汉邦科技
Hanbon Sci.& Tech.

SUPERCRITICAL FLUID CHROMATOGRAPHY SYSTEM

2018-2019

PRODUCT MANUAL



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01 The Concept and Advance of SFC

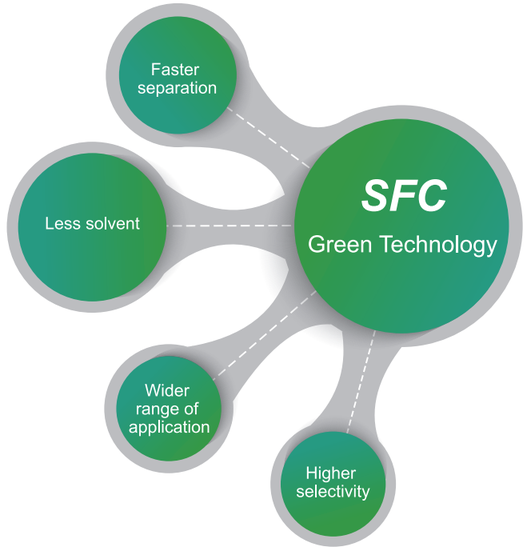
Supercritical Fluid Chromatography (SFC)

The supercritical fluid with good solubility and mass transfer characteristics is used as the mobile phase in SFC, and the analysis and preparation conditions were optimized by adjusting the composition and flow rate of the mobile phase, system temperature and back pressure.

SFC has better selectivity because its strong orthogonal function of positive phase separation makes the retention behavior of SFC very different from that of HPLC. The technique ensures that gradients are applied over the widest possible polar range, which allows the SFC to separate most samples that are soluble in organic solvents.

SFC is a new separation method following GC and HPLC. It has the ease of use of reverse phase chromatography and the separation ability of positive phase chromatography. In particular, it has irreplaceable advantages in chiral separation and large-scale preparation.

The Advances of SFC



Faster separation

The elution flow rate of SFC is usually 3 times higher than that of HPLC, which makes the separation faster and saves time.

Less solvent

Using CO_2 and a litter modifier as the mobile phase makes the separation work more green and environmental protection.

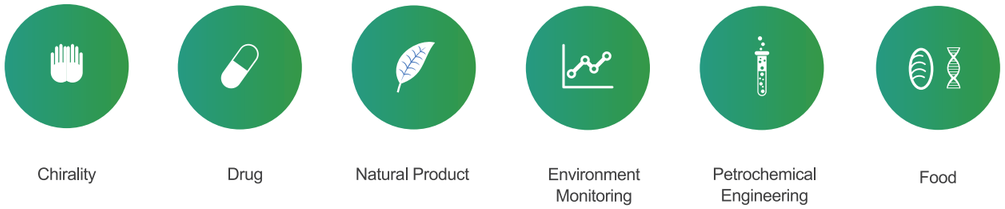
Wider range of application

It is suitable not only for the separation of small and medium polar molecules, but also for some hydrophilic macromolecules.

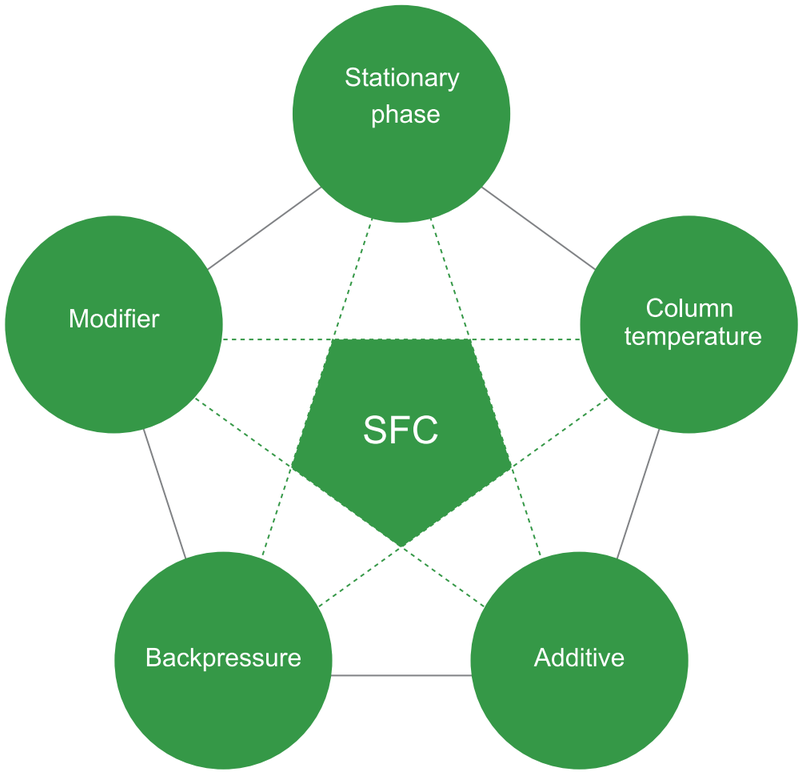
Higher selectivity

The retention behavior of SFC is significantly different from that of GC and HPLC, and it is committed to solving the problem that traditional separation methods cannot meet the requirements.

SFC Application Fields



Influence factors of SFC retention behaviors



Application of SFC



Sample analysis

Because the working process of SFC and HPLC is similar, the experimenters can easily switch methods and introduce SFC into analysis work to improve analysis efficiency.

Advantages:

SFC can improve the speed of analysis significantly, while improving the degree of separation and selectivity.

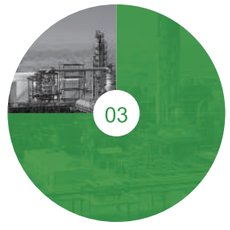


Pilot-scale preparation

SFC uses CO_2 and cosolvents as mobile phase to improve the working environment during the separation process, especially in the positive phase separation.

Advantages:

SFC can not only complete the preparation work faster, but also improve the separation degree and increase the sample loading for samples with high separation difficulty.



Industrial production

Production SFC can recycle CO_2, which is green. The production process is stable and has the good reproducibility.

Advantages:

Compared with HPLC, SFC can reduce the production cost both in the sample purification process and solvent post-treatment process.



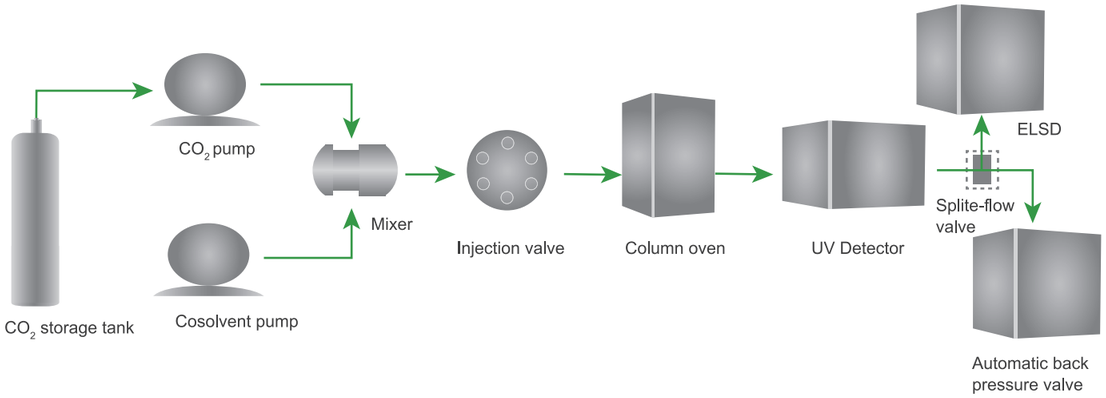
Sample post-treatment

CO_2 can be recycled directly by vaporizing, so the sample post-processing is no longer the most time-consuming part in the working process.

Advantages:

Post-treatment only need to be done within a small amount of organic solvent, which will simplify the post-treatment process. So the experimenters can handle more separation and analysis work.

Hardware differences between SFC and HPLC



01

In view of the sensitivity of CO_2 density to pressure and temperature, the control of SFC on pressure and temperature is better than that of HPLC.

02

An independent back pressure system, on the one hand, can provide the back pressure, so that CO_2 does not vaporize when out of the column. On the other hand, it can provide a stable pressure environment for the system.

03

In the mobile phase delivery system, the CO_2 cooling device is included to ensure that CO_2 enters the pump at a relatively constant density.

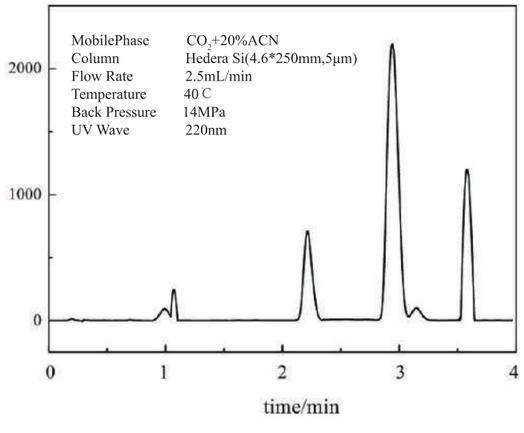
04

The flow collection system contains the buffer device that can avoid sample loss caused by CO_2 vaporization and improve the yield.

SFC separates achiral samples

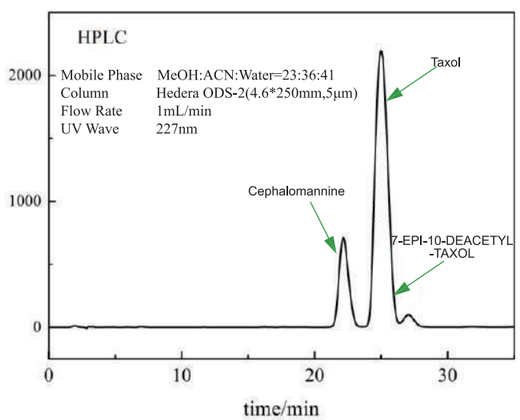
Faster separation - SFC separates derivatives of vitamin E

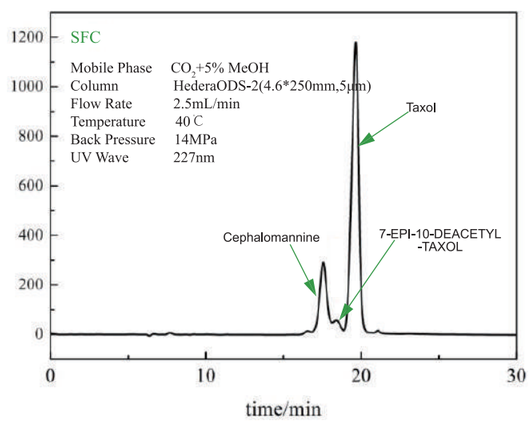
The flow rate of NS8001 type SFC is 3 times higher than that of HPLC with low percentage of modifier, so that researchers can complete the sample analysis quickly.



Retention behavior differences between SFC and HPLC – the separation of taxol

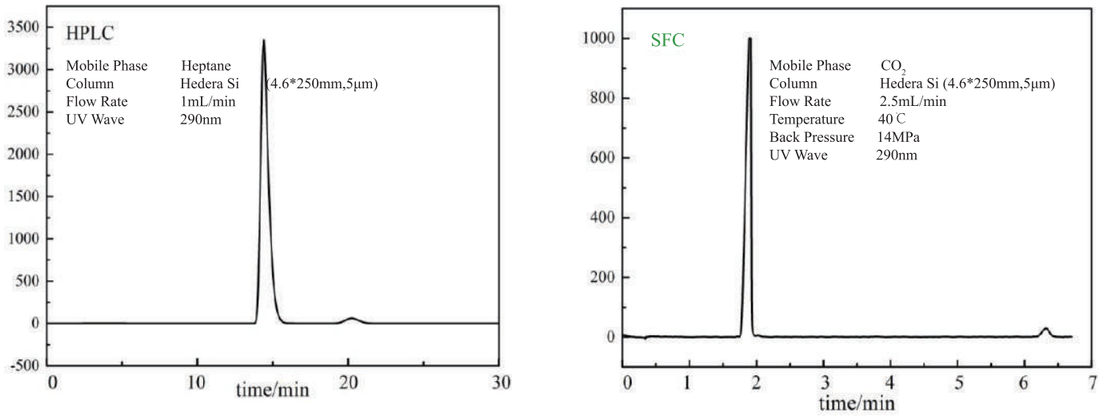
7-EPI-10-DEACETYL-TAXOL was behind Taxol by HPLC analysis, while 7-EPI-10-DEACETYL-TAXOL was between Cephalomannine and Taxol by SFC analysis. The strong selectivity of SFC provides a more diversified choice for sample analysis and preparation.



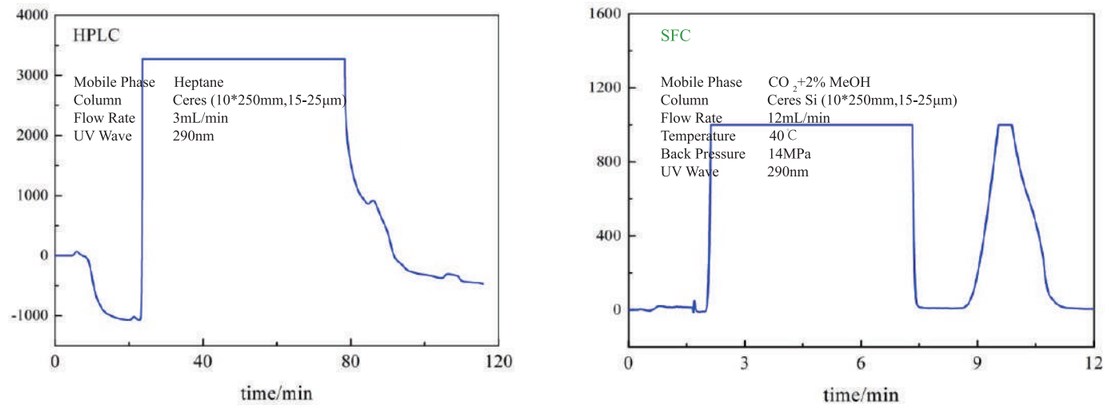


Economical purification methods – the preparation of QD803

Compared with HPLC purification, SFC purifying anti-tumor drug QD803 has these advantages such as more loading quantity of sample, shorter elution time, smaller solvent usage amount, higher sample purity and yield.



Comparison diagram about QD803 analysis between SFC and HPLC



Comparison diagram about QD803 preparation between SFC and HPLC

Comparison table of cost analysis of QD803 preparation between SFC and HPLC

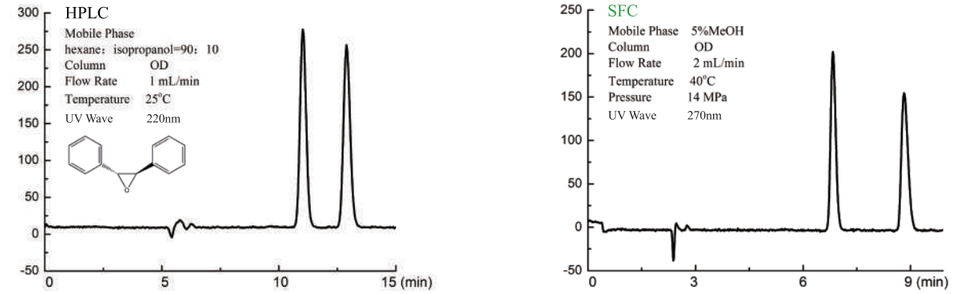
Item	Time(min)	Organic solvent consumption(L)	Solvent aftertreatment(L)	Cost(%)
SFC	12	0.02	0.1	65
HPLC	120	8.4	2.5	100

SFC separates chiral samples

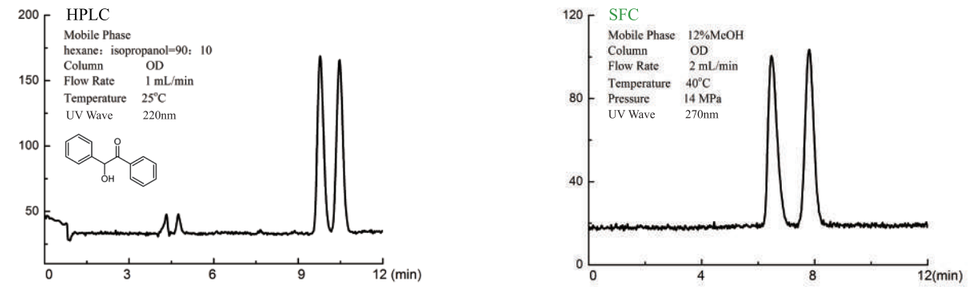
Faster separation, higher degree of separation - SFC separates TSO and Benzoin

The flow rate of NS8001 type SFC is 3 times higher than that of HPLC with low percentage of modifier, so that researchers can complete the sample analysis quickly.

The separation of TSO

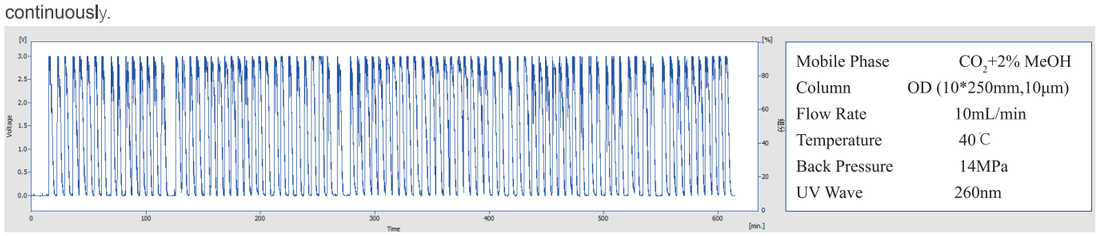


The separation of Benzoin



The first choice of chiral resolution—Preparation of enantiomers of Ranolazine

The SFC separates Ranolazine by the method of repeated injection that the sample was loaded once every 6min and loaded 91 times continuously.



Cost comparison table of 1 g chiral sample separated by SFC and HPLC by using chromatographic columns with the same specification

Item	Time(h)	Organic solvent consumption(L)	Solvent aftertreatment(L)	Cost(%)
SFC	6	0.2	0.17	45
HPLC	38	3	2.5	100

02 **SFC Product**

Analytical

Supercritical Fluid Chromatography



Semi-preparative

Supercritical Fluid Chromatography



02 **SFC Product**

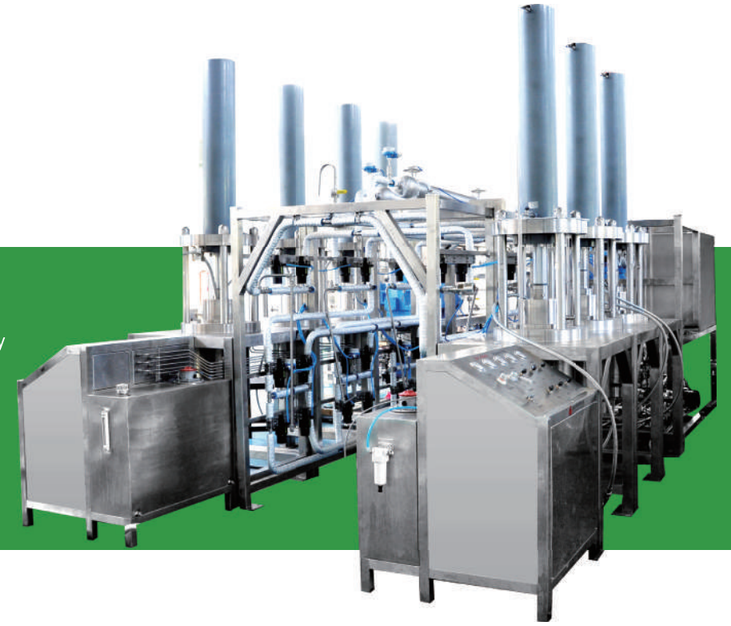
Preparative

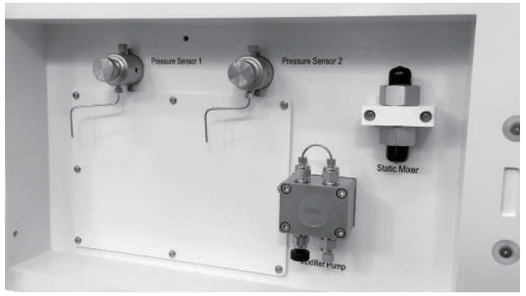
Supercritical Fluid Chromatography



Industrial

Supercritical Fluid Chromatography





Mobile phase transmission module

The mobile phase transmission system adopts an independent temperature control module to improve the temperature control accuracy and realize CO_2 precise transmission.



Cooling module

New refrigeration mode is adopted to reduce equipment noise and improve refrigeration efficiency.



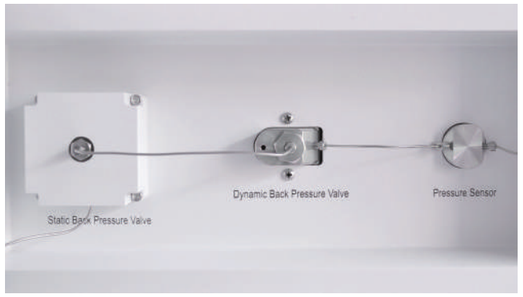
Column temperature control module

High pressure multi-channel switch valve is built in the column oven and it can realize online switching of 6 chromatographic columns or less.



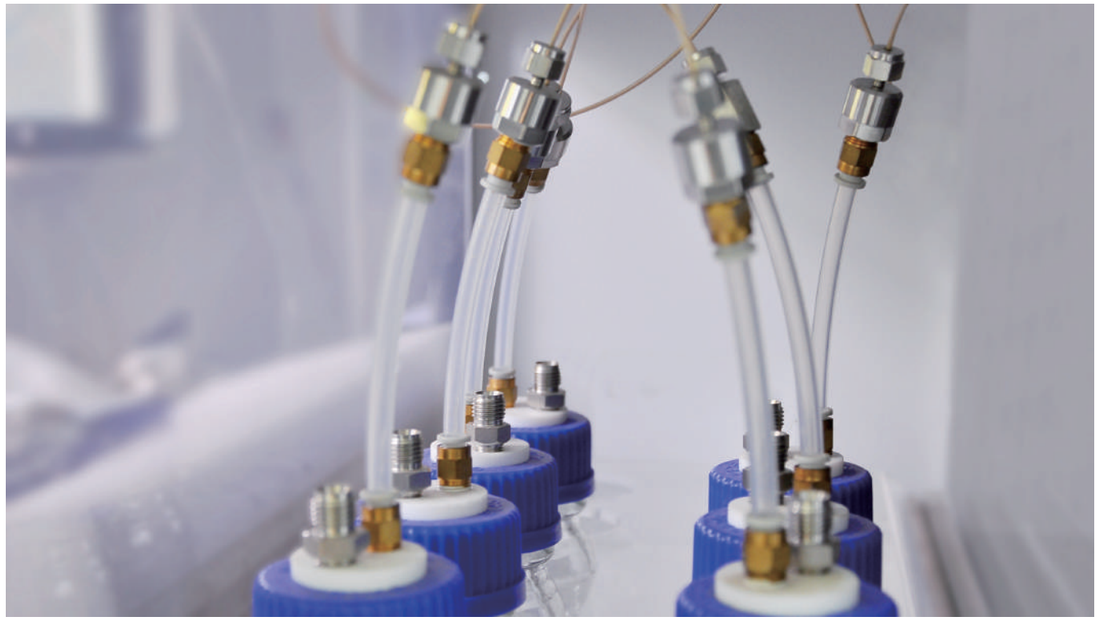
Heating module

PTC cyclic heating module, adopting the advanced PID control mode, ensures that the temperature accuracy is ±0.5℃.



Back pressure module

Unique back pressure design ensures the control precision and avoids the ice blocking effectively.

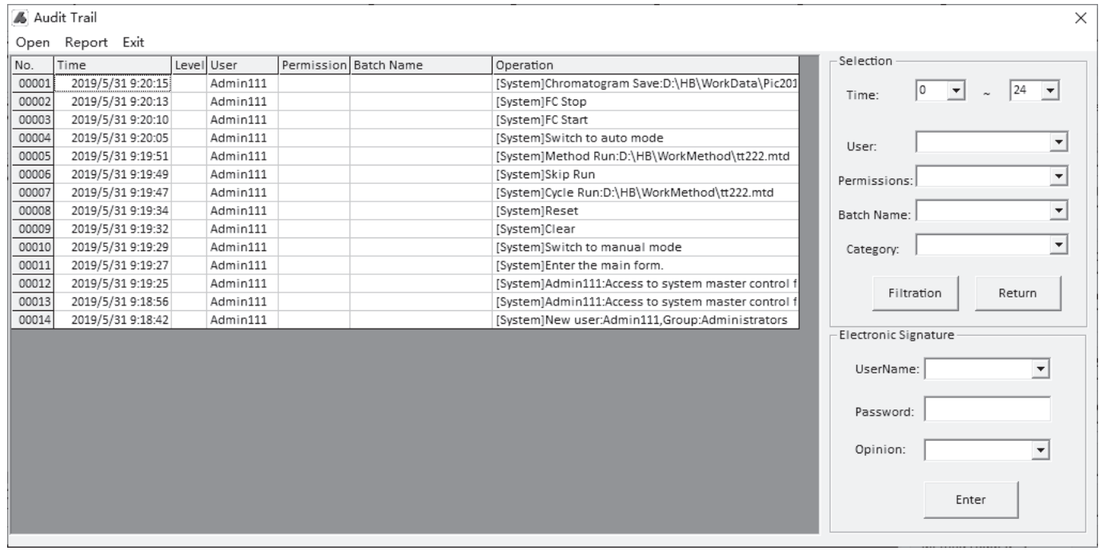


Flow collection module

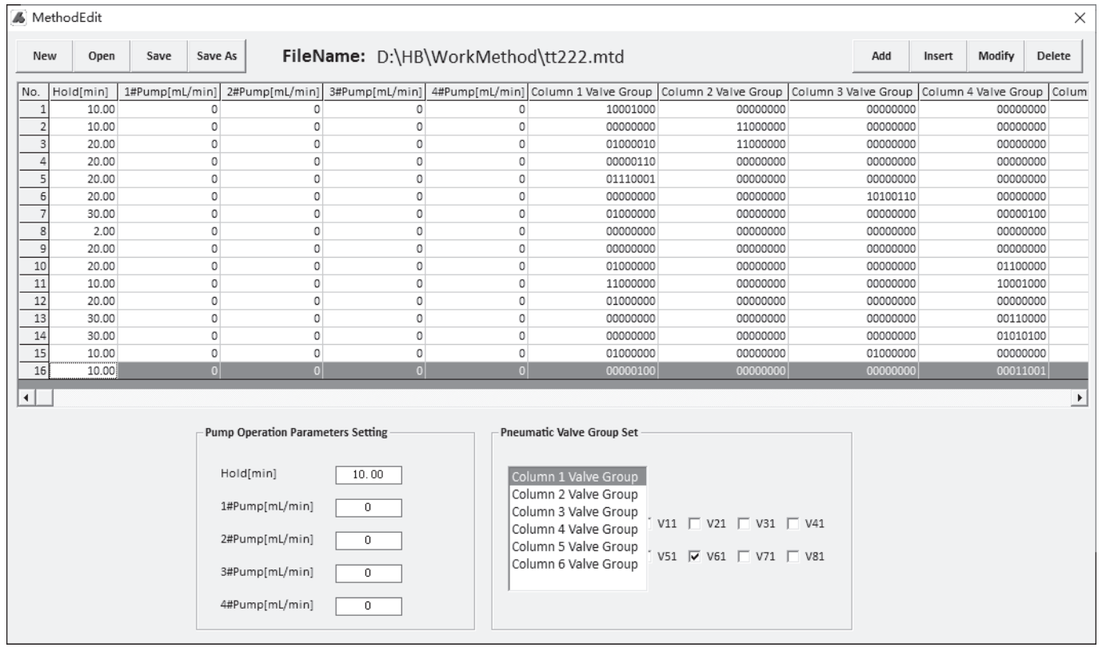
The flow collection module contains the buffer device that can avoid sample loss caused by CO_2 vaporization and improve the yield.

Chromatography working station

Audit trial

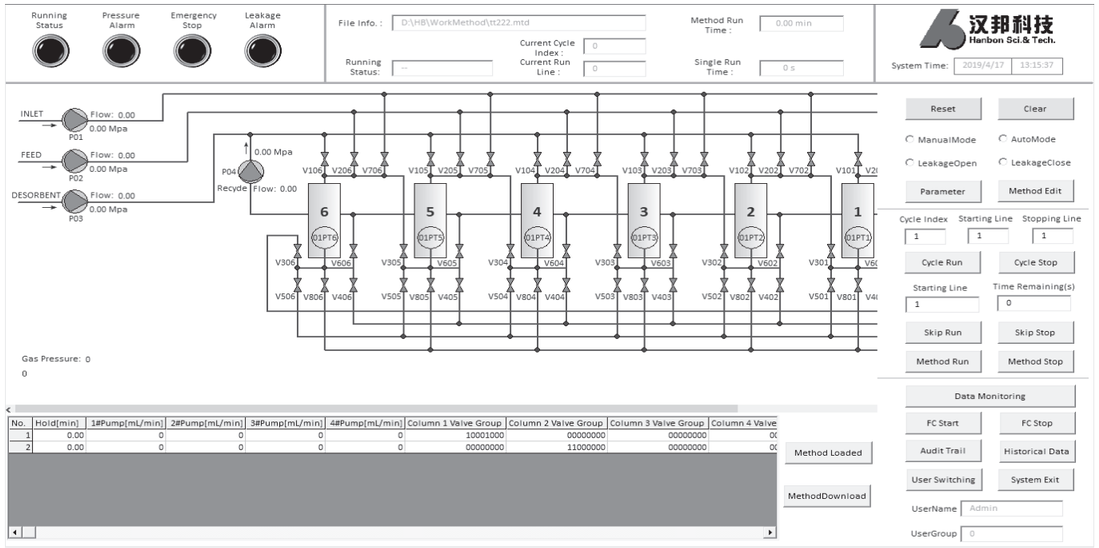


Method editor

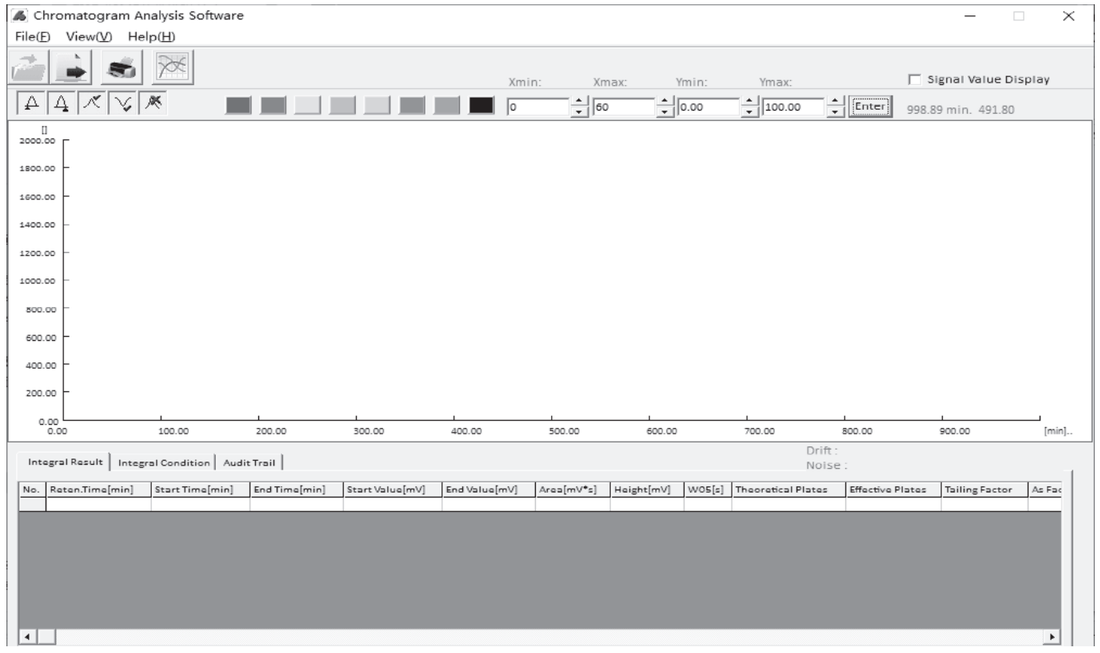


Chromatography working station

System Monitoring



Chromatogram Analysis Sofware





NS8001A/B

Analytical Supercritical Fluid Chromatography

Parameters of NS8001A/B analytical SFC

Mobile phase transmission module

Item	NS8001A	NS8001B
Flow rate of CO_2 pump	≤3.999ml/min	≤9.999ml/min
Flow rate of cosolvent pump	≤3.999ml/min	≤9.999ml/min
Flow rate increment	0.01ml/min	
Flow rate accuracy	±0.5%(Cosolvent pump) / ±1%(CO_2Pump)	
Flow repeatability	RSD≤0.1%	
Pressure range	≤42MPa(SS316L Pump head)	
Pressure pulsation	≤0.2MPa	
Quantity of the cosolvent	4-6(Optional)	
Dimension(W x H x D)	430x260x640(mm)	

Column oven

Quantity of chromatographic columns	≤6
Temperature range	Room temperature~100℃
Temperature accuracy	±0.5℃
Dimension(W x H x D)	270x630x590(mm)

Detector module

Wavelength range	190-400nm, single and dual wavelength modes are optional
Light source	Deuterium lamp (standard), Tungsten lamp (optional)
Wavelength accuracy	±2nm
Wavelength repeatability	±0.2nm
Flow cell optical path	1-5mm, adjustable optical path
Flow cell connector	1/16"
Range ability	≤3AU
Automatic zero setting	Digital zeroing, full scale
Control mode	Anti-control by computer
Dimension(W x H x D)	430x180x640(mm)

Back pressure module

Back pressure range	≤40MPa
Back pressure accuracy	±0.05MPa

Parameters of optional modules

Automatic sampler

Injection volume	0-500ul (250ul loop is optional)
Injection accuracy (injection volume > 5ul)	＜0.3%(Full loop) /＜0.5%(Partial Loopfill)
	1.0%(ul-Pick-up)
Injection model	Full loop/Partial Loopfill/ul-Pick-up
Sample viscosity	0.1-5 cP
Sample disk	6x8x2x1.5ml

NU3000D UV-Vis detector

Wavelength range	190-700nm
Light source	Deuterium lamp and tungsten lamp



NS8002/ NS8005/8010

Semi-preparative supercritical fluid chromatography

Parameters of NS8002/8005/8010 semi-preparative SFC

Mobile phase transmission module

Item	NS8002	NS8005	NS8010
Flow rate of CO_2 pump	≤19.99ml/min	≤49.99ml/min	≤99.99ml/min
Flow rate of cosolvent pump	≤19.99ml/min	≤49.99ml/min	≤49.99ml/min
Flow rate increment	0.01ml/min		
Flow rate accuracy	±1%		
Flow repeatability	RSD≤0.1%		
Pressure range	≤25MPa	≤20MPa	
Pressure pulsation	≤0.2MPa		
Quantity of the cosolvent	4-6(Optional)		
Dimension(W x H x D)	430x260x640(mm)		

Column oven

Quantity of chromatographic columns	≤6
Temperature range	Room temperature~100℃
Temperature accuracy	±0.5℃
Dimension(W x H x D)	270x630x590(mm)

Detector module

Wavelength range	190-400nm, single and dual wavelength modes are optional
Light source	Deuterium lamp (standard), Tungsten lamp (optional)
Wavelength accuracy	±2nm
Wavelength repeatability	±0.2nm
Flow cell optical path	1-5mm, adjustable optical path
Flow cell connector	1/8"
Range ability	≤3AU
Automatic zero setting	Digital zeroing, full scale
Control mode	Anti-control by computer
Dimension(W x H x D)	430*180*640（mm）

Back pressure module

Back pressure range	≤40MPa	≤25MPa
Back pressure accuracy	±0.05MPa	±0.05MPa

Parameters of optional modules

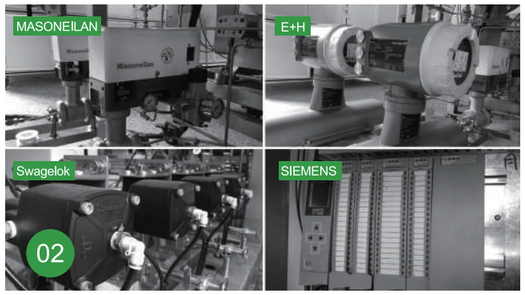
Automatic sampler

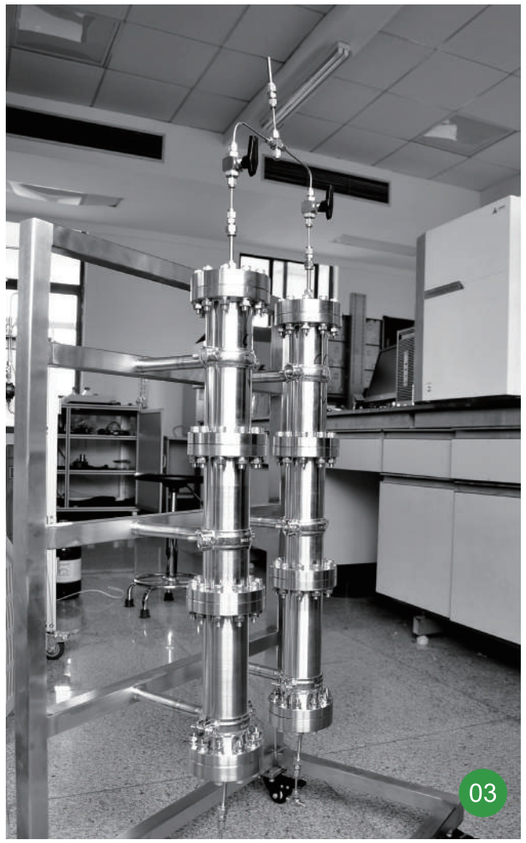
Injection volume	0-19,999ul
Injection accuracy	＜1%(Injection volume＞10 ul)
Injection model	Partial Loopfill
Sample disk	2*12*10ml（6*8*2*1.5ml is optional）

NU3000D UV-Vis detector

Wavelength range	190-700nm
Light source	Deuterium lamp and tungsten lamp







01

Flow path design

The closed-loop flow path design is adopted to ensure the flow accuracy, thus ensuring the stability and reproducibility of the production process.

02

Key parts

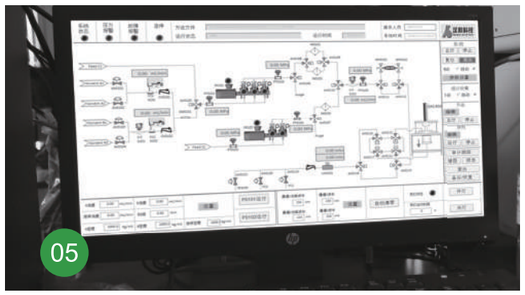
Key parts of the system are from E+H, MASONEILAN, Swagelok, SIEMENS and other international famous brands, which effectively ensure the stability and reliability of the equipment.

03

CO_2 recovery device

Standard CO_2 recovery device: after filtration, pressurization and cooling, the CO_2 will be liquefied again after purification and returned to the system for recycling.







04

Verifying files

The overall design of the equipment conforms to the requirements of GMP, cGMP, FDA and other relevant laws and regulations. It can realize the process of balance, sample loading, washing, elution, automatic collection, online cleaning and other processes, and provide the verifying files in line with the requirements of GMP and other relevant laws and regulations.

05

Control software

The control software, secondary development based on IFix software of GE, complies with FDA 21CFR Part 11

06

Cyclone collector

The cyclone collector with proprietary intellectual property rights can separate CO_2 and cosolvent efficiently and improve the yield.



NS8030A/B
NS8100

Preparative Supercritical Fluid Chromatography

Parameters of NS8030A/B&NS8100 preparative SFC system

Mobile phase transmission module

Item	NS8030A	NS8030B	NS8100
Flow rate of CO2 pump	≤299.99ml/min	≤299.99ml/min	≤999.9ml/min
Flow rate of cosolvent pump	≤99.99ml/min	≤299.99ml/min	≤999.9ml/min
Flow rate increment	0.01ml/min		0.1ml/min
Flow rate accuracy	±1%		
Flow repeatability	RSD≤0.5%		
Pressure range	≤20MPa		
Pressure pulsation	≤0.5MPa		
Quantity of the cosolvent	2-4		

Fraction collection module

Quantity of collection ports	6-8
Collection method	Cyclone collector

Back pressure module

Back pressure range	≤20MPa
Back pressure accuracy	±0.1MPa

Detector module

Wavelength range	190-400nm, single and dual wavelength modes are optional
Light source	Deuterium lamp (standard), Tungsten lamp (optional)
Wavelength accuracy	±2nm
Wavelength repeatability	±0.2nm
Flow cell optical path	1-5mm, adjustable optical path
Flow cell connector	1/8"
Range ability	≤3AU
Automatic zero setting	Digital zeroing, full scale
Control mode	Anti-control by computer
Dimension(W x H x D)	430*180*640（mm）

Injection module

Injection mode	Pump injection
Flow rate range of the injection pump	≤49.99ml/min (Optional according to requirements)

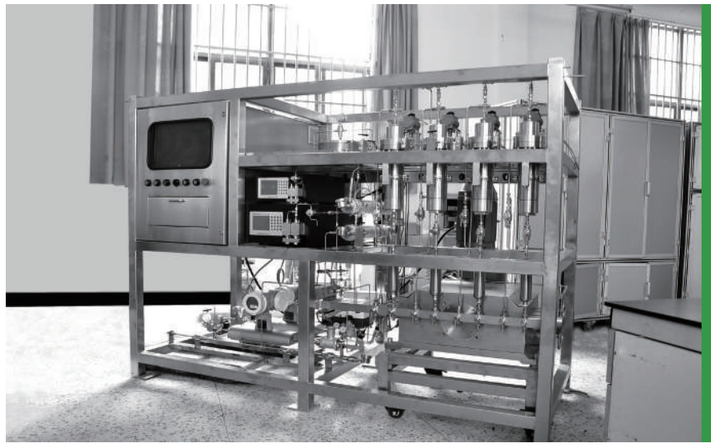
DAC parameters

Column ID	50mm	80mm
Temperature range	Room temperature~70 ℃	Room temperature~70 ℃
Column height	650mm	650mm
Effective packing height	≤450mm	≤450mm
Column inner wall roughness	≤0.2μm	≤0.2μm
Max pressure	20MPa	20MPa
Packing method	Down packing	Down packing

Parameters of optional modules

NU3000D UV-Vis detector

Wavelength range	190-700nm
Light source	Deuterium lamp and Tungsten lamp



NS8300A/B

Industrial supercritical fluid chromatography system

Parameters of NS8300A/B industrial SFC system

Mobile phase transmission module

Item	NS8300A	NS8300B
Flow rate of CO_2 pump	≤3000ml/min	≤3000ml/min
Flow rate of cosolvent pump	≤600ml/min	≤1000ml/min
Flow rate accuracy	±1%	
Flow repeatability	RSD≤0.1%	
Pressure range	≤20MPa	
Quantity of the cosolvent	2-4	

Fraction collection module

Quantity of collection ports	6-8
Collection method	Cyclone collector

Back pressure module

Back pressure range	≤20MPa

Detector module

Wavelength range	190-400nm, single and dual wavelength modes are optional
Light source	Deuterium lamp (standard), Tungsten lamp (optional)
Wavelength accuracy	±2nm
Wavelength repeatability	±0.2nm
Flow cell optical path	1-5mm, adjustable optical path
Flow cell connector	1/4"
Range ability	≤3AU
Automatic zero setting	Digital zeroing, full scale
Control mode	Anti-control by computer
Dimension(W x H x D)	430*180*640（mm）

Injection module

Injection mode	Pump injection
Flow rate range of the injection pump	≤49.99ml/min (optional according to requirements)

DAC parameters

Column ID	100mm	150mm
Temperature range	Room temperature~70℃	
Column height	650mm/680mm	
Effective packing height	≤450mm	
Column inner wall roughness	≤0.2μm	
Max pressure	≤20MPa	
Packing method	Down packing	

Parameters of optional modules

NU3000D UV-Vis detector

Wavelength range	190-700nm
Light source	Deuterium lamp and Tungsten lamp



SFC-SMB

As a combination of SFC and SMB, SFC-SMB can further reduce the usage of mobile phase and stationary phase in the preparation process, and improve the productivity of unit packing material. It is mainly used for the resolution of chiral substances, the purification of chemical drugs, the separation of natural products and so on.

Parameters of SFC-SMB

Mobile phase transmission module

Flow rate of CO_2 pump	Customized
Flow rate of cosolvent pump	Customized
Pressure range	≤20MPa
Quantity of the cosolvent	2-4

Detector module

Wavelength range	190-400nm (190-700nm is optional)
Light source	Deuterium lamp (Tungsten lamp is optional)
Wavelength accuracy	±1nm
Wavelength repeatability	±0.2nm
Flow cell optical path	1-5mm, adjustable optical path
Flow cell connector	1/16"or 1/8"or 1/4"

Back pressure module

Back pressure range	≤20MPa
Back pressure accuracy	±0.1MPa

Parameters of the chromatographic column

Quantity of chromatographic columns	Customized
Temperature range	Room temperature~70℃
Temperature accuracy	±0.5℃

Fraction collection module

Quantity of collection ports	6-8

SFC Using DAC Column（SFC-DAC）

Dynamic Axial Compression Column, DAC, has the most mature column packing technique in the field of preparative chromatography. It is able to self-load column, maintain the column pressure and self-unload column, with the function of the chromatographic column and packed column machine. The chromatographic column packed with DAC can meet the requirements of continuity, uniformity, stability and tightness of column bed and eliminate the influence of column-bed collapse.

01

The DAC column, specially designed for the SFC system, is able to withstand pressures up to 20MPa. This will improve the stability of the system.

02

Independently designed for SFC, the column temperature control module can realize precise temperature control and improve the reproducibility in the process of production and preparation.

03

The distributor with the proprietary intellectual property right ensures the uniform distribution of the mobile phase in the chromatographic column, which contributes to the good separation effect to the greatest extent

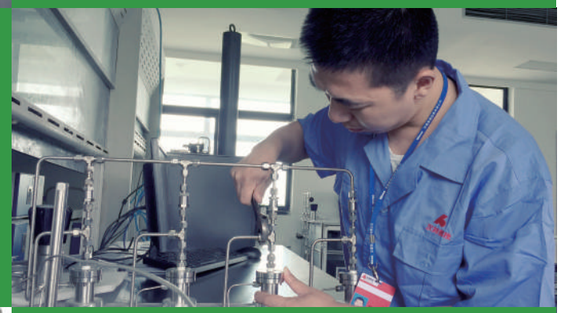
04

DAC can ensure the compactness and stability of the column-bed structure, and realize the linear amplification of the preparation process easily.





01
Experiment Service



02
After-sales Service



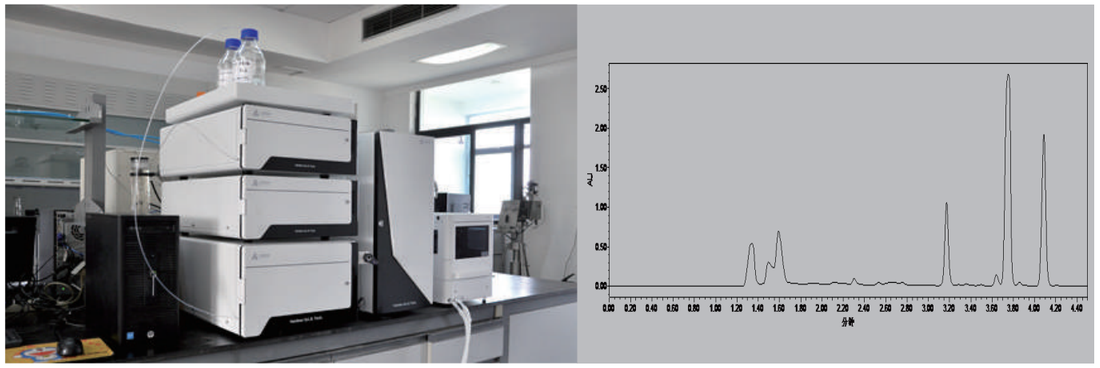
03
Training Service



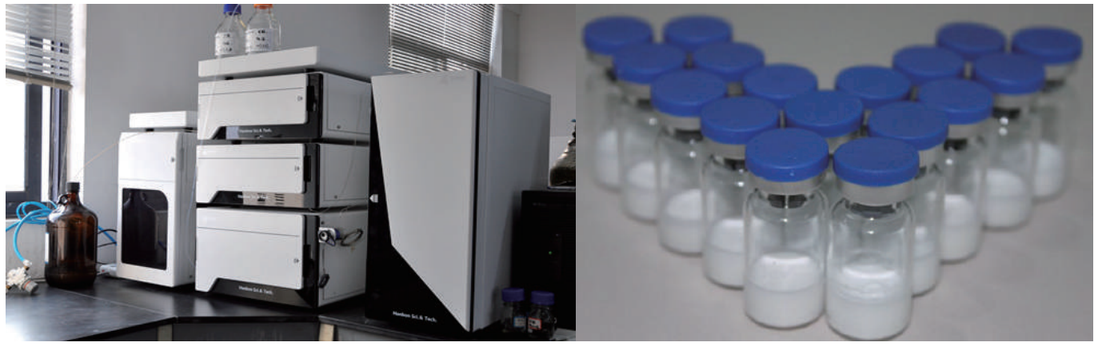
04
Authentication Service

Experiment and Technology Service

Sample SFC method development service assists you to determine the feasibility of SFC separation for samples



The preparation of samples from milligram to gram level, especially the resolution of chiral samples



Complete the amplification work from analysis to semi-preparation to preparation ensuring the smooth development of purification work in the later stage

