SelexION® Technology eBook

Differential mobility spectrometry (DMS) by SCIEX

Contents

SCIEX The Power of Precision

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Technology explained

Overcome your analytical separation challenges with an extra level of selectivity.

LC-MS/MS assay development can be challenging, especially when analytes coelute with contaminants or get buried within background noise.

Differential mobility spectrometry (DMS) is an analytical technique used to separate hard-to-resolve ions based on their gas phase mobility. Several types of ion mobility devices exist, such as drift tubes, traveling wave and high-field asymmetric waveform devices. Yet, the power of SCIEX SelexION® Technology for targeted analysis is difficult to match.

This compendium of technical notes demonstrates the difference SelexION® Differential Mobility Separation Technology can make through challenging application examples. All require the reproducibility, robustness and ease of use of the SelexION® Differential Mobility Separation Device to deliver highly selective and sensitive quantitative and qualitative analyses within a UHPLC timescale.

SelexION Technology enables you to:

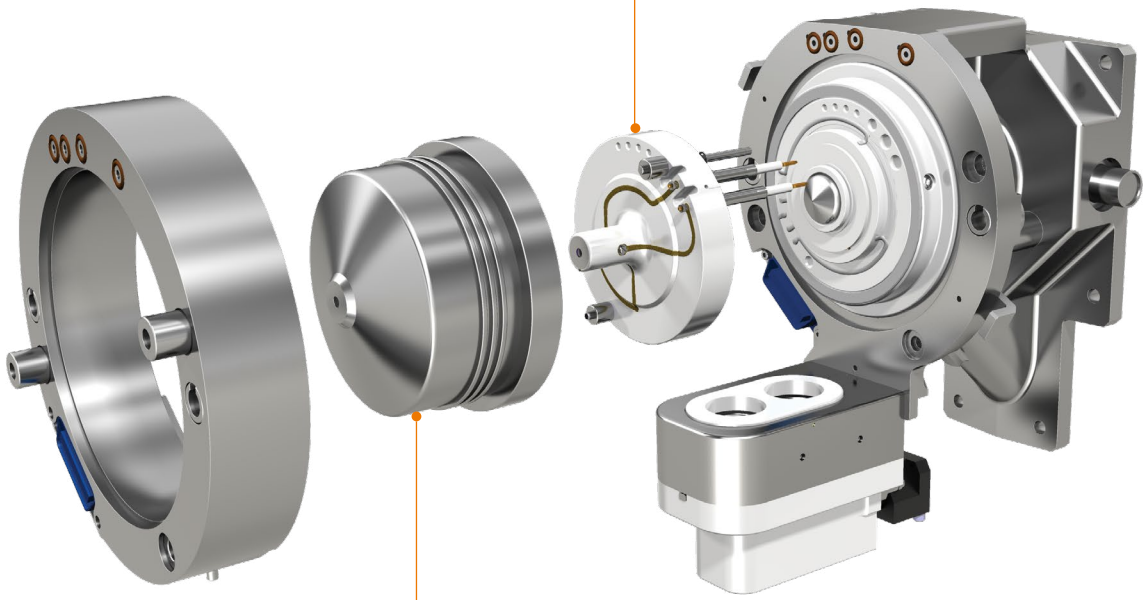
- Overcome coeluting matrix interferences and improve data quality in complex samples
- Separate isobaric compounds for increased confidence in detection
- Detect and quantify isobaric lipid molecular species for more accurate biological insights
- Reduce background noise that may be limiting your LOQ
- Save time with simplified sample preparation
- Maximize workflow flexibility with simple on and off switch of the SelexION device that doesn't require breaking the MS system vacuum

Technology explained

The SelexION Device is a small, planar mobility cell that significantly increases analytical separation power, even if compounds have identical molecular weights and chromatographic retention times, which is made possible by a mobility region and optional polar modifiers in the transport region.

Differential ion mobility cell

A compact and simple design allows the cell to be installed without the use of any tools and in less than 2 minutes.

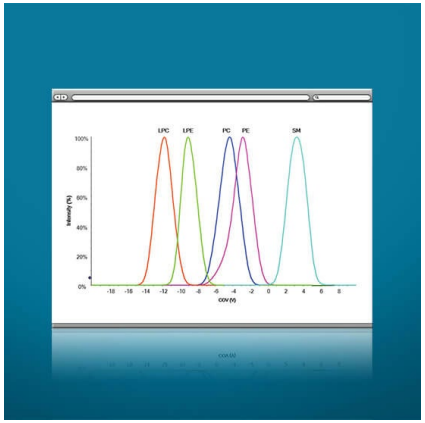


Curtain plate

An updated version of the traditional curtain plate accomodates the differential ion mobility cell. It maintains the same level of robustness and stability associated with the original design.

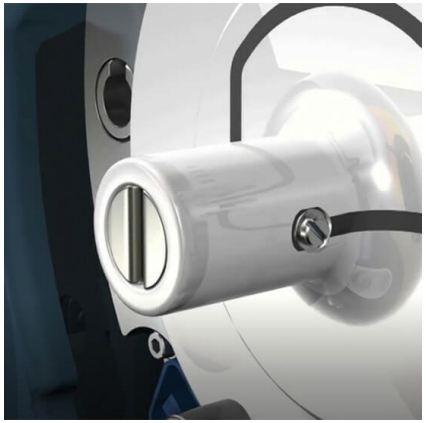
Technology explained

The SelexION Device offers a unique approach to separation that is unmatched by any other available method. First, it is a planar device that separates ions based on differences in mobility in 2 different regions of the field-dependent mobility curve.[1] Second, due to its size, the system can operate with very short residence times with optimal performance when using chemical modifiers, and it can be used in transparent mode to allow for maximum workflow flexibility.



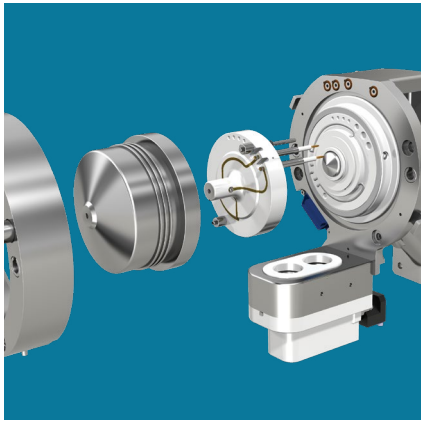
Enhanced isobaric separation

Other types of standard low-field mobility devices, such as drift tubes, separate ions based upon differences in the low-field mobility constant related to analyte mass, and are generally less effective at separating isobaric ions.[2,3]



Planar resolving power

Planar devices such as the SelexION Device eliminate heterogeneous electric fields within the device, leading to increased resolving power compared to curved surface mobility devices.[4,5]



Separation flexibility

The SelexION Device offers the ability to turn off separation voltage and operate in a “transparent” mode to transmit all ions, providing the option to perform non-ion mobility assays without removing the front-end device.

References:

1. Schneider, B. B., Nazarov, E. G., Londry, F., Vouros, P. and Covey, T. R. (2016), Differential mobility spectrometry/mass spectrometry history, theory, design optimization, simulations, and applications. Mass Spec Rev, 35: 687–737.
2. Shvartsburg AA, Prior DC, Tang K, Smith RD, “High-Resolution Differential Ion Mobility Separations Using Planar Analyzers at Elevated Dispersion Fields”, Anal. Chem., 2010, 82, 7649-7655.
3. Revercomb and Mason, “Theory of plasma chromatography/gaseous electrophoresis”, Anal. Chem., 47, 1975, 970-983.
4. Shvartsburg AA, Li F, Tang K, Smith RD, “High-Resolution Field Asymmetric Waveform Ion Mobility Spectrometry Using New Planar Geometry Analyzers”, Anal. Chem., 2006, 78, 3706-3714.
5. Krylov EV, Nazarov EG, Miller RA, “Differential Mobility Spectrometer: Model of Operation”, Int. J. Mass Spectrom., 266, 2007, 76-85.

Technology explained

SelexION Technology delivers a sample separation that is orthogonal to mass separation for your most challenging samples. Instead of returning to method development, SelexION Technology allows you to reduce noise and interferences from your sample so you can measure the molecules that count.

SelexION® Technology: the solution to selectivity challenges in quantitative analysis

DMS technology with QTRAP® or TripleTOF® systems brings the power of differential ion mobility separation to quantitative analysis in complex matrices, enabled by multiple innovations in ion mobility.

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SelexION® Technology peer-reviewed publications

Access a list of links to 10 peer-reviewed publications about SelexION Technology. Journal subscriptions may be required for full access.

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SelexION® Differential Ion Mobility Technology in action

Watch this video to learn more about SelexION DMS Technology

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Technology in action

Learn how SelexION Technology is utilized to enhance results in these key application areas:

- Lipidomics and metabolomics
- Peptide and protein quantification
- Small molecules bioanalysis and metabolism
- Clinical and biomarker research
- Forensics
- Food and environmental testing

SelexION Technology supports highly selective quantitative and qualitative LC-MS/MS workflows on SCIEX TripleQuad™, QTRAP®, and TripleTOF® systems.

Technical notes

Lipidomics and metabolomics

Resolve complex metabolite and lipid compound classes prior to the MS analysis to enable more confident identification of molecular species and more accurate quantification by MS/MS.

Differential mobility separation for improving lipidomic analysis by mass spectrometry

Twenty years ago, lipidomics research required extensive chromatographic separation and chemical derivatization. Today, ESI mass spectrometry can perform rapid in-depth analysis. This technical note demonstrates the ability of differential mobility separation to resolve multiple lipid classes from complex mixtures before the analysis by mass spectrometry.

Click here

Resolution of ether- and diacyl-linked phospholipids by differential ion mobility spectrometry (DMS)

This overview shows how SelexION Technology can resolve ether-linked and diacyl-linked phospholipid molecular species without the need for high-resolution MS or complicated chromatography.

Click here

Resolution of sphingomyelins in complex lipid extracts by differential ion mobility spectrometry (DMS)

This overview shows how SelexION Technology can resolve sphingomyelin and phosphatidylcholine before MS analysis to provide simplified MS spectra and interference-free MS/MS spectra.

Click here

Differential ion mobility separation of glycosylceramides (cerebrosides)

This technical note shows the resolution and quantification of 2 cerebroside isomers with no need for extensive sample preparation or chromatography.

Click here

Quantitative lipid analysis using MRM and differential ion mobility spectrometry (DMS)

This technical note shows how SelexION Technology can remove isobaric interferences during MRM analyses to improve quantitative results in complex mixtures.

Click here

Differential ion mobility separation of iso-elemental lipid species

This technical note shows the separation of PE and PC ether-linked species and demonstrates how SelexION Technology can distinguish iso-elemental lipid species.

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Differential mobility spectrometry resolves isobaric metabolite overlap for metabolic flux analysis

This technical note demonstrates the resolution and quantification of metabolites from the glycolysis and gluconeogenesis pathway using SelexION Technology coupled with the QTRAP system.

Click here

Differential mobility separation enhances the quantification of lysophosphatidic acid in plasma

This technical note presents a method for the quantification of LPA 18:1 in plasma. The use of SelexION Technology removes the matrix interferences observed when measuring plasma samples, allowing the use of higher-intensity MRM transitions for the quantification of LPA with much greater confidence.

Click here

Sensitive and accurate quantitation of retinoic acid isomers in biological samples

Here, a method using SelexION Technology is presented to effectively resolve the challenge of matrix and isomeric interferences for qualitative and quantitative retinoic acid analysis.

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Technical notes

Peptide and protein quantification

Enhance the analysis of peptides and proteins in complex matrices that suffer from interferences, poor fragmentation or lack of quality unique peptides compared to background noise. This results in more sensitive and selective detection of large molecule targets.

Multiple mass spectrometric strategies for high selectivity quantification of proteins and peptides

This study explores the quantification of brain natriuretic peptide (BNP) using highly selective mass spectrometric methodologies, including MRM, MRM^3, and SIM with differential mobility separation.

Click here

Using differential mobility spectrometry to separate and localize sites of post-translational modifications on peptides

This technical note explores post-translational modifications of peptide mixtures, including phosphorylation, acetylation, methylation and trimethylation. This study demonstrates the potential of SelexION Technology for use in the separation of isobaric biological modifications.

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Differential mobility separation mass spectrometry for quantitation of large peptides in biological matrices

This technical note investigates the utility of a SIM workflow combined with DMS for specificity to quantify large therapeutic peptides in a protein precipitated plasma matrix.

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Differential mobility spectrometry analysis of glycans and glycopeptides using SelexION® Technology

This technical note explores the use of differential mobility separation for the study of glycan and glycopeptide structural isomers, including sodiated and deprotonated glycans containing α2,3 or α2,6 linked sialic acid and protonated glycopeptides.

Click here

Differentiation of α2,3 and α2,6 sialic acid linked glycan isomers using SelexION® Differential Mobility Separation (DMS) Technology

This study explores the selectivity of DMS for the resolution of isobaric glycan species containing α2,3- and α2,6-linked sialic acid. The ability to separate glycans based on this linkage is demonstrated with both small glycans and large glycans.

Click here

Increased throughput for the characterization of bispecific antibodies on subunit level using SelexION® Differential Mobility Separation (DMS) Technology

This technical note presents an example of the separation of protein subunits using differential mobility to enable unambiguous characterization of each chain in a bispecific antibody.

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Technical notes

Small molecules bioanalysis and metabolism

Get an orthogonal level of separation to reduce background noise, decrease interferences and separate similar compounds to enable robust and reproducible bioanalytical methods without having to resort to complex HPLC conditions or sample workup procedures.

Improving LC-MS selectivity for mesalamine using differential ion mobility technology

This study evaluates the use of SelexION Technology coupled with MRM analysis for use in the bioanalysis of mesalamine in human plasma samples.

Click here

Separation of diastereomeric flubatine metabolites using SelexION® Technology

Here, isomeric flubatine monohydroxy metabolites, which have been produced after incubation with liver microsomes from mouse or human, have been studied. Because analysis is performed from the complex matrix, the use of differential mobility separation was important for the reduction in isobaric interferences and the separation of stereoisomers.

Click here

Sensitive quantitation of cyclic peptide by differential mobility separation analysis

This technical note presents a DMS-SIM workflow for cyclic peptide quantification in plasma. This workflow can be applied to quantify biotherapeutic molecules with low fragmentation efficiency in biological matrices as an alternative solution to traditional MRM analysis.

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Technical notes

Clinical and biomedical research

Biological fluids present many uncharacterized, endogenous compounds that may interfere with small molecules of interest in clinical and biomedical research studies.

SelexION Technology delivers high selectivity and specificity, leading to more confidence in results and opening up new discoveries. Explore how in the following application notes.

A clinical research method for the measurement of low-level testosterone in serum using differential mobility separation with LC-MS/MS

This study evaluates the use of differential mobility separation in conjunction with LC-MS/MS analysis for low-level testosterone measurement as a method to eliminate potential interferences caused by uncharacterized, endogenous components in biological fluids.

Click here

Analysis of prostaglandin isomers using the SelexION® Device

This study demonstrates how differential mobility separation can be used to resolve the isobaric species PGF2α and 8-iso-PGF2α prior to analysis by LC-MS/MS, thus removing the need for long chromatographic separation of these compounds.

Click here

Rapid, sensitive analysis of sphingolipid variant profiles with simplified sample extraction

This technical note presents a workflow for plasma sphingolipid analysis that employs simplified sample preparation combined with differential ion mobility and fast chromatography for the quantification of 7 different lipids of interest in disease research.

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Forensics

Forensic analytes can be difficult to accurately detect because of the complexity of matrices typically provided. SelexION Technology can reduce chemical noise and improve quantitative accuracy to rapidly deliver the data you need.

Separation of ephedrine and pseudoephedrine isomers using SCIEX SelexION® Differential Mobility Separation Technology

This study evaluates a forensic analysis method using differential mobility separation combined with the MRM^{HR} scan mode on a SCIEX TripleTOF® system for fast and accurate quantification of ephedrine and pseudoephedrine in plasma and urine samples.

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Food and environmental testing

While regulatory agencies require the analysis of certain compounds, they may be difficult to reproducibly detect due to complex matrices. SelexION Technology brings an additional level of separation to reduce background noise and interferences and enable robust and reproducible detection of food and environmental contaminants.

Improving selectivity of triazole derivative metabolites

This technical note evaluates the combination of DMS and LC-MS/MS to provide a high degree of selectivity for the analysis of triazole derivative metabolites across several extracted plant matrices.

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