Elemental Scientific LASERS
INNOVATION TO ILLUMINATE

Poster Note

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Performance and Data from an Elemental Microscope - The imageBIO266

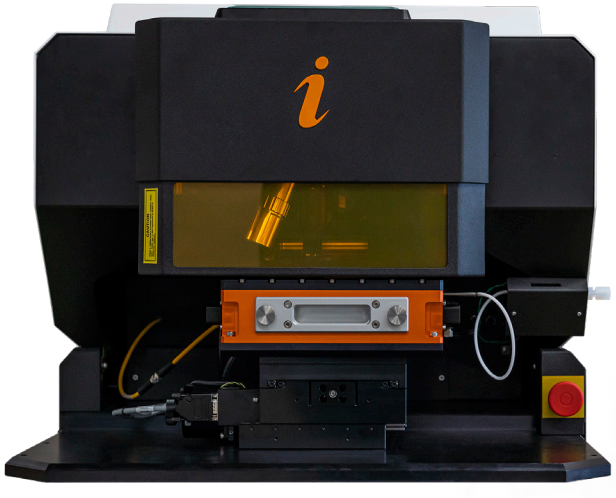
The imageBIO266 from Elemental Scientific

One of the most important growth areas in laser ablation is bioimaging, however, laser ablation systems designed for general use suffer from limitations brought on by compromises made to increase application range. Elemental Scientific has designed and built the imageBIO266 to be 100% optimized for bioimaging, especially to meet the industry's latest requirements for single cell imaging and high imaging speed. This has been combined with a laser source capable of delivering billions of shots with high stability and robustness.

In March 2015 the world's first elemental microscope – the imageBIO266 from Elemental Scientific – was delivered to Prof. Norbert Jakubowski at BAM (Bundesanstalt für Materialforschung und -prüfung).

The goal was to meet BAM's high expectations of:

- Genuine sub-micron ablation
- Ultra-fast sample washout
- High throughput, high resolution bioimaging



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Genuine Sub-Micron Ablation

Creating a beam delivery system that will deliver sub-micron ablations at cost-effective and useful wavelengths and pulse durations has long been a challenge since reducing the beam-sizing apertures results in diffraction, thereby imposing a lower limit on beam size. Elemental Scientific has designed a revolutionary beam train delivery system capable of genuine and confirmed sub-micron scale ablations at the sample surface – a first for laser ablation. This incredible feat opens up the possibilities of imaging at the sub-cellular level.

SEM image of a sub-micron ablation

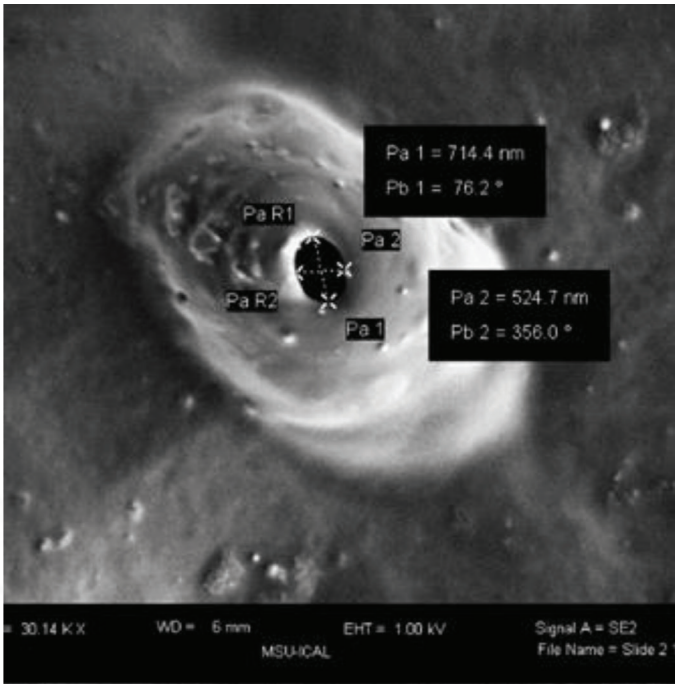

Figure 1. A SEM image of a sub-micron ablation (2 J/cm^2, 10 shots) on the surface of a compact disc, chosen as a substrate due to its uniform flatness and organic composition. Although slightly ellipsoid, the ablation is clean with no discernible damage corona. This is vital if small structures such a biological cells are interrogated by laser ablation as peripheral damage can cause structural changes in the yet-to-be-analyzed parts of the cell.

Ultra-Fast Sample Washout

Sub-micron ablation would be difficult for most ICP-MS systems to detect without an ultra-fast washout ablation cell, since washout rate is directly related to peak signal broadening and therefore overall peak height. Elemental Scientific has implemented the Dual Concentric Injector (DCI) sample transport technology developed at the University of Loughborough, which, when applied to Elemental Scientific's standard TwoVol2 ablation cell reduces the washout time from 750 ms to 20 ms.

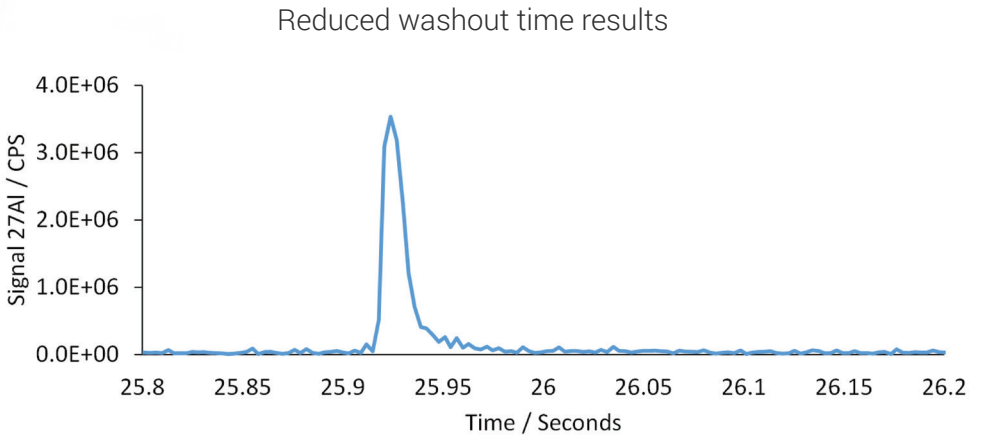

Figure 2. Computer generated result of washout time.

Ultrahigh Resolution Stages

Elemental Scientific has implemented floating stages to reduce the minimum step size and increase accuracy and precision at the micron level. The stage movement is directly linked to the cup centering motors in the TwoVol2 sample chamber to guarantee constant ablation transport geometry throughout the entire experiment.

Triple Objective Viewing System

Viewing samples at the sub-cellular level is not possible using a coaxial laser objective, so Elemental Scientific has integrated a motorized turret to automate viewing through a high powered secondary objective that is used only for sample viewing. A third objective lens is mounted on the same turret for sub-micron ablations.

Single Cell Imaging

The imageBIO266 has combined Elemental Scientific's strengths in engineering, laser manufacture, optical knowledge and experience, and skill in bioimaging to create the world's first bioimaging-specific laser ablation system, capable of rapid imaging and cellular analysis down to the sub-micron level.

The combination of a genuine sub-micron spot, ultrafast washout and high-precision, high-accuracy stages means that for the first time ever it is possible to truly image at the sub-micron level by LA-ICP-MS, which allows features such as the cell membranes and nuclei to be resolved.

Imaging with the DCI

The DCI is also available as a retrofit upgrade on all NWR (now ESL) systems. Recent studies have demonstrated that when applied to >micron scale imaging on a standard NWR platform the resulting images are acquired faster and at higher resolution due to the fast washout.