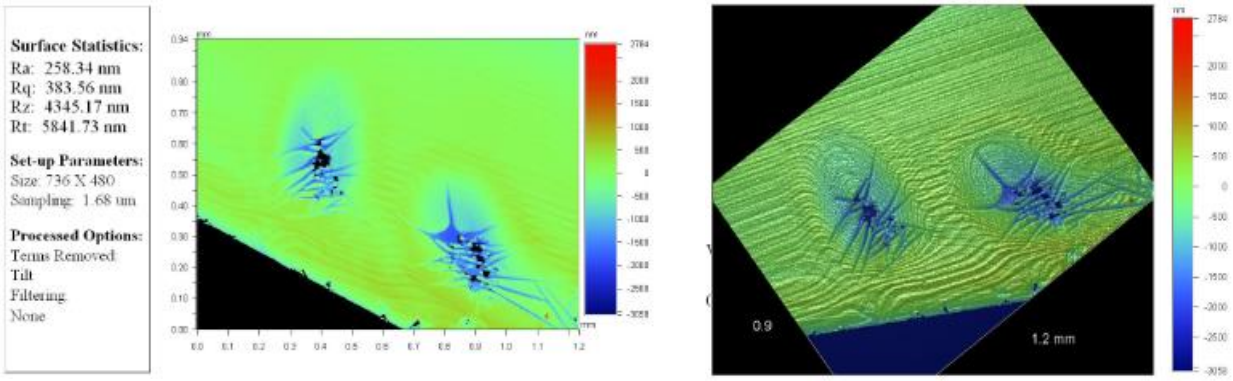

Figure 1. EDS map of different elements exposed during the cracking or scratching process.

Case Study #2

Figure 2 illustrates an SEM image of a steel wire failure. Bending of the wire back and forth has caused both sides of the wire to undergo compression and tension forces, and the final wire rupture.

Figure 2 shows the area close to the crack initiation region. In this image, the striations as typical fatigue characteristics caused by crack propagation can be easily seen. The image below at the right illustrates typical dimple structures from ductile fractures in the final fracture region. The dimples are formed due to high local plastic deformation during the final rupture of the wire.

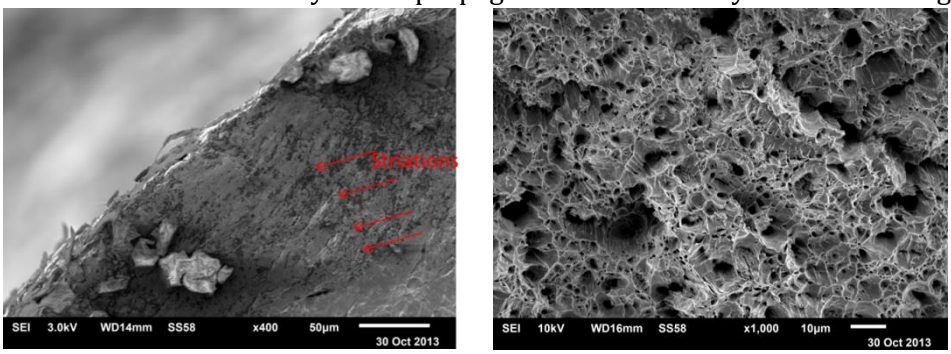

Figure 2. SEM image of a fractured steel wire (left). The areas of striations are viewed at higher magnifications (right).

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Proof and Verification

Whether you are looking to confirm, reject, or further define the details of patents or intellectual property, Ebatco's suites of tools can assist you. We can provide unparalleled support to the insurance and legal industry regarding documentation and identification analysis. The cases below illustrate verification situations.

Case Study #3

Raman microscopy can be used to quantitate the amounts of substances present in a pharmaceutical tablet. To determine the relative quantities of each of the active pharmaceutical ingredients (APIs: acetaminophen (blue), aspirin (red), and caffeine (green)) present in the pain relief tablet, 15 area maps were generated. Each area map covered an area of 150 µm x 150 µm at 75 pixels x 75 pixels (5625 total pixels each), and the integration time was 74 ms. Each scan took approximately 8 minutes, and the total acquisition time for all 15 scans was 120 minutes. The percentage of each API for each individual area map is shown in Figure 3 (bottom, left) along with the cumulative running average of each API (bottom, right). The relative amounts of acetaminophen, aspirin, and caffeine were determined to be 42 % ± 2 %, 45 % ± 2 %, 11 % ± 1 %, respectively. These values agree well with the packaging label, which indicated the relative amount of each API is 44 %, 44 %, 12 %, respectively.

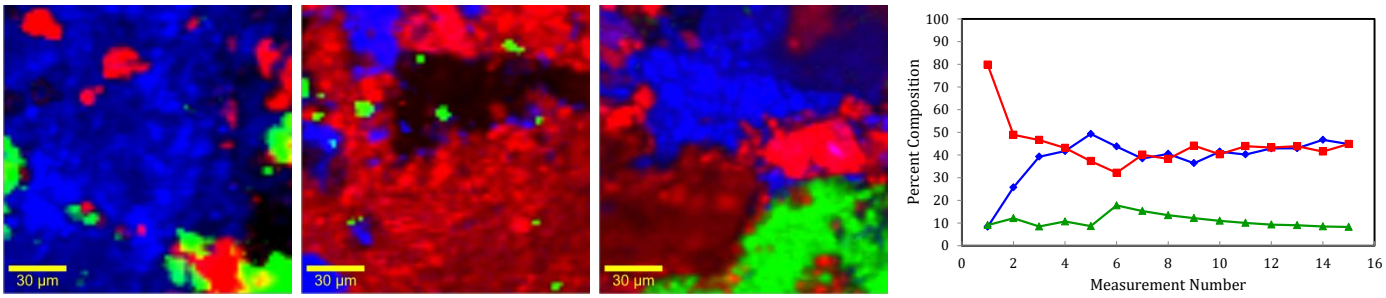


Figure 3. Three false color Raman images (left) show the locations of three APIs. The plot (right) shows how the relative amount of each API can be calculated by obtaining multiple Raman images.

Case Study #4

Fracture toughness is a measure of the material's ability to resist crack propagation and fracture under stress. Commonly used methods for evaluating fracture toughness of materials include bending, tension and impact tests of a specimen with a sharp crack or a defined notch. As regulated and recommended by many ASTM and international testing standards, these methods require the specimen with sufficient thickness and dimensions to ensure measurement validity. In many industrial and technical applications that involve small volume of materials, however, these requirements could not be practically met, for example in thin films, coatings, welds and miniaturized devices.

The unmet needs by the conventional fracture toughness measurement methods have offered an excellent opportunity for the nanoindentation based techniques that are developed for mechanical characterization of small volume materials at nanoscale. Benefited from the established model and in-situ scanning probe microscopy (SPM) imaging capability, fracture toughness measurement via nanoindentation has become a preferred technique for in-situ and small-volume fracture behavior study of materials.

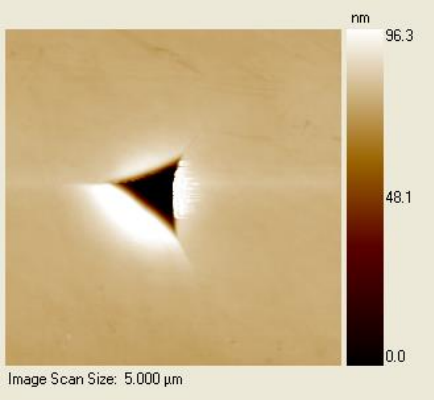


Figure 4. An indent is used to fracture the surface along the vertices of the indent.

Investigation Support

From investigating fire scenes, accidents, or other evidence, Ebatco is here to lend our state-of-the-art instrumentation and analytical tools to deliver quality and meaningful data. The case studies below show some of the investigative tools we have at our disposal to assist your efforts in particle, residue, or failure analysis.

Case Study #5

Corrosion is commonly related to many failures related to automobiles, buildings, and metallic structures. Working in tandem, SEM and EDS analyses can reveal a tremendous amount of useful information on corrosion processes and mechanisms, as well as material anti-corrosion properties. With the SEM system, micrographs can be taken for morphological inspection to understand how the corrosion surface is forming and changing. Pits, cracks, fractures and other microscopically observable characteristics of the corroded materials are useful to visualize what may have happened. In addition to SEM observations, the EDS system can further assist in identifying and quantifying the chemical compositions of the micro areas of interest by measuring the characteristic X-rays produced by atoms that are present in the lattice of the material when excited by electron bombardment. To obtain quick and accurate results, the EDS system in use operates using a peak to background ZAF algorithm analysis technique. This method utilizes the Bremsstrahlung X-rays created to calculate fundamental peak to background ratios which are then used to analyze the detected peak characteristic X-rays from the sample. This analysis procedure provides accurate results without the need for calibration using reference standards.

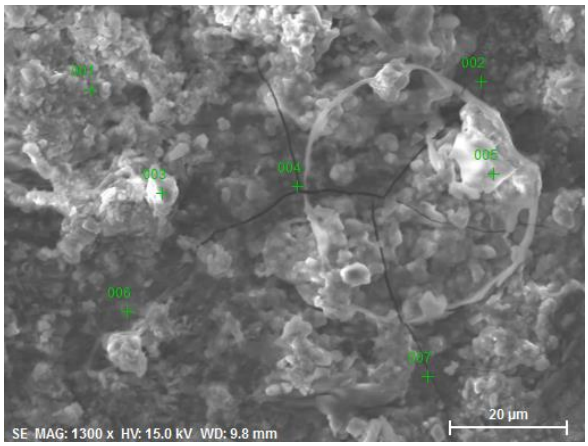
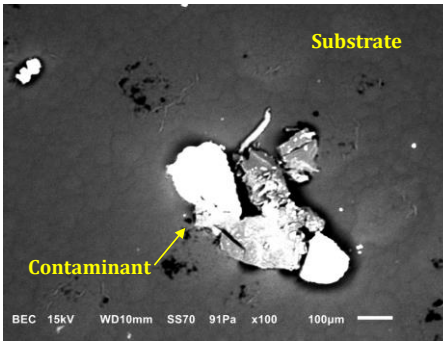


Figure 5. Micrograph image of corroded area, taken with SEM; EDS point analysis locations indicated in green numbers.

Case Study #6

Particulate matter is often found during the course of any investigation. By virtue of its selected area imaging controls, FTIR microscopy is well suited for particulate analysis. Illustrated here, FTIR imaging creates an extremely accessible route for particle analysis. While this particular example illustrates carbon tape contamination, the process could easily be extended to almost any particulate analysis. Furthermore, particle analysis is just one of many uses of the selected area imaging capabilities. The characterization of multicomponent systems will benefit from this feature including residues, polymers, ink samples, rock inclusions, pharmaceutical tablets, food ingredients, and many others.



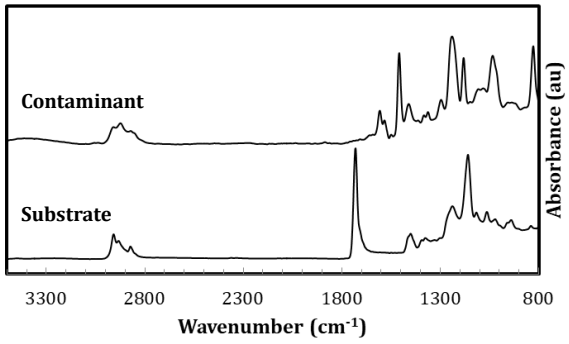


Figure 6. An SEM image of a contaminant particle on a black carbon tape substrate (left). The corresponding spectra obtained using FTIR microscopy are also shown (right).

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Litigation and IP Support

Ebatco can provide expert testimony, site investigation support, and data analysis assistance to help with patent verification, infringement, or other issues. Previously, we have assisted clients by providing patent claims support to help protect their intellectual property. We can also securely store evidence and invite parties to our facility to discuss and analyze data. A case related to wettability is described below.

Case Study #7

A material is considered hydrophilic, or water attracting, if the contact angle made by water on the substrate is less than 90°. This means that the water will wet the surface of the material and interact with the surface molecules. Hydrophobicity is a phenomenon that is observed when water is deposited on a substrate and the contact angle is 90° or higher. This means that water will be less likely to wet the surface or interact with the surface.

Water is used as the depositing liquid to test the contact angle with the surfaces, which will determine the wettability of each surface. To illustrate the degree of wettability on a desired substrate, water contact angles on both stainless steel and PTFE were investigated (Figure 7). It can be noted that surfaces with higher contact angles are less likely to have particles adhere to the surface and would be ideal when used in water-resistant applications.

At ambient laboratory temperature and humidity the contact angle of water on stainless steel is 74.1°, and the contact angle of water with PTFE is 109.3°. Due to this result, a correlation can be made that the water has a higher degree of wetting on the stainless steel substrate compared to that of PTFE. From a wetting and adhesion point of view, PTFE would be a better non-stick substrate than stainless steel.

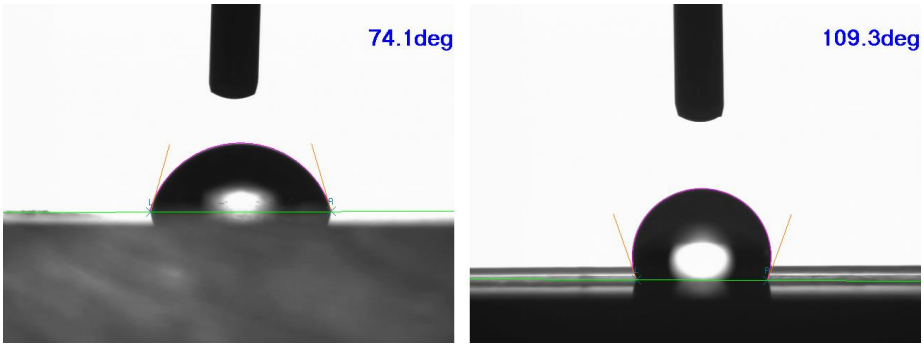

Figure 7. Water contact angle measurements on steel (left) and PTFE (right).