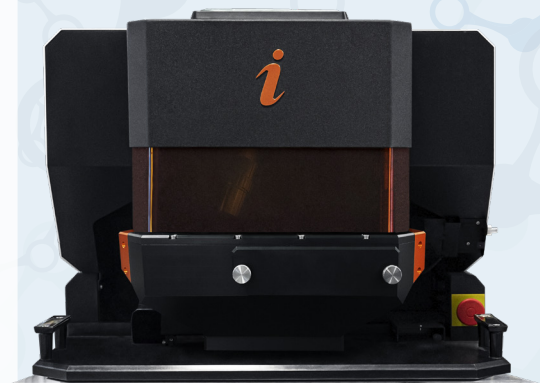


imageBIO266

imageBIO266,
biomaterial specific
266 nm laser system,
iolite TvTuner for
SPR optimization,
kHz Imaging, iolite 4
data analysis



Tristen Taylor, (ESL)

Keith Macaenaris (Quantitative Bio-Element Analysis and Mapping (QBEAM) Center, Michigan State University)

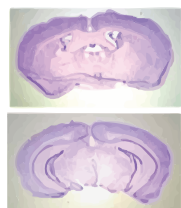
Pushing the boundaries of highspeed imaging: Exceeding 1000 Hz Bioimaging using the imageBIO266

Synopsis

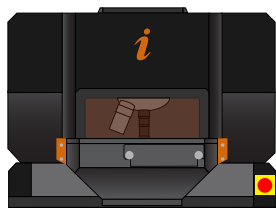
ESL's imageBIO266 routinely provides single pulse responses (SPR) of <1 ms at a dosage of 1, allowing high-speed imaging at a true 1000 pixels per second and above. An imageBIO266 coupled to an ICP-TOF-MS was configured for high-speed imaging (imaging cup and DCI2). The TvTuner software-addin was used to automatically optimize SPR in this work to <0.8 ms (Fig. 1). This short SPR allowed the image below (Fig. 2) to be collected at a record breaking 1001 Hz laser repetition rate without risk of image blur or the need for averaging of shots (dosages higher than 1). The 266 nm laser used in the imageBIO266 provides a large bandgap between

the ablation threshold of biological tissue and glass. This allows for the use of higher laser energies (compared to shorter wavelength systems) of up to ~4 J/cm², facilitating the quantitative ablation of the sample and the gelatin standard, at a dosage of 1, without ablating the glass below. For quantification gelatin standards were cryo-sectioned at the same thickness as the tissue sample and used to generate concentration maps via multi-point calibration in iolite 4. At the same thickness, the quantitative ablation of the sample and standard guarantees equal ablation yield for both measurements which negates the matrix effects and ensures accurate concentration information.

Sample Preparation



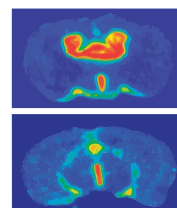
imageBIO266



Optimization



Quantitative Image Generation



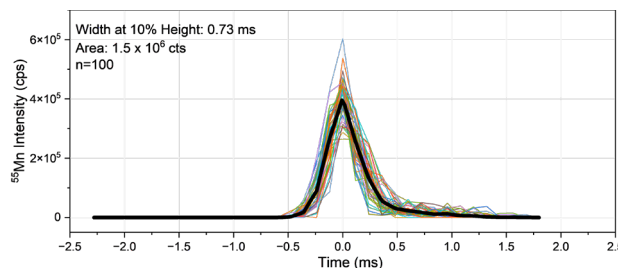
Analytical Workflow: Brain samples and gelatin standards are cryosectioned (10 micron thickness) onto glass microscope slides. TvTuner facilitates semiautomated (SPR) tuning for cup flow, cell flow, Z offset, laser fluence, spot size, and rep rate. The imageBIO266 laser ablation instrument and ICP-TOF-MS, both configured for high speed imaging applications were employed. iolite 4 data processing software was used to process the data including calibration and for image generation.



Learn More

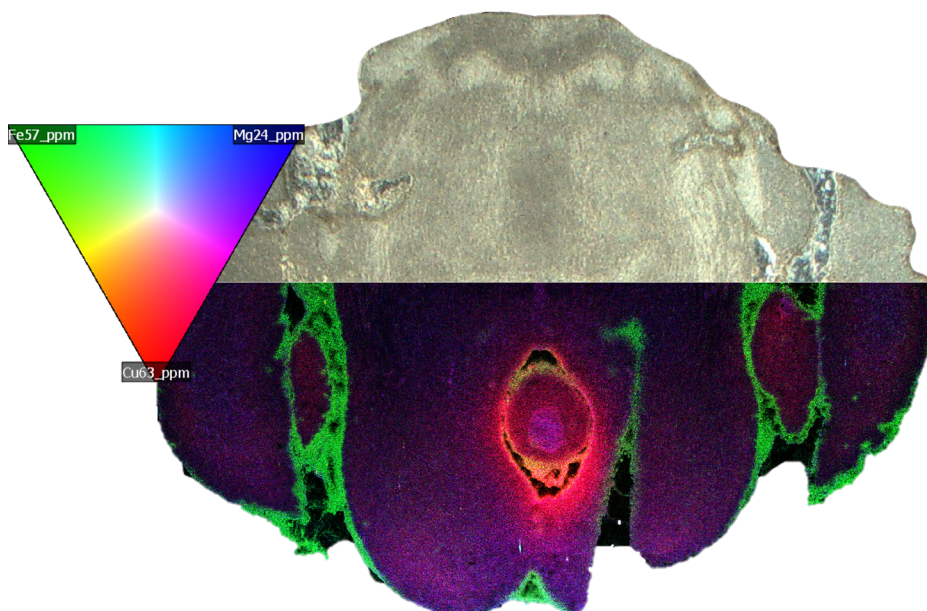
>1000 Hz Quantitative Bioimaging with the imageBIO266

Single Pulse Response (SPR) with TvTuner



TvTuner output of ^{55}Mn for 100 pulses. The average peak width measured is <0.75 ms.

LA-ICP-TOF-MS Image of a Mouse Brain



Mouse brain microscope image with overlaid (bottom) RGB quantitative elemental image showing the distribution of ^{57}Fe (G), ^{24}Mn (B), and ^{63}Cu (R) in ppm. Tissue section was 10 μm thick mapped using 5 x 5 μm spots at a dosage of 1, proving a mapping rate of 25 mm^2 per hour.

Conclusion

This work demonstrates the first example of quantitative elemental bioimaging at acquisition rates exceeding 1000 Hz. Critically, the imageBIO266 enabled a dosage of 1 to be used for both the sample and standard materials, ensuring quantitative ablation and eliminating matrix-related biases—key to accurate quantification. Beyond its exceptional analytical performance, the

imageBIO266 also offers practical advantages: it is a solid-state laser system that does not require expensive ArF gas, operates with air cooling (eliminating the need for water cooling), and features a highly durable optical design rated for billions of laser shots. Together, these attributes make the imageBIO266 an ideal platform for high-speed, quantitative bioimaging by LA-ICP-TOF-MS



© Elemental Scientific Lasers LLC | lasers@icpms.com | www.icpmslasers.com