

Comprehensive Two-Dimensional Liquid Chromatograph

Nexera-e



Nexera™ -e

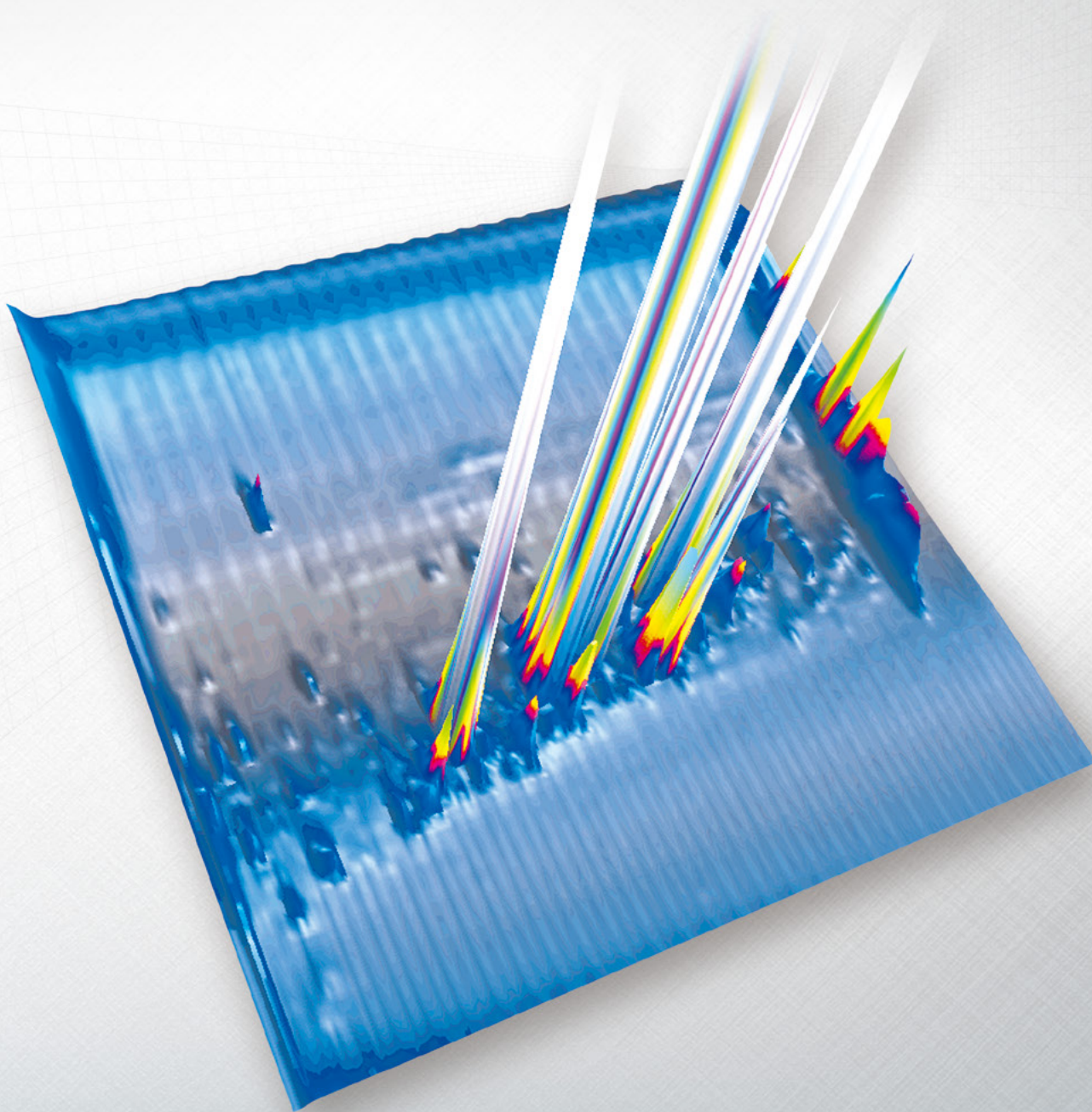
Comprehensive Two-Dimensional Liquid Chromatograph

Excellent separation method for complex samples

Comprehensive 2D-LC methodology is a paradigm shift in liquid chromatography separation. By combining two independent separation modes orthogonally in combination with a dual-loop/dual-valve alternate switching design, the highest possible peak capacity is achieved.

The new Nexera-e is the ideal solution for the separation and characterization of most challenging and complex samples. It is particularly useful for the analysis of pharmaceutical impurities, proteolytic digests, food extracts, natural products and synthetic polymers.



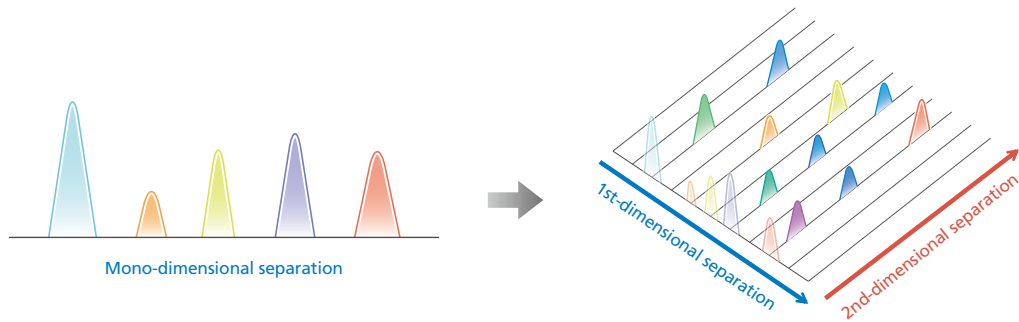


Comprehensive Two-Dimensional Liquid Chromatograph

Separation technology for analyzing complex components

Maximizing the full potential of two separation modes to perform comprehensive two-dimensional separation

Comprehensive 2D-LC is an analytical methodology combining two independent separation modes orthogonally, greatly increasing separation efficiency. The combination of different modes enables the separation of peaks that are difficult to separate using conventional LC, providing excellent results for the analysis of complex sample matrices.

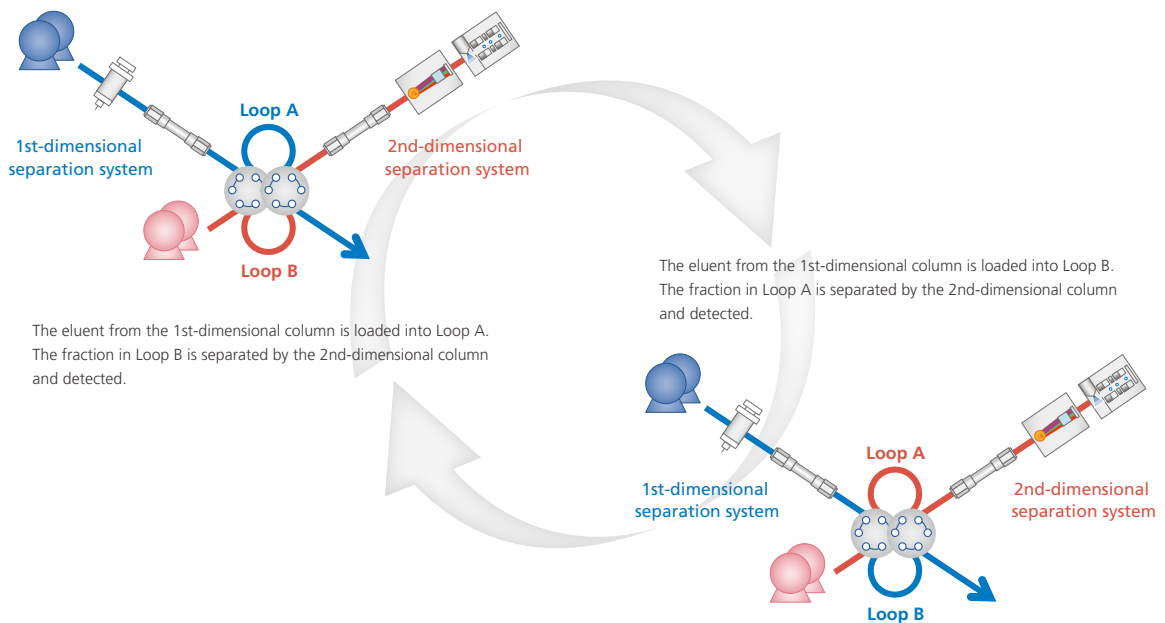


Insufficient peak separation may be observed for complicated samples.

The peaks from the 1st dimensional column are automatically transferred into the 2nd dimensional column for increased separation

Differences between a conventional 1D-LC and a comprehensive 2D-LC

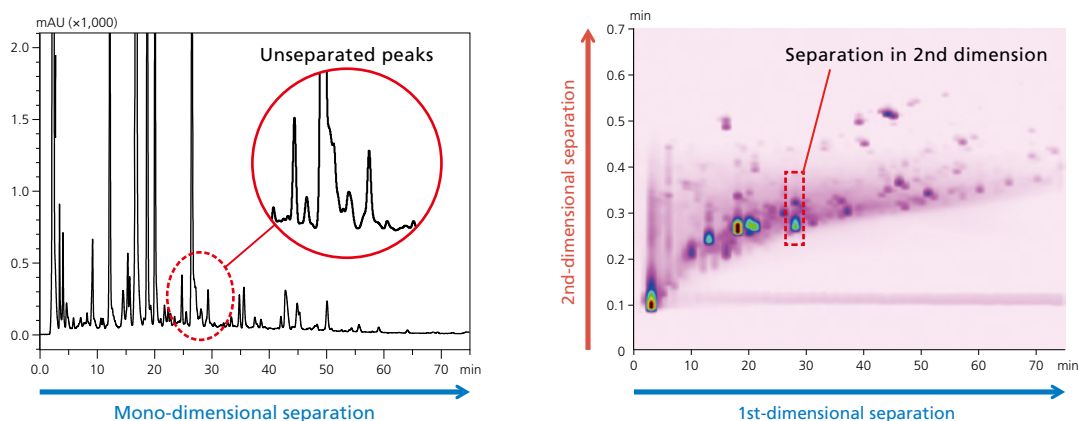
In comprehensive 2D-LC, all eluates from the first dimension can also be analyzed in the second dimension. The eluates from the first dimension are injected on to the column in the second dimension using two sampling loops that are alternately repeated by a switching valve.



Flow line and mechanism of the comprehensive 2D-LC system

Improved resolving power compared to conventional 1D-LC

How many peaks are co-eluted under one peak? The more complex the sample, along with a high percentage of similar compounds, there exists a high probability of co-eluting compounds found under single peaks. Even though the co-eluting compounds may not be separated by mono-dimensional separation, an orthogonal two-dimensional system will provide the best possible result.

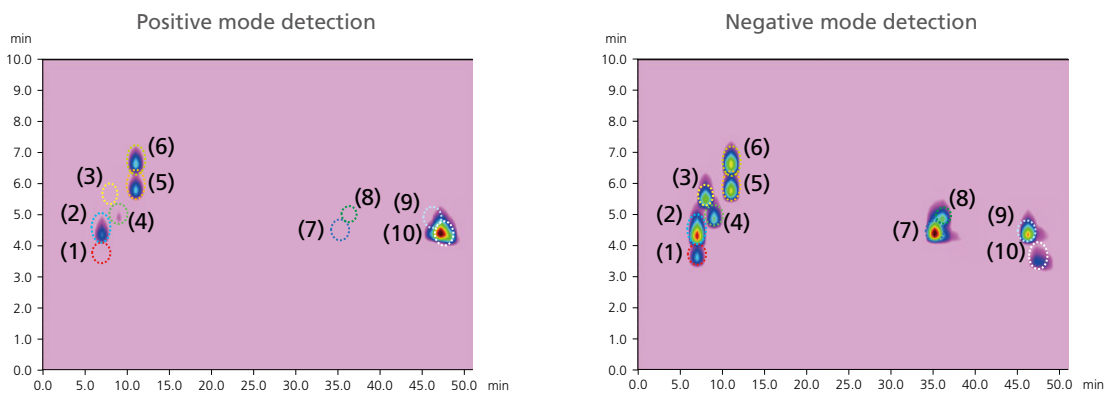


Chromatogram of a traditional Chinese medicine sample using Nexera-e

Simultaneous detection in positive and negative mode

Shimadzu triple quadrupole mass spectrometers (TQMS) have the world-class polarity reversal speed (5 ms) and data capture speed (1.5 ms). In comprehensive 2D-LC analysis, the analysis time of second dimension is short, therefore the high-speed performance of the LC-MS affects the quality of the data. Thanks to the high-speed analytical performance of the Shimadzu TQMS, it was possible to obtain stable data even for high-speed analysis of multiple component in comprehensive 2D-LC.

The figures below show contour plotting data obtained from simultaneous analysis of 10 polyphenol components using Nexera-e with shimadzu TQMS. Although some components are detected in positive mode and others in negative mode, it is possible to acquire both data in a single analysis using the Shimadzu TQMS.



Simultaneous analysis of polyphenols

(1) gallic acid, (2) catechin, (3) hesperidin, (4) quercetin-3-o-glucoside, (5) isorhamnetin-3-o-glucoside, (6) sinapic acid, (7) quercetin, (8) naringenin, (9) kaempferol, (10) apigenin

Nexera Series



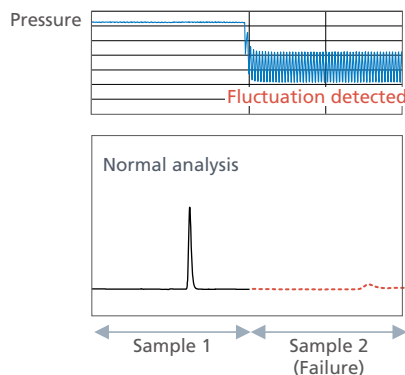
Comprehensive 2D-LC by the Shimadzu Nexera series enables comprehensive data collection by analyzing at an extremely low flow rate in the first dimension and ultra-high speed in the second dimension.

The Nexera is equipped with the "Auto-Diagnostic" function, which monitors baseline changes and pressure fluctuations to check for abnormalities. When it detects an unusual fluctuation, it can automatically pause the analysis.

This feature prevents the loss of valuable samples due to abnormal pumping.



Nexera-e (PDA Model)



Auto-Diagnostics Algorithm

Auto-Diagnostics for Trapped Bubbles (Patent Pending)

If an air bubble becomes trapped in the pump head, it causes an abrupt drop in pressure, after which periodic pressure changes (pulsations) will occur. This can be detected using Shimadzu's proprietary bubble detection algorithm which assesses these distinctive pressure fluctuations caused by trapped bubbles to distinguish them from any expected changes in pressure.

LCMS-8060NX: suitable for analyzing complex samples

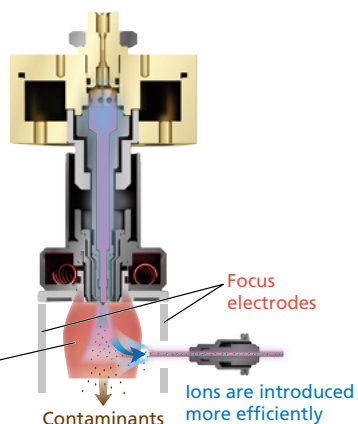
The triple quadrupole mass spectrometer LCMS-8060NX is highly robust due to its superior ionization and ion transport sections. This enables stable analysis of complex samples that tend to contaminate instruments.

■ IonFocus™ unit

A newly-developed ESI probe with focus electrodes introduces ions into the mass spectrometer more efficiently, while expelling contaminants to reduce noise and provide more stable data. In addition, an improved heat-assist design promotes the ionization of a wide range of compounds. (Patented technology.)



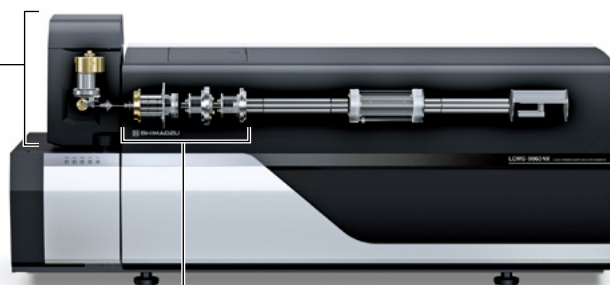
Simple design without cables or tubes. Remove or replace easily with the "one-touch" lever.



Heating gas with improved heat transfer efficiency

Contaminants

Ions are introduced more efficiently



■ UF-Qarray™ II, UF-Lens™ II

Re-engineered ion guide improves robustness without compromising on sensitivity. Maintenance of UF-Qarray II and UF-Lens II can be performed easily without tools.



Easy setting of 1D and 2D analysis parameters

Comprehensive 2D-LC requires the setting of analytical parameters for the first and second dimensions, respectively. However, setting up the first dimension for ultra-low flow rate analysis and the second dimension for ultra-high-speed analysis can be complicated.

Nexera-e has a dedicated support function to facilitate these settings. The analytical conditions for the first dimension can be set up in the same way as for normal analytical LC, and the gradient settings for the second dimension are automatically generated based on the modulation time.



1D parameter

2D parameter

Gradient map

Time	A Conc	B Conc	
1	95.0	5.0	
2	1.00	95.0	5.0
3	9.00	20.0	80.0
4	9.99	20.0	80.0
5	9.10	95.0	5.0
6	11.00	95.0	5.0
7			

Segment ID	Gradient Height %	Start Time /min	Start Conc. %	End Time /min	End Conc. %
<input checked="" type="checkbox"/> 01	45	0.01	5	1	5
<input checked="" type="checkbox"/> 02	45	1.01	5	9	55
<input checked="" type="checkbox"/> 03	0	9.1	55	9.5	5
<input type="checkbox"/> 04	0.0	1.00	0.0	2.00	0.0
<input type="checkbox"/> 05	0.0	1.00	0.0	2.00	0.0
<input type="checkbox"/> 06	0.0	1.00	0.0	2.00	0.0
<input type="checkbox"/> 07	0.0	1.00	0.0	2.00	0.0
<input type="checkbox"/> 08	0.0	1.00	0.0	2.00	0.0
<input type="checkbox"/> 09	0.0	1.00	0.0	2.00	0.0
<input type="checkbox"/> 10	0.0	1.00	0.0	2.00	0.0

ChromSquare, the data analysis software for 2D-LC

2D qualitative and quantitative analysis using Contour Graphics

Acquired data is converted to two-dimensional contour plotting using ChromSquare, the software for comprehensive 2D-LC analysis. A peak on a chromatogram is recognized as a spot on the contour plot. The qualitative and quantitative data processing are performed for the target spot.

2-dimensional contour plotting

2-dimensional chromatogram

Mass spectrum at the point where the pointer is placed

Overall view of 2-dimensional data

Calibration curve

Conc.	Area
0	0
10	1000000
20	2000000
30	3000000
40	4000000
50	5000000
60	6000000
70	7000000
80	8000000
90	9000000
100	10000000

Two-dimensional chromatogram data processing screen

ChromSquare is a product of Chromaléont S.r.l., Italy.





Automated support functions utilizing digital technology, such as M2M, IoT, and Artificial Intelligence (AI), that enable higher productivity and maximum reliability. Allows a system to monitor and diagnose itself, handle any issues during data acquisition without user input, and automatically behave as if it were operated by an expert. Supports the acquisition of high quality, reproducible data regardless of an operator's skill level for both routine and demanding applications.

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