

DESI XS – Designed to Deliver

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DESI XS – a new fully integrated source delivering improved build quality, reliability and simplicity for MS imaging.

GOAL

To introduce the new DESI™ XS MS imaging source, showcasing its design and construction, demonstrating the benefit of this fully integrated source to MS imaging customers.

BACKGROUND

For more than a decade Waters™ has been actively involved in the MS imaging technology space, with a focus on DESI imaging for the past 6 years. See Figure 1 for an overview of the major DESI milestones.

In order to build upon the continuing success in MS imaging, as of October 1, 2019, Waters acquired exclusive rights to DESI (Desorption Electrospray Ionization) technology from Prosofia Inc. and the Purdue Research Foundation. With commitment to DESI technology complementing existing MALDI technology, Waters is positioned to pursue an exciting future advancing the field of MS imaging.

Now, with in-house design it is possible to deliver a robust, re-engineered source designed to be fully compatible with the SELECT SERIES™ Cyclic™ IMS, SYNAPT™ XS, and Xevo™ G2-XS QToF mass spectrometers. The DESI XS source design not only provides a future-proof solution, it is simple to set-up and maintain, and ensures a consistent, high-level of performance to all imaging customers.

The DESI XS source (Figures 3–5) has been designed with the user in mind. Compared to previous DESI sources its concept delivers significantly improved build quality and reliability, allows rapid delivery of new source developments, and ensures future enhancements will integrate seamlessly – always keeping scientists ahead of the innovation curve for MS imaging.

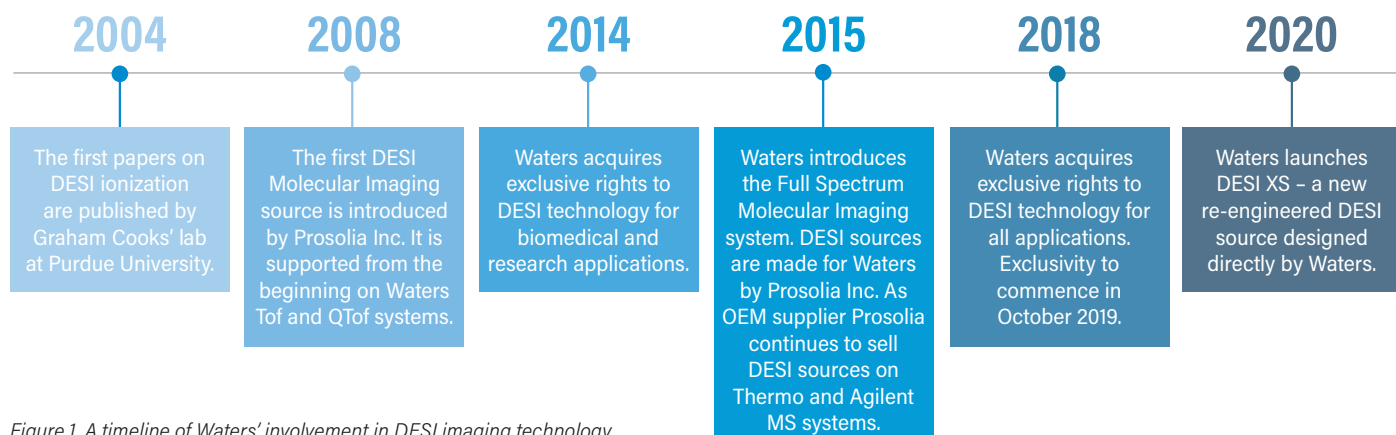


Figure 1. A timeline of Waters' involvement in DESI imaging technology.

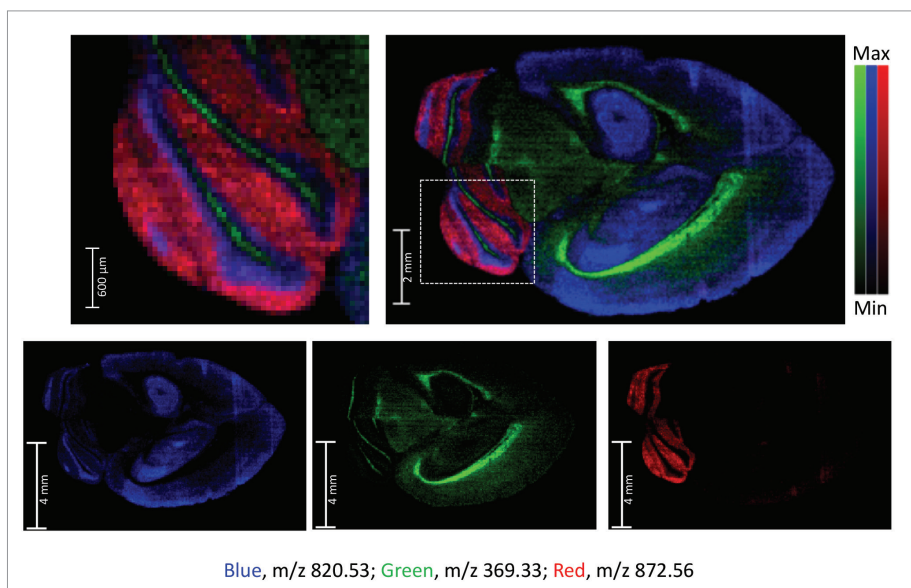


Figure 2. DESI XS brain image showing an overlay of three lipids imaged within a murine brain section.

THE SOLUTION

The new source design includes a partially sealed housing (Figure 3) that increases environmental stability and reduces atmospheric interference during the sample analysis, compared to an open DESI source. It offers a secure environment for both the user and the sample, providing a potential barrier from solvent vapors and sample aerosols while protecting the sample under analysis from contamination.

Unlike previous top-down visualization, the source also provides a camera for viewing the side of the DESI sprayer and the sample. This helps the user to locate the optimal spraying position for the DESI analysis more easily.

Internal components of the source have been designed with robustness and usability in mind. The sprayer armature (Figure 4) is precision manufactured with a spring loaded arm encompassing caged roller bearings to give precision and durability for large scale acquisitions.

Partnering with a leading microscope stage manufacturer, a cutting-edge stepper motor stage has been incorporated into the source (Figure 5) which has been designed to utilize different holders, enabling examination of a wide range of specimen types. Its unique S curve acceleration algorithm allows fast, smooth positioning without vibration, reducing disruption to samples and promising focused, consistent imaging.

For the first time, the source boasts integrated electronics and gas handling, meaning gases and voltages are automatically shut off at the end of your analysis. This is not only more environmentally friendly, but also saves on the cost of MS imaging consumables and prolongs the life of the DESI sprayer.

The DESI XS source enables the generation of ion images, with consistent, reliable signal intensity allowing for clear visualization of molecular spatial distributions. Discovery research is accelerated through greater confidence in decision making during analyses. This source ensures images that display clearly defined distributions and components, and are easily and rapidly processed through High Definition Imaging (HDI™) Software. Figure 2 is an example image showing a murine brain section, generated using the DESI XS source mounted to a orthogonal acceleration time-of-flight mass spectrometer. The DESI image was acquired with a 50 µm pixel size at 2 scans per second, taking a total time of 2.2 hours to produce (47,700 pixels). Three lipids have been overlaid using red (m/z 872.56), green (m/z 369.33), and blue (m/z 820.53) colors. From set-up, through acquisition, to fully processed image took approx. 2.2 hours, from which point ion images could be easily extracted to truly visualize the different patterns of component localization within the sample.

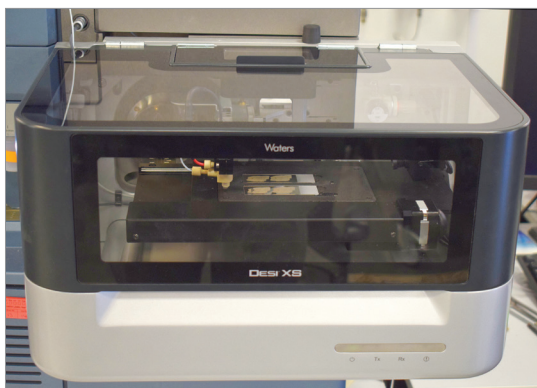


Figure 3. DESI XS source showing partially sealed housing.

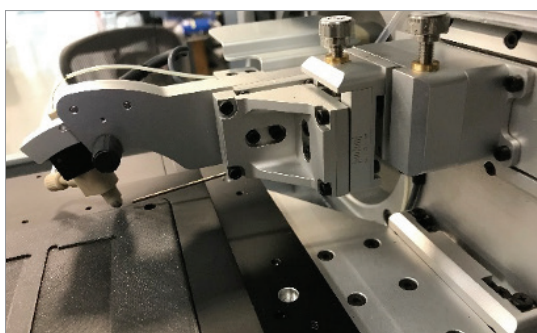


Figure 4. Robust precision armature.

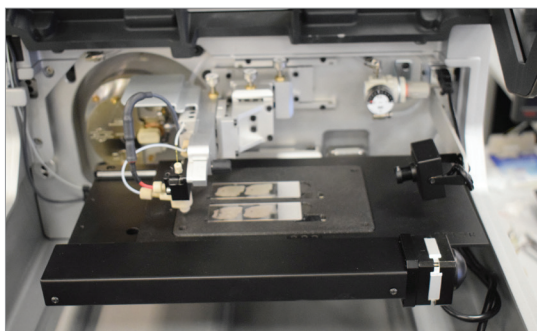


Figure 5. DESI XS internal view showing stage with glass slides.

Tissue structure and differential lipid distribution demonstrates the stability of the DESI XS source for large tissue imaging. This data has been TIC (total ion current) normalized.

SUMMARY

This technology brief describes the design of the new DESI XS source for MS imaging. This source is deployable across the Waters MS portfolio including the SELECT SERIES Cyclic IMS, the SYNAPT XS, and the Xevo G2-XS QTof. It brings to the market a durable fully integrated solution, providing simplicity and ensuring a consistent, high-level of performance for imaging applications. This source promises to be a foundation upon which the next generation developments in Waters DESI MS imaging will be built, future-proofing MS imaging needs.

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