Beyond Chromatography: A Revolutionary Approach to Traditional Laboratory Workflows

Hayley Crowe, Mass Spec Detection Product Specialist, PerkinElmer

Labs are commonly faced with the challenges of lengthy sample preparation, complex method development, and long sample analysis times. Constantly met with demands of providing results fast, current technology can be time consuming and required highly skilled scientists, as is the case with the operation of traditional chromatography integrated with mass spectrometry. An ambient ionisation source integrated with the time-of-flight mass spectrometer can be introduced to a laboratory. This easy to use system can reduce time for sample prep and increase cost-efficiency and productivity.

A New Approach to Analysing Samples

An ambient ionisation source integrated with a time-of-flight mass spectrometer, like PerkinElmer's AxION DSA (*Figure 1*), can be introduced to a laboratory to reduce time for sample preparation, while increasing cost-efficiency and productivity. Such a system enables direct ionisation of liquid, solids, or gases at the entrance of the mass spectrometer. This occurs without chromatography, sample preparation, or complicated method development, providing exact mass measurements of samples within seconds. Based on a field free atmospheric pressure chemical ionisation (APCI) source, the system's design provides very high sensitivity and reduced background noise. Field-free APCI design incorporates the corona needle directly into the probe housing. The proposed mechanism of action is similar to that of the field-free APCI. The system is heated from 180°C to 450°C and uses nitrogen gas. Heated nitrogen gas flows over the high voltage needle, and the charge is transferred to the nitrogen gas creating nitrogen radicals. These nitrogen radicals then interact with moisture in the atmosphere creating hydronium ions. A heated, charged thundercloud is then emitted out of the end of the probe, causing desorption of the surface ions at the entrance of the system. No solvent or additional reagents are required, and the ions are analysed in seconds providing high resolution, accurate mass results. This enables the user to confidently identify known and unknown ions within four decimal places of the mass.

Figure 1: AxION DSA

A Faster Sample Analysis

With this system, total sample analysis time can be reduced by 99%. Analysis time is reduced from 25 minutes to 25 seconds for a typical sample by eliminating sample preparation steps (*Figure 2*). Allowing for faster and more reliable results, the DSA system dramatically improves the traditional laboratory workflow. Chromatographic method development, which requires skilled users and long development times, is no longer needed. For example, a typical screening analysis of 500 samples for a particular set of compounds using chromatographic separation would be around 208 hours, given a 5-minute run time. However, if the integrated system is used for this same screening, total analysis time would be around 3.5 hours. Additionally, the entire source housing is enclosed, which prevents outside laboratory atmosphere contamination of results and also gives increased signal to noise due to low background ions. Overall, the DSA system can revolutionise laboratory workflows providing rapid, accurate mass spec results directly from a sample all in a matter of seconds.

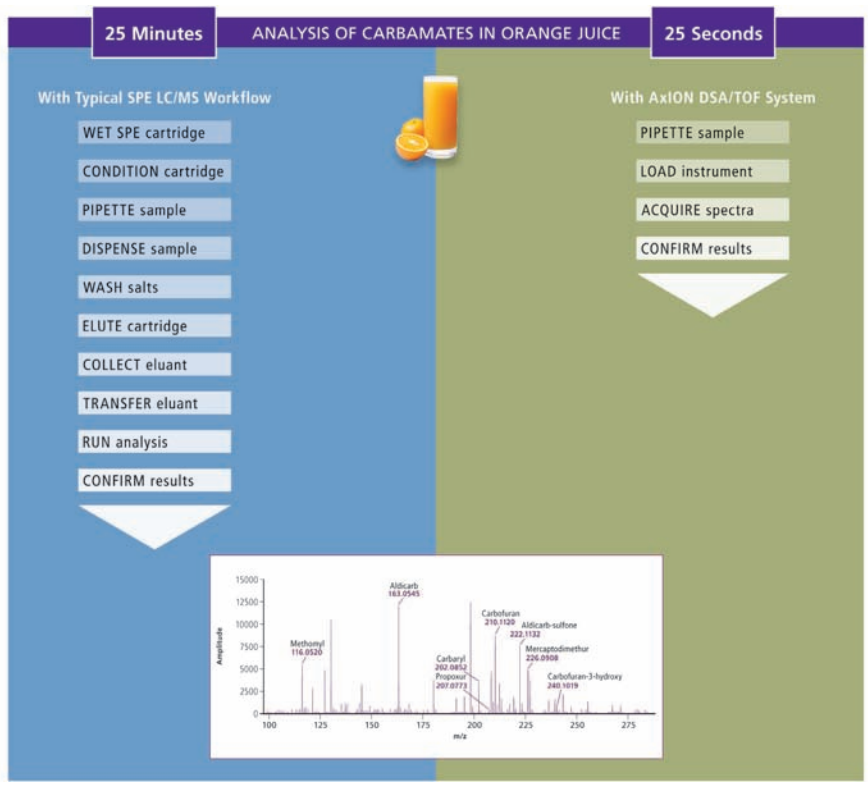
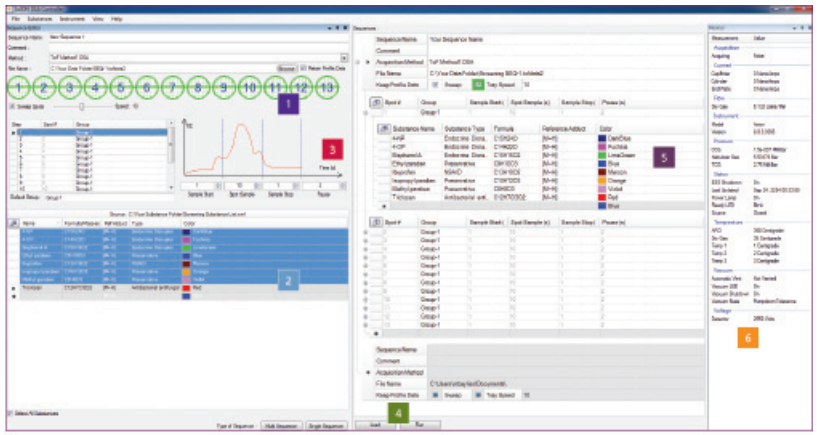


Figure 2: Traditional Sample Analysis vs. AxION DSA/TOF Sample Analysis

A More Cost Efficient, Productive Lab

In addition to screening samples more quickly than the traditional chromatographic methods, the breakthrough technology allows a more cost-efficient, productive lab. For the same analysis listed above, it could cost approximately $3,000 for solvent consumption and



1 Easy, step-by-step Sequence Creator automates the analysis of multiple samples.

2 Flexible Substance Tracker allows you to assign the same or different substances to each sample.

3 Optimize sample analysis by adding pre- and post-sample dwell times for a specific sequence.

4 Readily accessible control buttons let you quickly load samples and run analyses.

5 Comprehensive and flexible Sequences window lets you view each analysis as it's running.

6 Real-time diagnostics allow monitoring of system status.

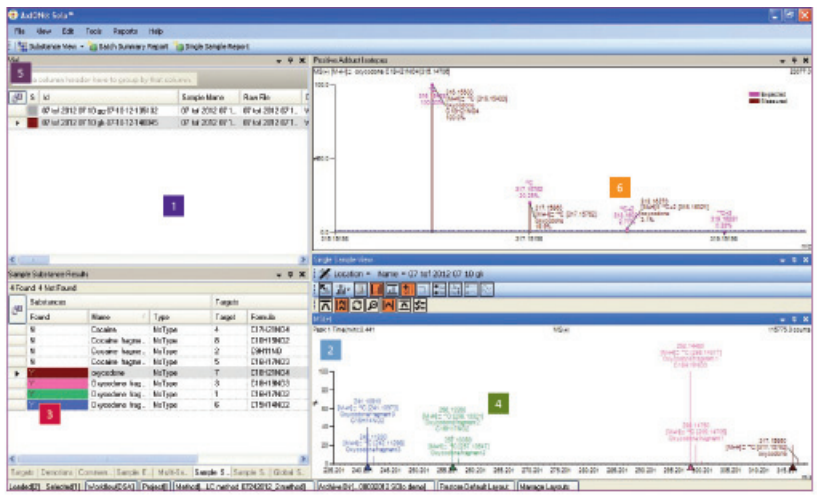
Figure 3: AxION Solo Software

disposal compared to the new systems' solvent cost of $10 for cleaning the TOF-MS. Total cost savings for a lab could potentially range from $50,000 to $100,000, as the DSA eliminates the need for chromatography and associated operating expenses. There is no need for additional caustic solvents or reagents with this technology, therefore both lower operating costs and a safer environment can occur. In addition, productivity can increase in the lab due to the ease of use of the DSA system.

Sample analysis is as simple as placing a sample, such as a piece of food or small amount of liquid, on the sample holders and running the system. This replaces the technical training required for extraction, followed by solid phase extraction and finally chromatography. Dedicated target analysis software, like PerkinElmer's AxION Solo™, can enable quick visualisation of results (*Figure 3*). If chromatography is needed, the system can also be interchanged for chromatography within two minutes without breaking the vacuum on the TOF MS, enabling a completely flexible system.

A User-Friendly System

Without the demand for complex knowledge of the technology, the system can be easily implemented in the lab. Operators do not need to be highly skilled so complicated training and lengthy learning curves can be virtually eliminated. The field-free APCI design enables an easy-to-use system. Allowing for easy data interpretation, nitrogen gas is used to provide true molecular ions instead of metastable ions. Fit with disposable sample holders for solids and liquids, the system enables easy sample handling, while also decreases a cross contamination risk. The source housing is enclosed and has a vent for off-gassing of samples, which provides increased safety for dangerous samples. Additional features include a kickstand for easy storage and a simple hand tight screw for rapid removal. Finally, the entire system is controlled by a single, intuitive software interface, and data is quickly analysed using AxION Solo software (*Figure 4*).



1 Quickly and easily screen batches by substance.

2 Detailed data allows you to quickly identify outliers and anomalies, minimizing review time.

3 Color-coded found scoring enables rapid review of samples.

4 Automatic peak annotations make it easy to distinguish targets, and to identify adducts and dimers.

5 Multiple plates or sample lists can be viewed in parallel for convenient cross-referencing and enhanced productivity.

6 Expected and observed isotopic ratio matching allows you to confirm results with complete confidence.

Figure 4: AxION DSA Controller Software