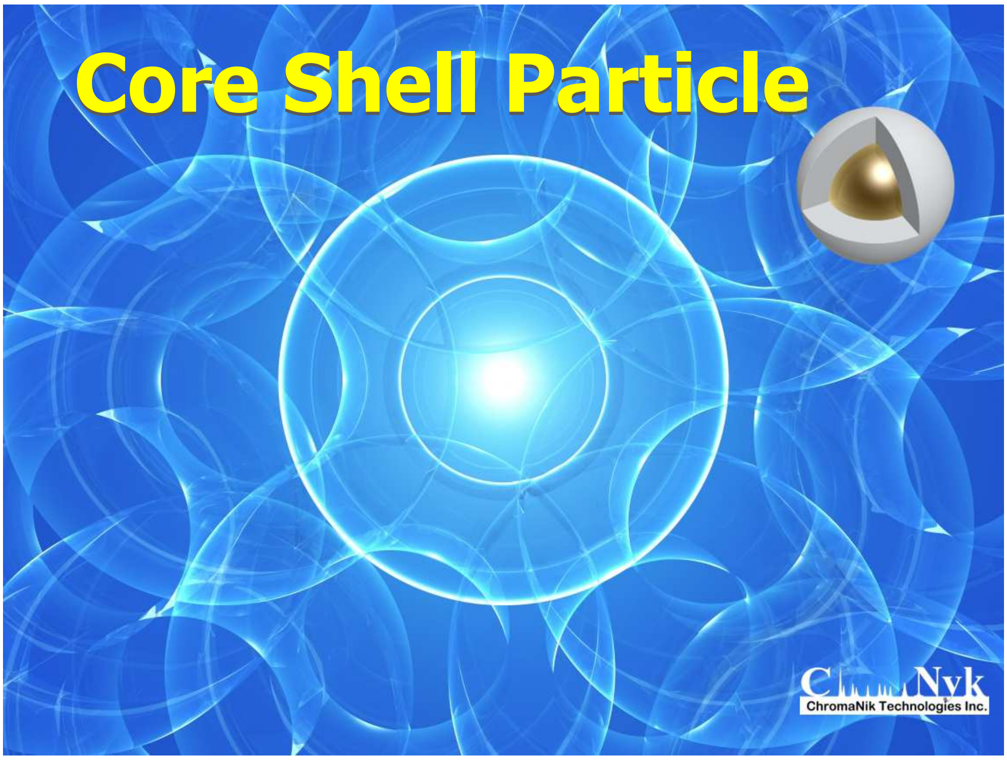
C18, C18-WP, HFC18-16, RP-AQUA, C8, C30, PFP, PFP&C18, Phenyl, Biphenyl, Cyano, C8-30HT, C4-100, HILIC-Amide, HILIC-S and 2-EP

SunShell

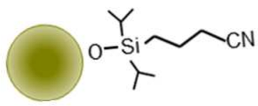
2 µm, 2.6 µm, 3.4 µm, 3.5 µm and 5 µm HPLC column



New Product

SunShell Cyano

Diisopropylcyanopropyl group



ChromaNik Technologies Inc.

"SunShell " is a core shell silica column made by ChromaNIk Technologies.

The next generation to Core Shell particle

SUNSHELL

Superficially porous silica

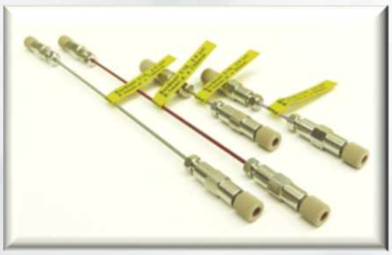
Features of SunShell

* 1.2 µm, 1.6 µm, 2.3 µm, 3.0 µm and 3.4 µm of core and 0.4 µm, 0.5 µm, 0.2 µm and 0.6 µm of superficially porous silica layer
*Higher efficiency and higher throughput to compare with totally porous silica with same size
*Same chemistry as Sunniest technology (reference page 6)
*Good peak shape for all compounds such as basic, acidic and chelating compounds
*High stability (pH range for SunShell C18, 1.5 to 10)
* Low breeding

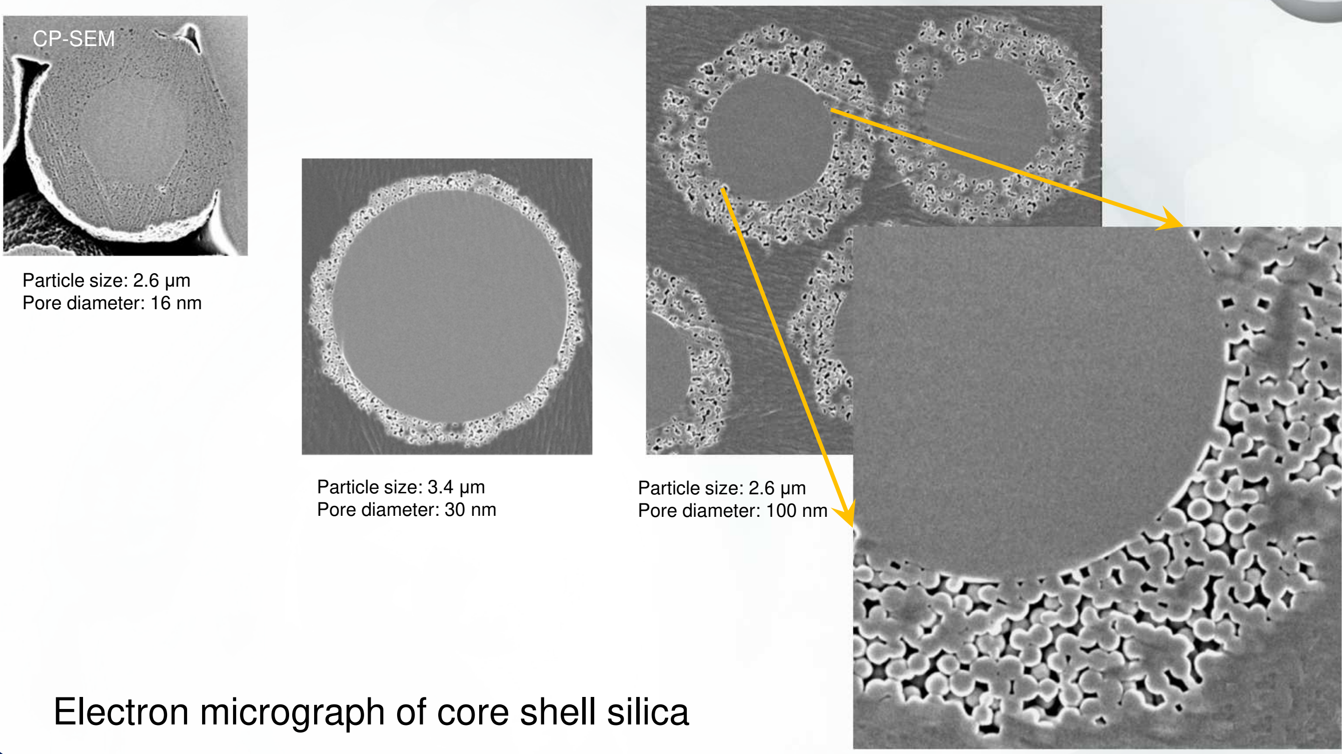
※ Metal free columns and nano- and microcolumns are listed on page 24





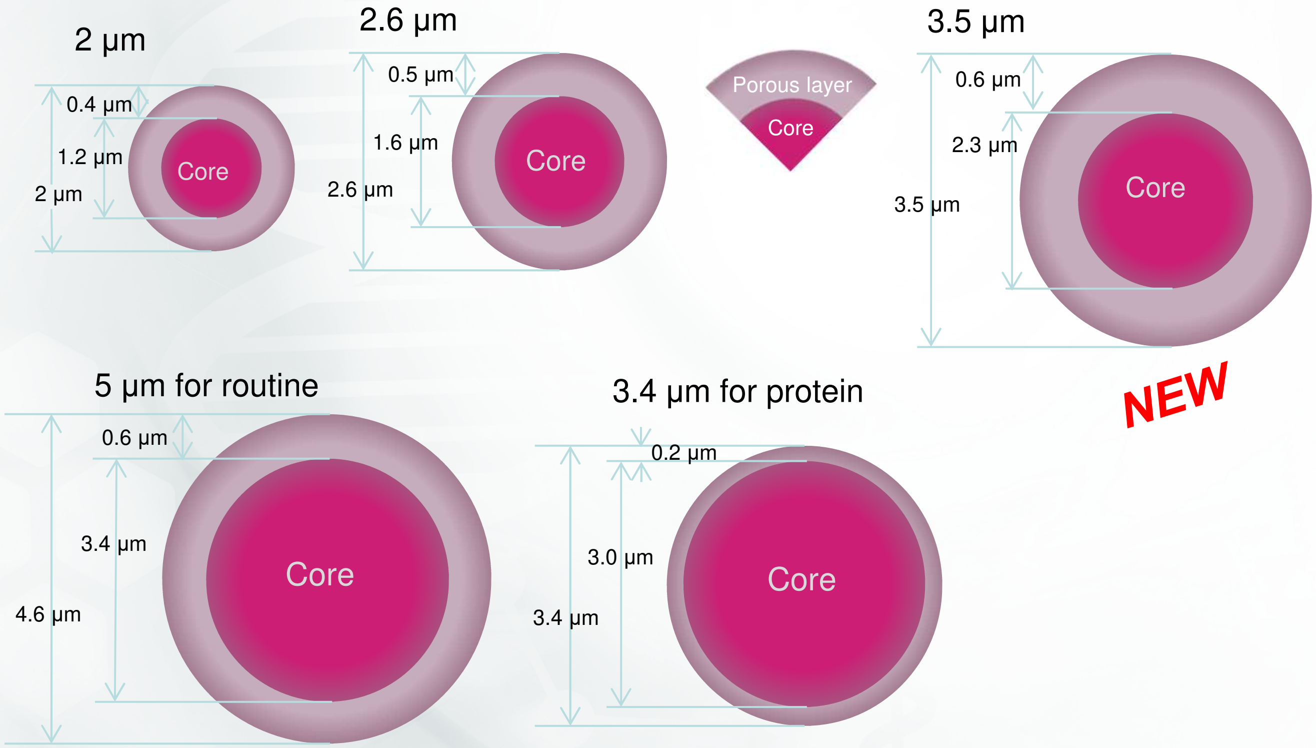


※ SunShell guard cartridge columns are listed on page 25



Electron micrograph of core shell silica

Core shell silica particles were embedded in resin, cross-section processed by Ar ion milling, Os (osmium) vapor deposited for conduction treatment, and observation. You can see the core (fused silica) and the porous layer around it。



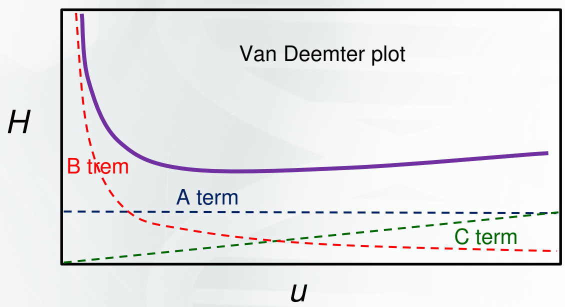
Schematic diagram of a core shell silica particle, 2.0, 2.6, 3.4 3.5 and 4.6 µm

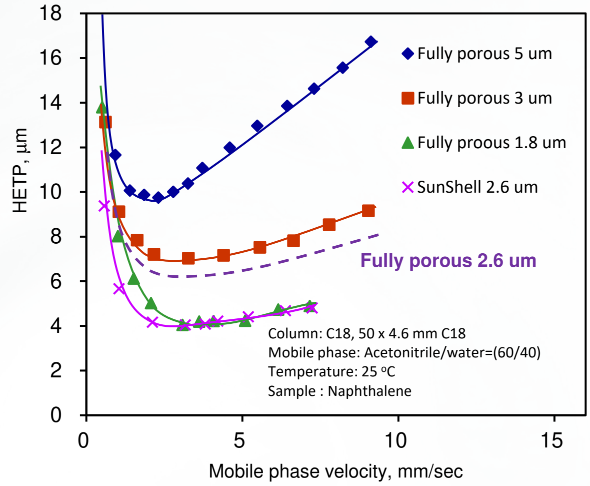
Why does a 2.6 µm core shell particle show the same performance as a sub 2 µm particle?

Van Deemter Equation

$$H = Ad_p + B\frac{D_m}{u} + C\frac{d_p^{\,2}}{D_m}u$$

A term : Eddy diffusion(dp is particle diameter)
B term : Longitudinal diffusion
(Dm is diffusion coefficient)
C term : Mass transfer



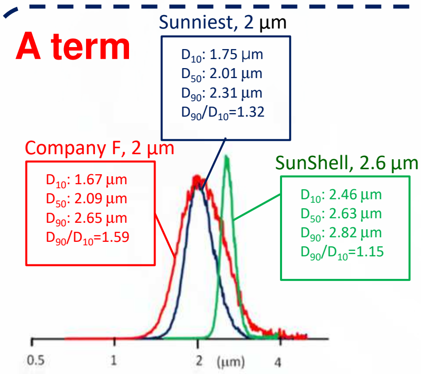


Comparison of plate height plots

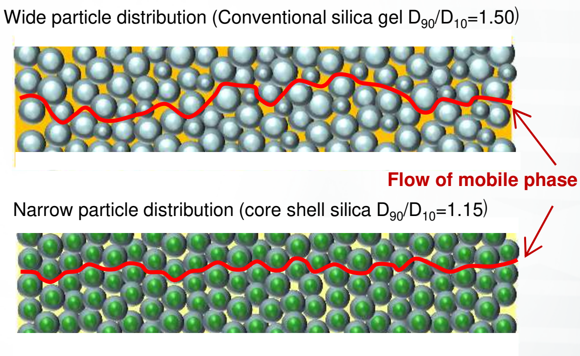
SunShell C18 shows same efficiency as a sub 2 µm C18. In comparison between fully porous 2.6 µm and core shell 2.6 µm (SunShell), SunShell shows lower values for A term, B term and C term of Van Deemter equation. The core shell structure leads higher performance to compare with the fully porous structure.

All terms in Van Deemter Equation reduce.

A term



Comparison of Particle Size Distribution



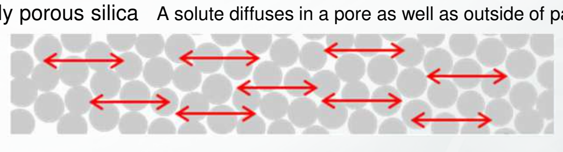
Packing state of core shell and fully porous silica

The size distribution of a core shell (SunShell) particle is much narrower than that of a conventional totally porous particle, so that the space among particles in the column reduces and efficiency increases by reducing Eddy Diffusion (multi-path diffusion) as the A term in Van Deemter Equation.

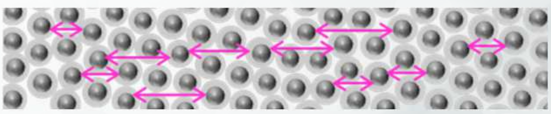
Diffusion of a solute is blocked by the existence of a core, so that a solute diffuses less in a core shell silica column than in a totally porous silica column. Consequently B term in Van Deemter Equation reduces in the core shell silica column.

B term

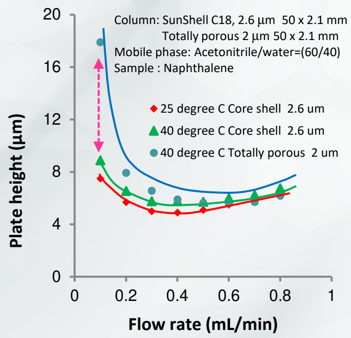
Totally porous silica   A solute diffuses in a pore as well as outside of particles.



Core shell silica   A core without pores blocks diffusion of a solute.

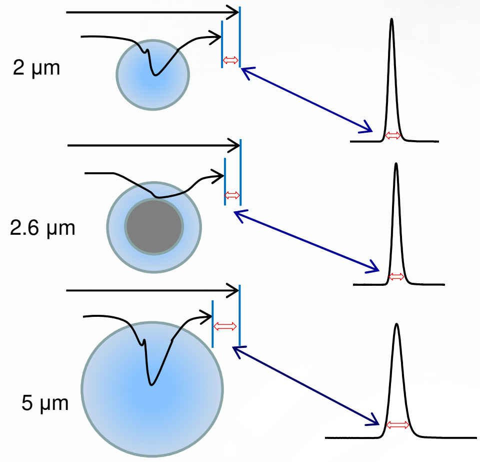


Difference of longitudinal diffusion



Plot of Flow rate and Plates height

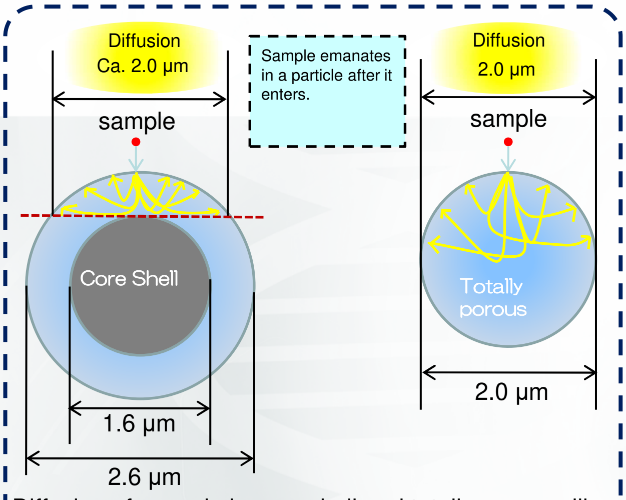
C term



Comparison of diffusion path

As shown in the left figure, a core shell particle has a core so that the diffusion path of samples shortens and mass transfer becomes fast. This means that the C term in Van Deemter Equation reduces. In other words, HETP (theoretical plate) is kept even if flow rate increases. A 2.6 µm core shell particle shows as same column efficiency as a totally porous sub-2 µm particle.

Considering diffusion of solute within pore

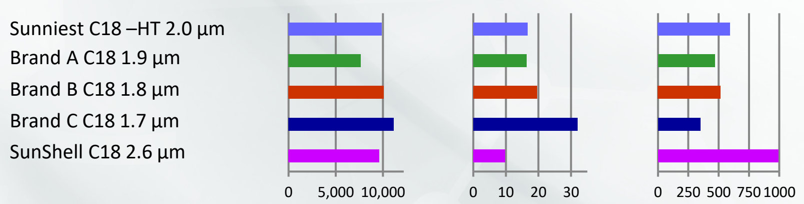


Diffusion of sample in core shell and totally porous silica

The left figure shows that a diffusion width of a sample in a 2.6 µm core shell particle and a 2 µm totally porous particle. Samples or solutes enter into the particle and move by diffusion, then they go out of a particle. In this moment, sample peak width is broadened. This broadening width is statistically same for 2.6 µm core shell particle and 2 µm fully porous particle. The 2.6 µm core shell particle is superficially porous, so that the diffusion width becomes narrower than particle size. Same diffusion means same efficiency.

Comparison of Performance by Plate/Pressure

	Plate	Back press. (MPa)	Plate/back press.
Sunniest C18 –HT 2.0 µm	9,900	16.7	593
Brand A C18 1.9 µm	7,660	16.3	470
Brand B C18 1.8 µm	10,100	19.6	515
Brand C C18 1.7 µm	11,140	32.0	348
SunShell C18 2.6 µm	9,600	9.7	990



Back pressure and theoretical plate were compared for 2 µm and sub 2 µm C18 and 2.6 µm SunShell C18. All columns showed almost the same theoretical plate except for brand A C18 1.9 µm. However back pressure was not same. Especially Brand C C18 1.7 µm showed the highest back pressure. And SunShell C18 2.6 µm showed the lowest back pressure. On the comparison of theoretical plate per back pressure, SunShell indicated the largest value. This is a big advantage.

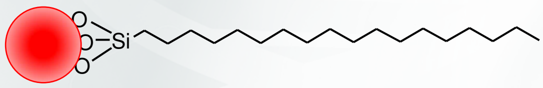
Column: 50 x 2.1 mm C18, Mobile phase: Acetonitrile/water=(70/30), Temperature: 25 ºC

SUNSHELL

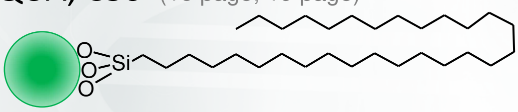
STATIONARY PHASE

Reversed phase

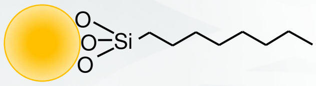
C18, C18-WP (7 page, 16 page, 20 page, SunShell Bio)



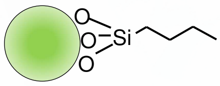
RP-AQUA, C30 (16 page, 19 page)



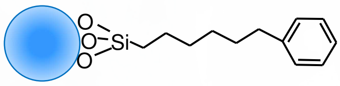
C8, C8-30HT (16 page, 20 page, 21 page)



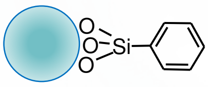
C4-100 (20 page, 21 page, SunShell Bio)



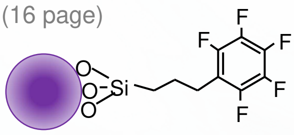
Phenyl (16 page)



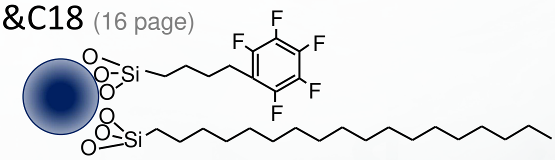
Phenyl (SunShell Bio)



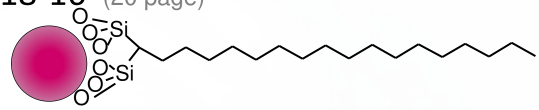
PFP (16 page)



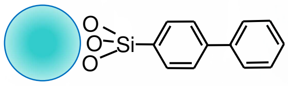
PFP&C18 (16 page)



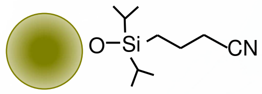
HFC18-16 (20 page)



Biphenyl (16 page)

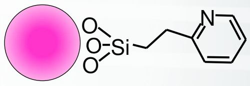


Cyano (16 page)

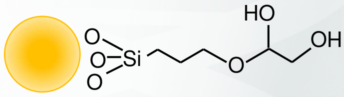


HILIC and SFC

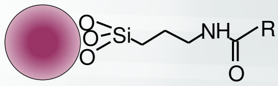
2EP (SunShell SFC)



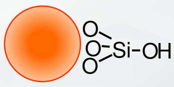
Diol (SunShell SFC, SunShell HILIC)



HILIC-Amide (23 page, SunShell HILIC)



HILIC-Silica (23 page, SunShell SFC, SunShell HILIC)



**All revered phases except for PFP and PFP&C18was end-capped at high temperature using Sunniest Endcapping technique.

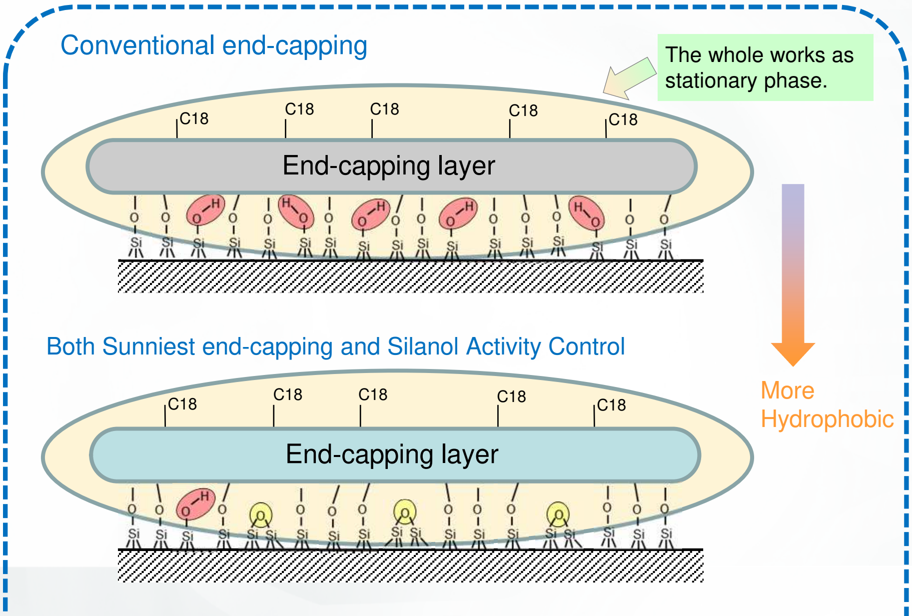
*Stationary phase for both SFC and HILIC was not end-capped.

SunShell Bio (1000Å), SunShell SFC and SunShell HILIC see individual catalogue.

ChromaNik Technologies Inc.

Unique end-capping by new concept

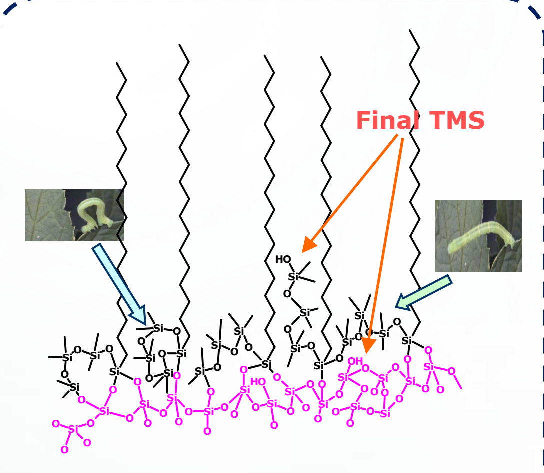
This figure shows comparison of hydrophobicity between two C18 stationary phases. We developed silanol activity control technique which was a reaction at extremely high temperature. This technique makes residual silanol groups change to siloxane bond. The upper one is a C18 phase with conventional end-capping and the lower one is a C18 phase with both Sunniest end-capping and silanol activity control. A residual silanol group contributes as a polar site and makes hydrophobicity of stationary phase decrease. On the other hand siloxane bond in the lower one doesn't make hydrophobicity decrease. Consequently the lower one is more hydrophobic than the upper one.



State of stationary phase with unique end-capping and comparison of hydrophobicity

End-capping method

1) Unique end-capping reagent
   <<Hexamethetyltrisiloxane>>
2) Secondly TMS end-capping



Schematic diagram of bonding of SunShell C18

An end-capping of hexamethyltrisiloxane works as an arm. This arm moves like a Geometrid caterpillar, so that a functional group on the tip of the arm can bond with a silanol group which is located anywhere.
Finally TMS reagent is bonded to a remaining silanol group.

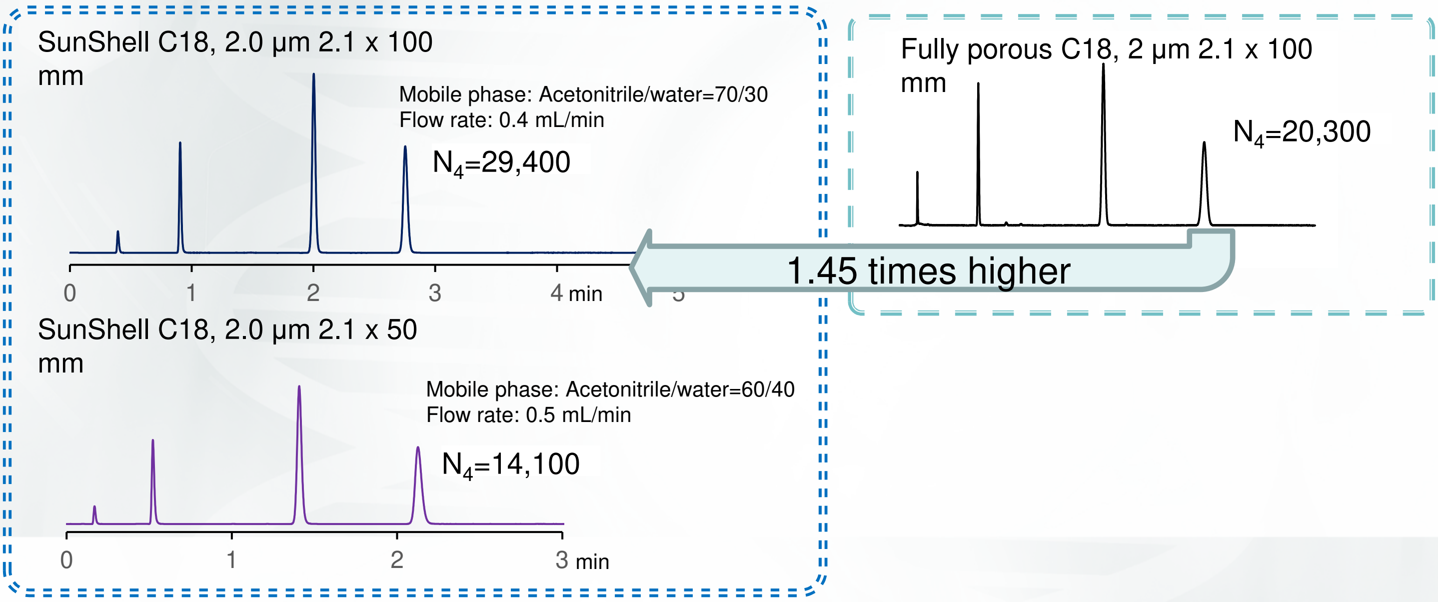
SunShell C18, 2 µm, 2.6 µm, 3.5 µm, 5 µm

Characteristics of SunShell C18

	Core shell silica			C18 (USP L1)				
	Particle size	Pore diameter	Specific surface area	Carbon content	Bonded phase	End-capping	Maximum operating pressure [a]	Available pH range
SunShell C18	2.0 µm	9 nm	120 m^2/g	6.5%	C18	Sunniest endcapping	100 MPa or 14504 psi	1.5 - 10
SunShell C18	2.6 µm	9 nm	150 m^2/g	7%	C18	Sunniest endcapping	60 MPa or 8,570 psi	1.5 - 10
NEW SunShell C18	3.5 µm	9 nm	120 m^2/g	6.5%	C18	Sunniest endcapping	60 MPa or 8,570 psi	1.5 - 10
SunShell C18	4.6 µm	9 nm	90 m^2/g	5.5%	C18	Sunniest endcapping	50 MPa or 7,141 psi	1.5 - 10

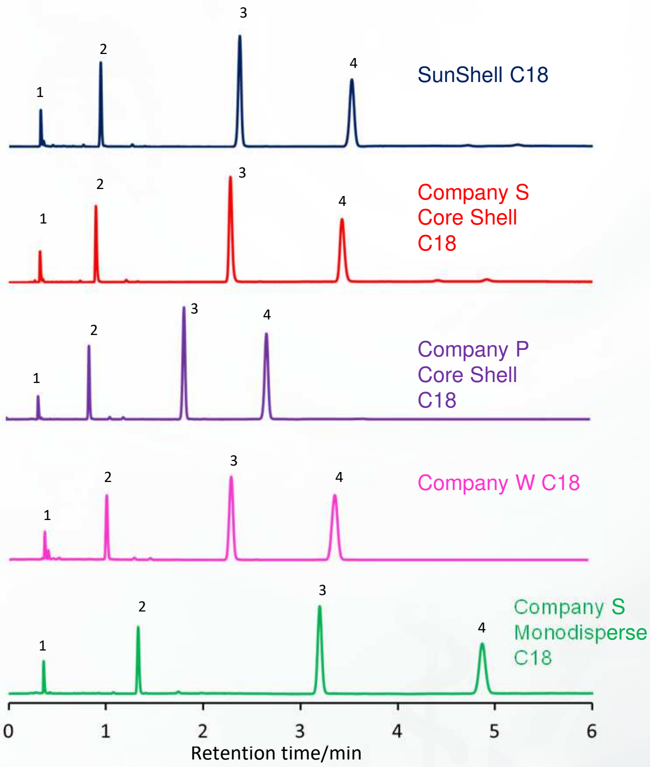
a) Unless otherwise specified in the column test report

Core Shell particle shows 1.4 to1.5 times higher plate than fully porous particle.



Theoretical plate and tailing factor

Used columns: SunShell C18 2 µm, Ascentis Express C18 2 µm, Kinetex C18 1.7 µm, Acquity BEH C18 1.7 µm, Titan C18 1.9 µm

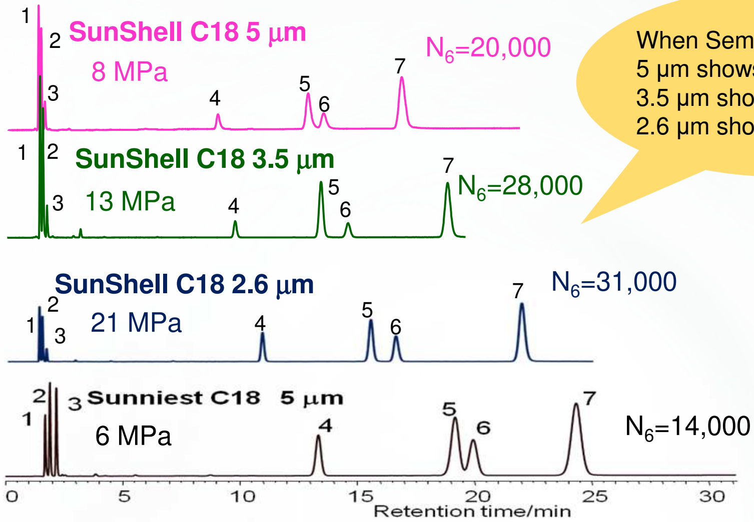


Column: SunShell C18, 2 µm 100 x 2.1 mm
Company S Core Shell C18, 2 µm 100 x 2.1 mm
Company P Core Shell C18, 1.7 µm 100 x 2.1 mm
Company W C18, 1.7 µm 100 x 2.1 mm
Company S Monodisperse C18, 1.9 µm 100 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.5 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil, 2 = Ethylbenzoate, 3 = Acenaphthene, 4 = Butylbenzene

	Acenaphthene		Pressure (MPa)	Theoretical plate /pressure (MPa^{-1})
	Theoretical plate	Tailing factor		
SunShell C18	29,721	1.04	48.5	613
Company S Core Shell C18	25,533	1.19	53.5	477
Company P Core Shell C18	24,700	0.97	53.8	458
Company W C18	14,511	1.01	54.1	269
Company S Monodisperse C18	26,592	1.05	43.9	605

*Ascentic Express is a registered trade mark of Sigma Aldrich. Titan is a registered trade mark of Sigma Aldrich.
Comparative separations may not be representative of all applications.

Comparison of retention and plate using HPLC

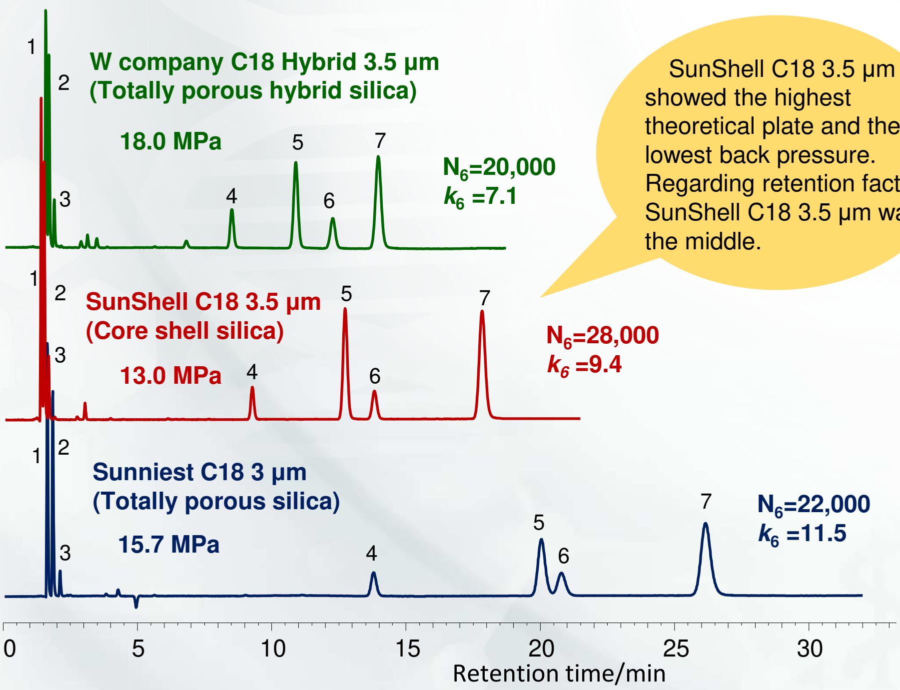


When Semi-Micro LC is used,
5 µm shows 24,000plates,
3.5 µm shows 31,000plates,
2.6 µm shows 38,000plates.

Column size: 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil
2 = Caffeine
3 = Phenol
4 = Butylbenzene
5 = o-Terphenyl
6 = Amylbenzene
7 = Triphenylene
HPLC: Hitachi LaChrom ELITE
(Tubing, 0.25 mm i.d.)

	Totally porous silica Sunniest C18, 5 µm		Core shell silica SunShell C18, 2.6 µm		Core shell silica SunShell C18, 3.5 µm		Core shell silica SunShell C18, 5 µm	
Specific surface area	340 m²/g		150 m²/g		120 m²/g		90 m²/g	
Packings weight (150x4.6mm)	1.5 g		2.7 g		2.7 g		3.2 g	
Surface area in a column	510 m²/g (100%)		405 m²/g (79%)		324 m²/g (64%)		288 m²/g (56%)	
	Retention time (t_R)	Retention factor (k)	Retention time (t_R)	Retention factor (k)	Retention time (t_R)	Retention factor (k)	Retention time (t_R)	Retention factor (k)
1) Uracil	1.70	0	1.34	0	1.33	0	1.30	0
6) Amylbenzene	19.96	10.74	16.56	11.36	13.90	9.45	12.43	8.56
Relative value of Amylbenzene	100%	100%	83%	106%	70%	88%	63%	80%

Comparison between porous C18 and SunShell C18 3.5 µm column

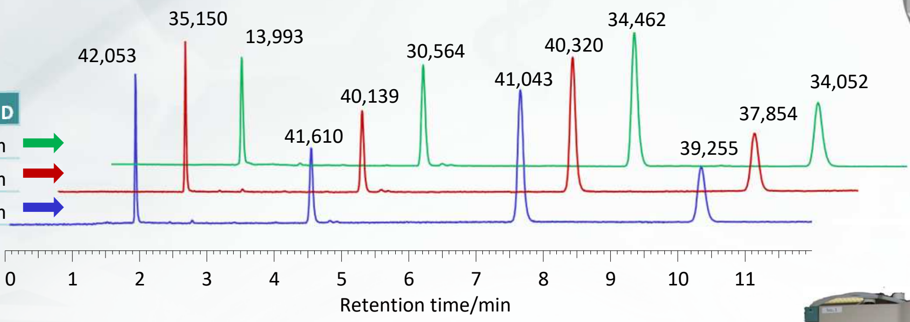


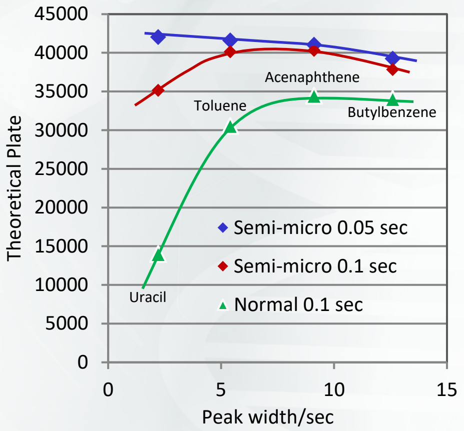
SunShell C18 3.5 µm showed the highest theoretical plate and the lowest back pressure. Regarding retention factor, SunShell C18 3.5 µm was the middle.

Column size: 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil
2 = Caffeine
3 = Phenol
4 = Butylbenzene
5 = o-Terphenyl
6 = Amylbenzene
7 = Triphenylene
HPLC: Conventional HPLC instrument
(Tubing, 0.25 mm i.d.)

Comparison between normal and semi-micro HPLC

Flow cell	Response	Sampling	Tubing ID
Normal	0.1 sec	0.4 sec	0.25 mm
Semi-micro	0.1 sec	0.4 sec	0.13 mm
Semi-micro	0.05 sec	0.05 sec	0.13 mm





Relationship between Peak width and theoretical plate

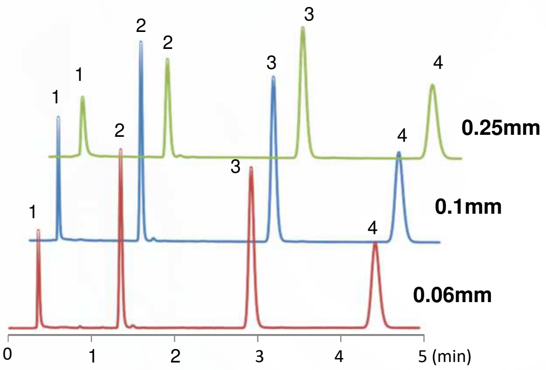
Comparison of chromatograms

Column:
SunShell C18, 5 µm 250 x 4.6 mm
Mobile phase:
CH_3CN/H_2O= 70/30
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Pressure: 6.7 MPa
Detection: UV@250 nm
Sample: 1 = Uracil
2 = Toluene
3 = Acenaphthene
4 = Butylbenzene

HPLC: Hitachi LaChrom ELITE

Semi-micro HPLC derives near 100% performance of a core shell column. Even if normal HPLC is used, it derives 80% performance except for a narrow peak whose width is less than 5 second

Effect of inner diameter of tubing



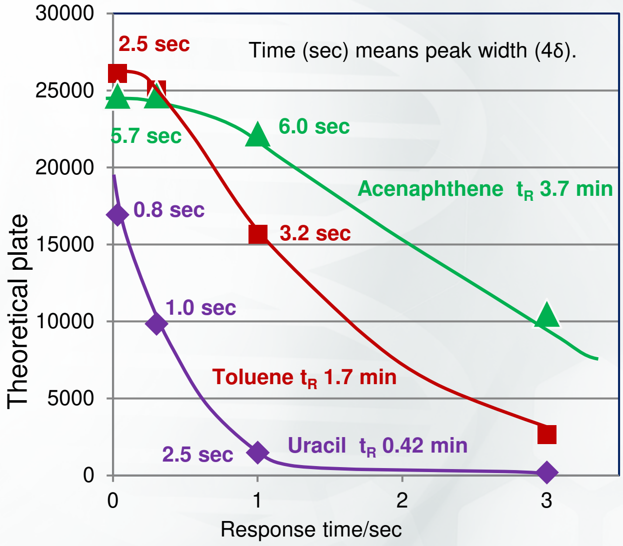
Average of theoretical plate (n=3)

Inner diameter of tubing	0.06mm	0.1mm	0.25mm
Peak (1)	792	785	246
Peak (2)	7790	7652	3535
Peak (3)	10704	10345	7998
Peak (4)	10113	9772	7689

Column: SunShell C18, 2.6 µm 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.3 mL/min Temperature: Ambient
Tube length: 30 cm (Peek, from the column to the flow cell)
Instrument: X-LC(JASCO) Response time: 0.01 sec

The above theoretical plate was compared changing the inner diameter of tubing between a column and a flow cell of the detector. A tubing with a large inner diameter has a large dead volume, so that it makes the peak width be wide. As a result, theoretical plate decreases. I recommend to use the tubing with 0.1 mm or less than 0.1 mm inner diameter for core shell columns.

Effect of response time of detector



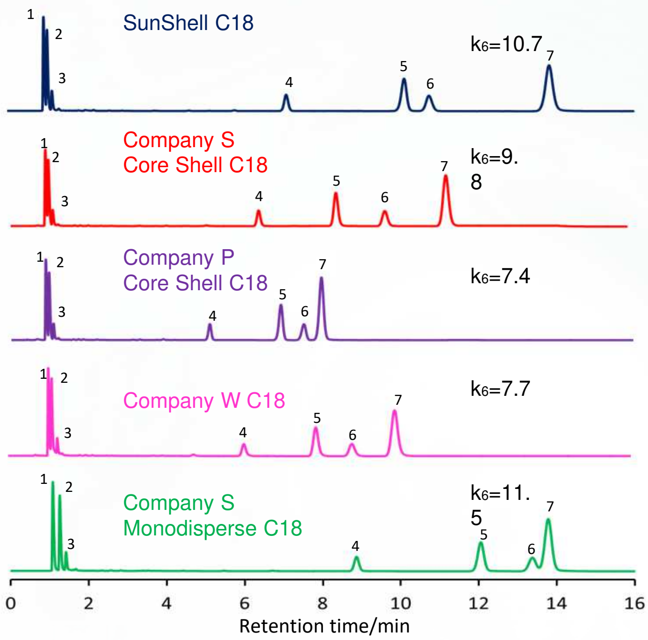
Column: SunShell C18, 2.6 µm 100 x 4.6 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 1.8 mL/min Temperature: Ambient
Sample: Toluene Tube: i.d.0.1㎜ x 20 cm Peeksil
Instrument: X-LC(JASCO)

The response time of a detector is important. Regarding uracil, the real peak width is less than 0.8 sec. When the peak width is less than 1 sec, 0.03 sec of response time is needed. Furthermore, the sampling rate of an integrator should be set to be 0.1 sec.

Comparison of core shell 2 μm and totally porous sub 2 μm

Used columns: SunShell C18 2 μm, Ascentis Express C18 2 μm, Kinetex C18 1.7 μm, Acquity BEH C18 1.7 μm, Titan C18 1.9 μm

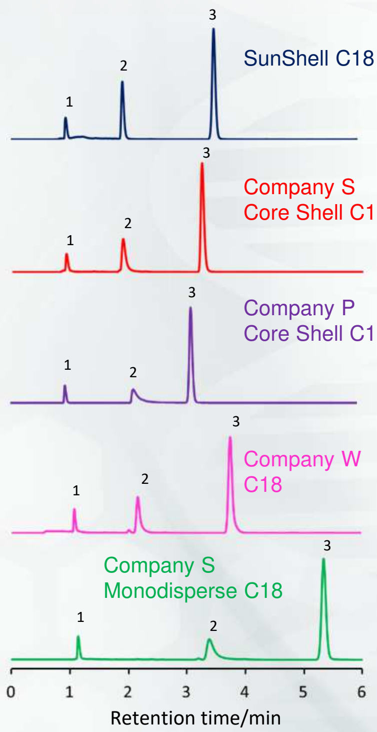
Separation of standard samples



Column: SunShell C18, 2 μm 100 x 2.1 mm
Company S Core Shell C18, 2 μm 100 x 2.1 mm
Company P Core Shell C18, 1.7 μm 100 x 2.1 mm
Company W C18, 1.7 μm 100 x 2.1 mm
Company S Monodisperse C18, 1.9 μm 100 x 2.1 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene
5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene

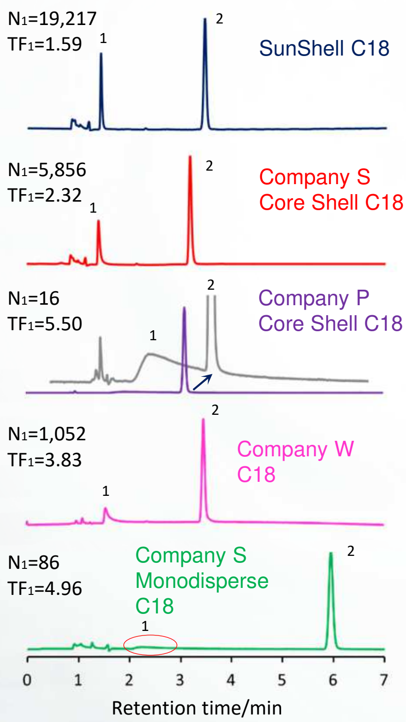
	Hydrogen bonding (Caffeine/Phenol)	Hydrophobicity (Amylbenzene/Butylbenzene)	Steric selectivity (Triphenylene/o-Terphenyl)
SunShell C18	0.43	1.59	1.41
Company S Core Shell C18	0.37	1.59	1.38
Company P Core Shell C18	0.45	1.57	1.17
Company W C18	0.35	1.55	1.30
Company S Monodisperse C18	0.53	1.58	1.16

Comparison of Pyridine (2) as a basic compound



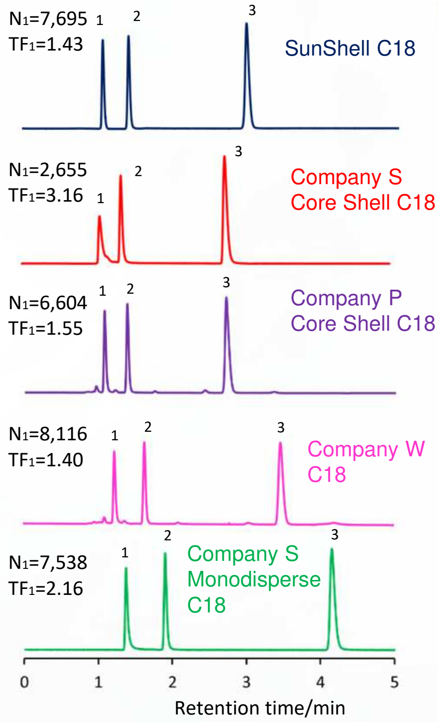
Column dimension: 100 x 2.1 mm
Mobile phase: CH_3OH/H_2O=30/70
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = Uracil
2 = Pyridine
3 = Phenol

Comparison of Oxine (1) as a metal chelating compound



Column dimension: 100 x 2.1 mm
Mobile phase: CH_3CN/20mM H_3PO_4=10/90
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = 8-Quinolinol (Oxine)
2 = Caffeine

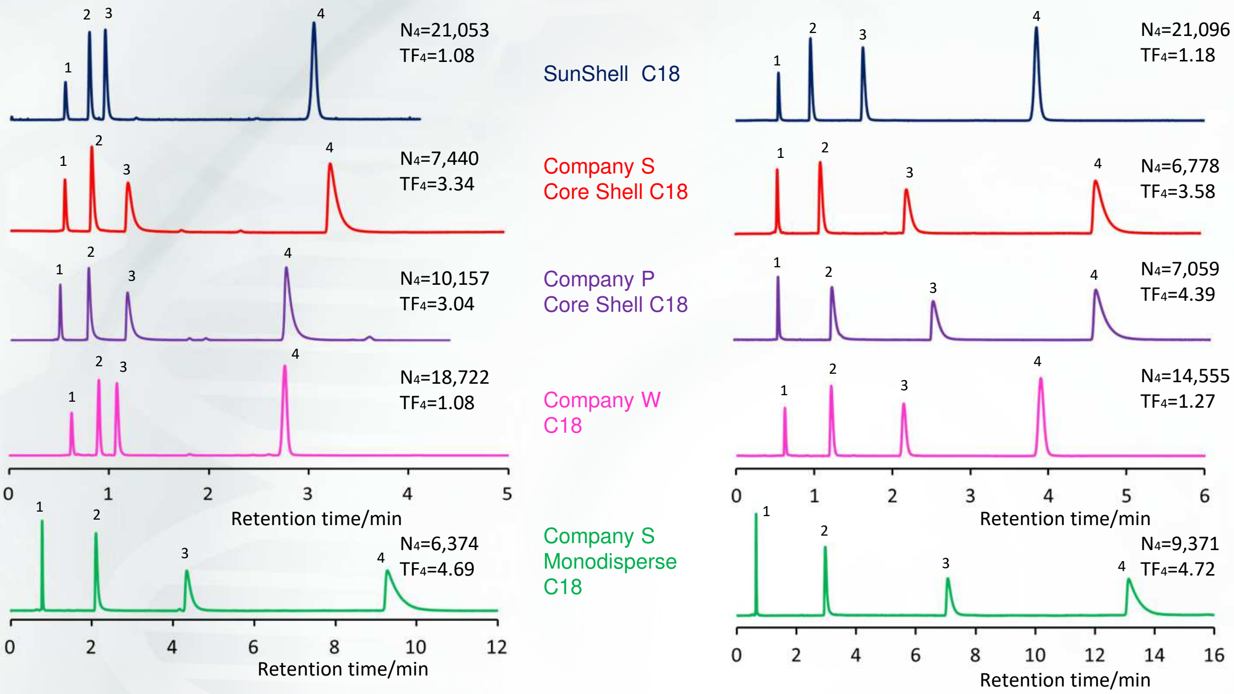
Comparison of Formic acid (1) as an acidic compound



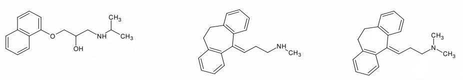
Column dimension: 100 x 2.1 mm
Mobile phase: CH_3CN/0.1% H_3PO_4=2/98
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Detection: UV@210nm
Sample: 1 = Formic acid
2 = Acetic acid
3 = Propionic Acid

SunShell C18 2 µm

Comparison of Amitriptyline (4) as a strong basic compound

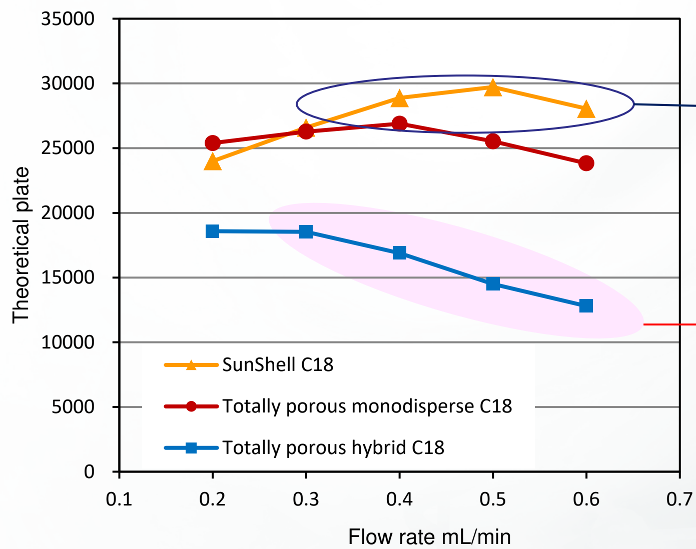


Column dimension: 100 x 2.1 mm
Mobile phase: CH_3CN/20 mM Phosphate buffer pH 7.0=60/40
Flow rate: 0.3 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1 = Uracil, 2 = Propranolol, 3 = Nortriptyline, 4 = Amitriptyline



Column dimension: 100 x 2.1 mm
Mobile phase: CH_3CN/10 mM ammonium acetate pH 6.8=40/60
Flow rate: 0.3 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1 = Uracil
2 = Propranolol
3 = Nortriptyline
4 = Amitriptyline

Decreasing of theoretical plate due to frictional heating effect



Core shell silica has a solid core (non-porous silica), so that thermal conductivity is high in the column. There is no influence of reducing theoretical plate by frictional heating.

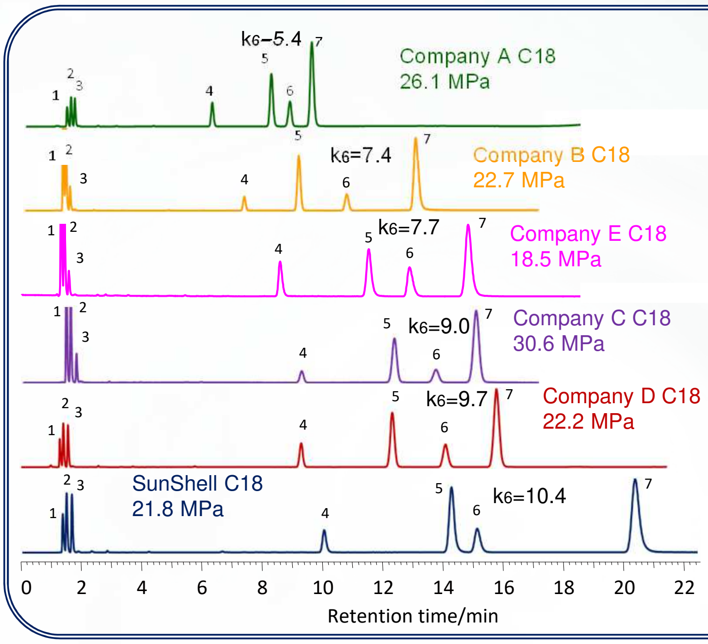
Regarding totally porous hybrid silica, not only totally porous structure but also including ethylene groups make thermal conductivity be low in the column. It is considered that frictional heating deflects thermal distribution in the column and theoretical plate decreases..

Column: 100 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Temperature: 40 ºC
Sample: Acenaphthene,

Comparison of core shell 2.6 µm columns

Used columns
1. Kinetex C18, 2.6 µm
2. Accucore C18, 2.6 µm
3. PoroShell C18 EC, 2.7 µm
4. Ascentis Express C18, 2.7 µm
5. Cortecs C18, 2.7 µm
6. SunShell C18, 2.6 µm

Comparison of standard samples among core shell C18s

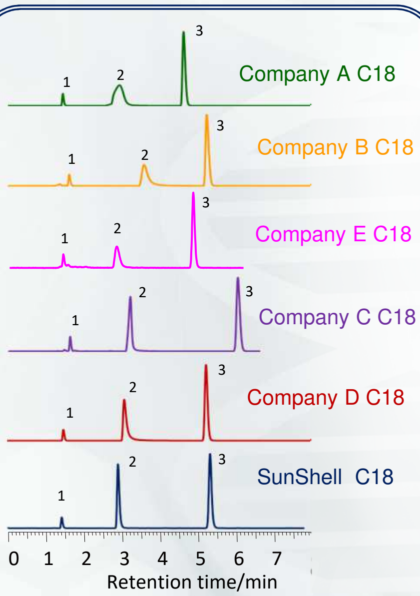


Column: Company A C18, 2.6 µm 150 x 4.6 mm (26.1 Mpa, 30,800 plate)
Company B C18, 2.6 µm 150 x 4.6 mm (22.7 MPa , 31,600 plate)
Company W C18, 2.7 µm 150 x 4.6 mm (18.5 MPa , 23,300 plate)
Company C C18, 2.7 µm 150 x 4.6 mm (30.6 MPa , 30,200 plate)
Company D C18, 2.7 µm 150 x 4.6 mm (22.2 MPa , 31,800 plate)
SunShell C18, 2.6 µm 150 x 4.6 mm (21.8 MPa , 31,900 plate)
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min, Temperature: 40 ºC
Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene
5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene

	Hydrogen bonding (Caffeine/Phenol)	Hydrophobicity (Amylbenzene/Butylbenzene)	Steric selectivity (Triphenylene/o-Terphenyl)
Company A C18	0.48	1.54	1.20
Company B C18	0.35	1.56	1.50
Company E C18	0.38	1.59	1.32
Company C C18	0.42	1.57	1.25
Company D C18	0.44	1.60	1.31
SunShell C18	0.39	1.60	1.46

Retention of standard samples and back pressure were compared for six kinds of core shell type C18s. Company A C18 showed only a half retention to compare with SunShell C18. Steric selectivity becomes large when ligand density on the surface is high. SunShell C18 has the largest steric selectivity so that it has the highest ligand density. This leads the longest retention time.

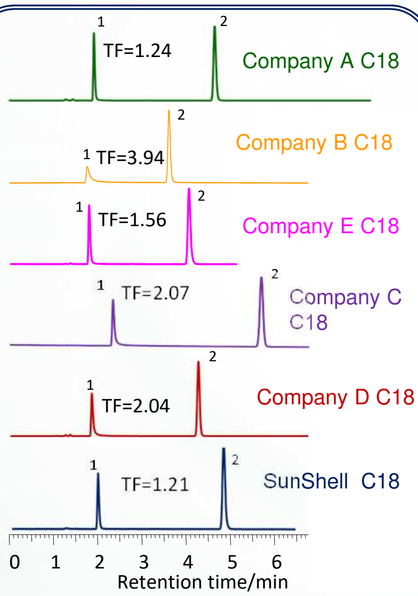
Comparison of pyridine



Column dimension: 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=30/70
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = Uracil
2 = Pyridine
3 = Phenol

Residual silanol groups make pyridine be tailing under methanol/water mobile phase condition. SunShell C18 shows a sharp peak for pyridine.

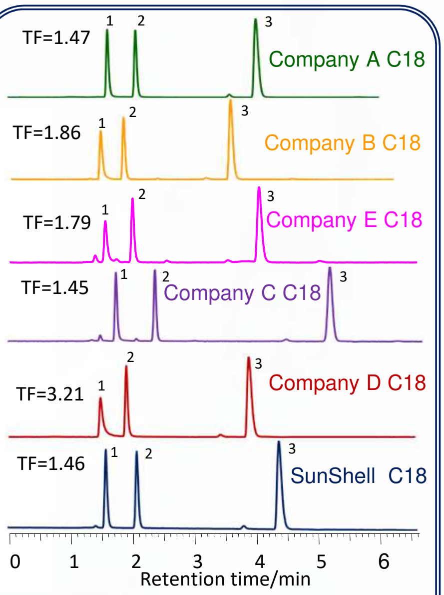
Comparison of Oxine



Column dimension: 150 x 4.6 mm
Mobile phase: CH_3CN/20mM H_3PO_4=10/90
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = 8-Quinolinol (Oxine)
2 = Caffeine

8-Quinolinol (Oxine) is a metal chelating compound. Metal impurities in the core shell particle leads the tailing for oxine peak.

Comparison of formic acid



Column dimension: 150 x 4.6 mm
Mobile phase: CH_3CN/0.1% H_3PO_4=2/98
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@210nm
Sample: 1 = Formic acid
2 = Acetic acid
3 = Propionic Acid

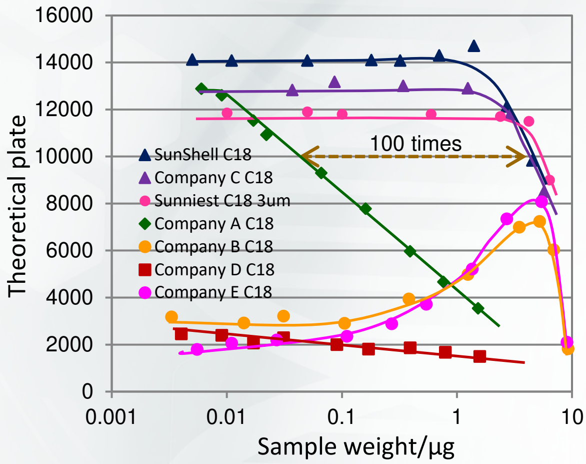
Formic acid is used as an indicator for a acidic inertness. SunShell and Company A and C C18 show a sharp peak.

Loading capacity of amitriptyline as a basic compound

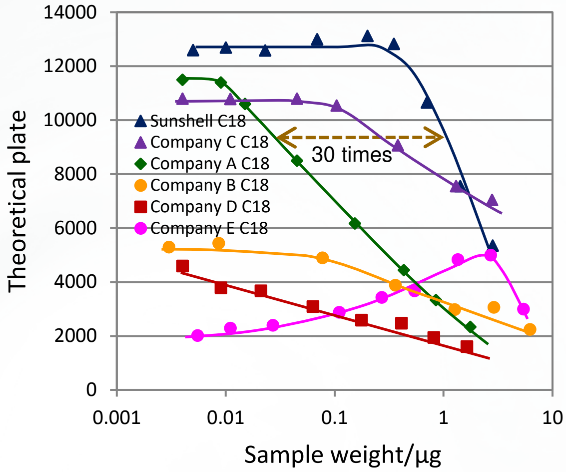
Amitriptyline overlords much more at acetonitrile/buffer mobile phase than methanol/buffer. Three kinds of core shell C18s were compared loading capacity of amitriptyline at three different mobile phases.

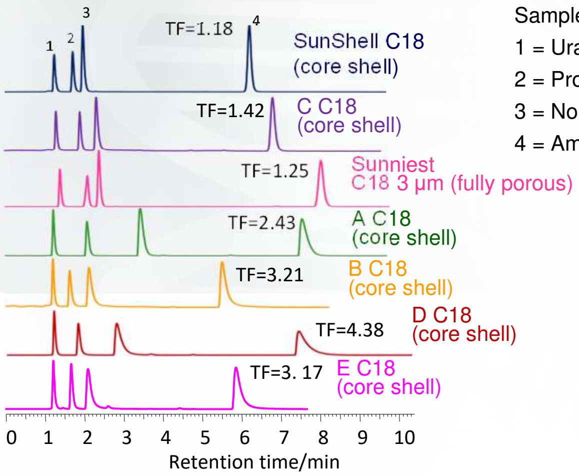
Common condition: Column dimension,150 x 4.6 mm, flow rate; 1.0 mL/min, temperature; 40 °C

Mobile phase: Acetonitrile/**20mM phosphate buffer pH7.0**=(60:40)

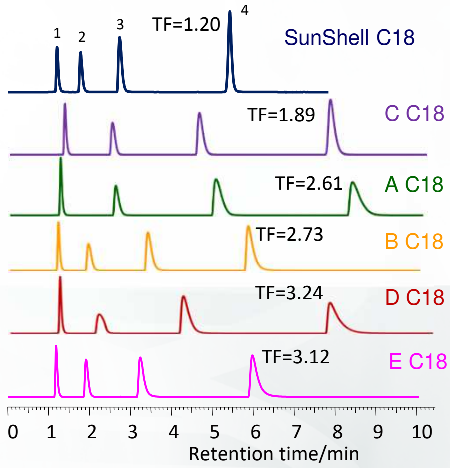


Mobile phase: Acetonitrile/**10mM acetate ammonium pH6.8**=(40:60)

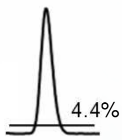




Sample:
1 = Uracil (0.07µg)
2 = Propranolol (1.53µg)
3 = Nortriptyline (0.32µg)
4 = Amitriptyline (0.32µg)



Theoretical plate was calculated by 5σ method using peak width at 4.4% of peak height.



Physical properties

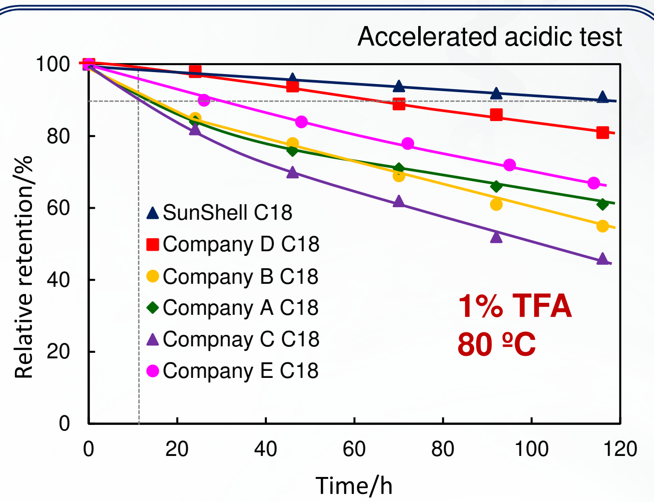
	Carbon loading (%)	Specific surface area ᵃ (m²/g)	Pore volume ᵃ (mL)	Pore diameter ᵃ (nm)
SunShell C18	7.3 (7)ᵇ	125 (150)ᵇ	0.261	8.34 (9)ᵇ
Ascentis Express C18	8.0	133 (150)ᵇ	0.278	8.20 (9)ᵇ
PoroShell C18 EC	8.5 (8)ᵇ	135 (130)ᵇ	0.414	12.3 (12)ᵇ
Accucore C18	8.8 (9)ᵇ	130 (130)ᵇ	0.273	8.39 (8)ᵇ
Cortecs C18	7.3 (6.6)ᵇ	113	0.264	9.32
Kinetex C18	4.9 (12 effective)ᵇ	102 (200 effective)ᵇ	0.237	9.25 (10)ᵇ

a. Measured after sintered at 600 degree Celsius for 8 hours.
b. Value cited in company brochure or literature.

Comparison column
1. Kinetex C18, 2.6 µm
2. Accucore C18, 2.6 µm
3. PoroShell C18 EC, 2.7 µm
4. Ascentis Express C18, 2.7 µm
5. Cortecs C18 2.7 µm
6. SunShell C18, 2.6 µm

All columns are core shell type. All columns sized 150 x 4.6 mm except for company E show 38,000 to 40,000 plates for a neutral compound. However regarding a basic compound like amitriptyline, SunShell C18 and company C C18 showed a good peak, while Company A, B and D C18 showed a poor peak. Company A C18 overloaded at more than 0.01 µg of amitriptyline while SunShell C18 overloaded at more than from 0.3 to 1 µg of amitriptyline. Surprisingly loading capacity of company A C18 was only one hundredth to compare with SunShell C18 under acetonitrile/20mM phosphate buffer pH7.0=(60:40) mobile phase. Company D C18 always showed poor peak of amitriptyline.

◆Evaluation of Stability

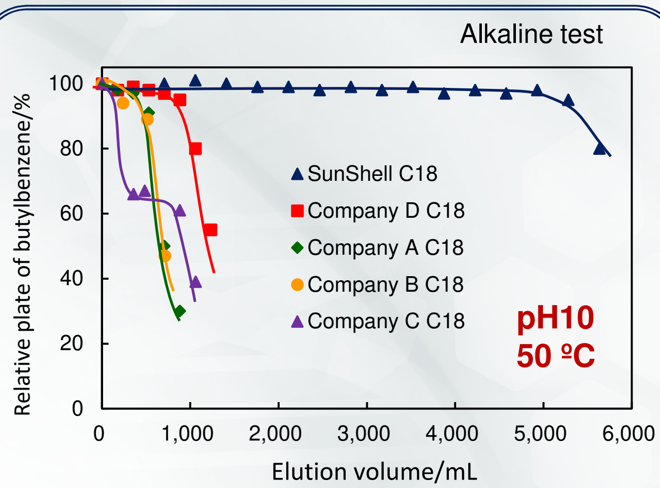


Durable test condition

Column size: 50 x 2.1 mm
Mobile phase: CH_3CN/1.0% TFA, pH1=10/90
Flow rate: 0.4 mL/min
Temperature: 80 ºC

Measurement condition

Column size: 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.4 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil (t_0)
2 = Butylbenzene



Durable test condition

Column Size: 50 x 2.1 mm
Mobile phase:
CH_3OH/20mM Sodium borate/10mM NaOH=30/21/49 (pH10)
Flow rate: 0.4 mL/min
Temperature: 50 ºC

Measurement condition

Column Size: 50 x 2.1 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 0.4 mL/min
Temperature: 40 ºC
Sample: 1 = Butylbenzene

Stability under acidic pH condition was evaluated at 80 ºC using acetonitrile/1% trifluoroacetic acid solution (10:90).

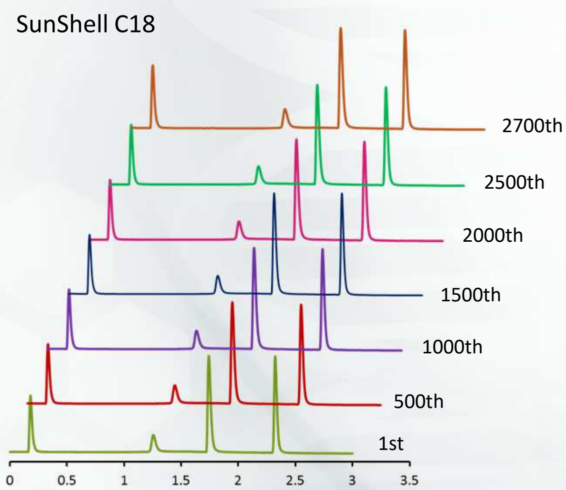
★Sunshell C18 has kept 90% retention for 100 hours under such a severe condition. SunShell C18 is 5 to 10 times more stable than the other core shell C18.

Stability under basic pH condition was evaluated at 50 ºC using methanol/Sodium borate buffer pH 10 (30:70) as a mobile phase. Sodium borate is used as a alkaline standard solution for pH meter, so that its buffer capacity is high.

Elevated temperature of 10 ºC makes column life be one third. The other company shows stability test at ambient (room temperature). If room temperature is 25 ºC, column life at room temperature (25 ºC) is sixteen times longer than that at 50 ºC.

★ SunShell C18 is enough stable even if it is used under pH 10 condition. Regarding stability under basic pH condition, there is little C18 column like SunShell C18 except for hybrid type C18. It is considered that our end-capping technique leads high stability.

◆Continuous analysis under pH9.5 condition

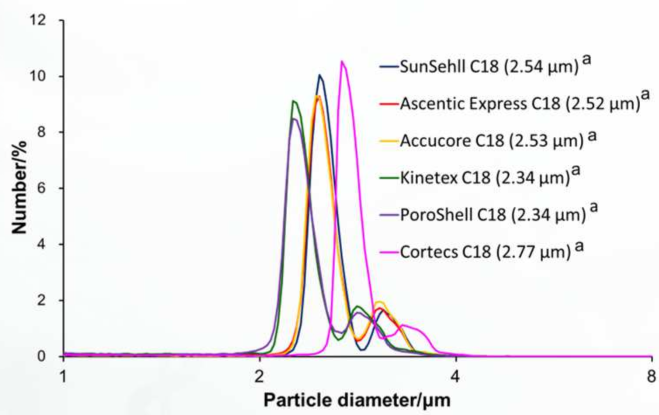


Column: SunShell C18, 2.6 µm 50 x 2.1 mm
Mobile phase: A) 10 mM Ammonium bicarbonate pH 9.5
B) Acetonitrile
Gradient program:

Time (min)	0	1	3	3.1	5
%B	30	90	90	30	30

Flow rate: 0.5 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1=Uracil, 2=Propranolol, 3= Nortriptyline, 4=Amitriptyline

◆Comparison of particle size

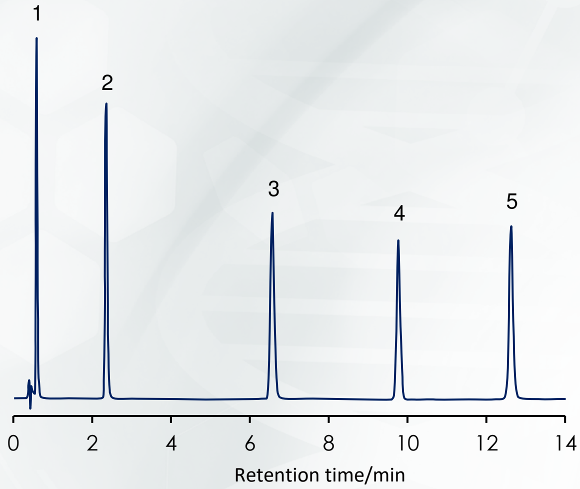


*Measured using Beckman Coulter Multisizer 3 after C18 materials were sintered at 600 degree Celsius for 8 hours. The measured value of each sintered core shell silica is considered to be different from that of the original core shell silica.

a. Median particle size

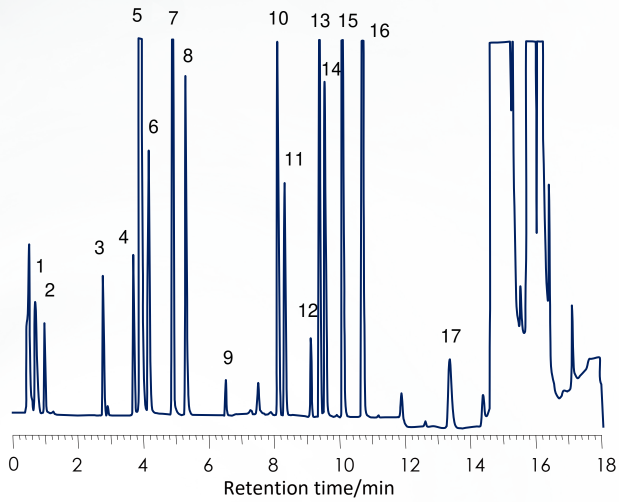
SunShell

Peptides (using the 1.0 mm i.d. column)



Column: SunShell RP-AQUA, 2.6 µm 100 x 1.0 mm
Mobile phase: A) 0.1 % trifluoroacetic acid (TFA) in water
B) 0.08 % trifluoroacetic acid (TFA) in acetonitrile
%B 10% to 30% in 25 min
Flow rate: 0.15 mL / min
Temperature: 60 °C
Detection: UV@214 nm
Sample: 1 = Gly-Tyr, 2 = Val-Tyr-Val, 3 = Met enkephalin,
4 = Leu enkephalin, 5 = Angiotensin II
(HPLC peptide standard mixture by Sigma-Aldrich)

Amino Acids derivatized with OPA and FMOC

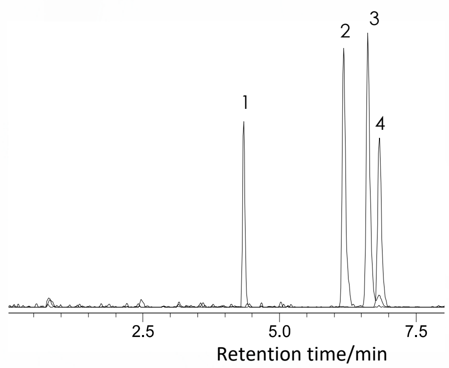


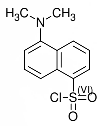
Column: SunShell C18 2.6 µm, 150 x 2.1 mm
Mobile phase: A) 10mM Na_2PO_4 + 10mM $Na_2B_4O_7$ + 0.5mM NaN_3 (pH7.8)
B) Acetonitrile/Methanol/Water (45/45/10 %V)

Time (min)	0	0.4	12.8	13.8
%B	5	5	50	100

Flow rate: 0.61 mL/min
Temperature: 40 ºC
Detection: UV@338 nm
Sample: 1=Aspartic acid, 2=Glutaminc acid, 3=Serine, 4=Histidine, 5=Glycine, 6=Threonine, 7=Arginine, 8=Alanine, 9=Tyrosine, 10=Valine, 11=Methionine, 12=Tryptophan, 13=Pnehylalanine, 14=Isoleucine, 15=Leucine, 16=Lysine, 17=Proline

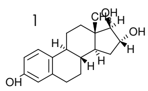
Dansylated estrogen hormones





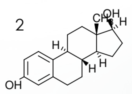
Dansyl chloride

1



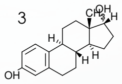
Estriol,

2



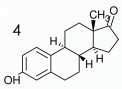
17Beta-estradiol,

3



17Alpha-estradiol

4



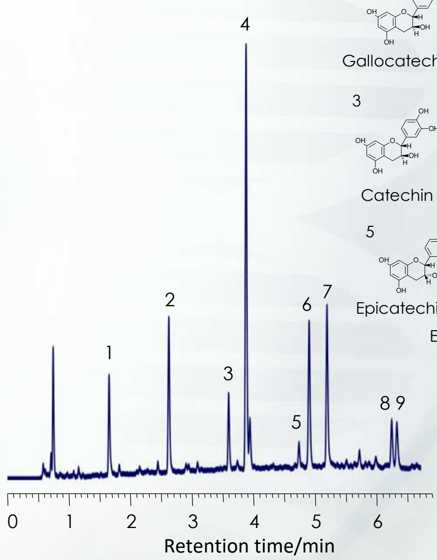
Estrone

Column: SunShell C18 2.6 µm, 100 x 2.1 mm
Mobile phase:
A) H_2O with 0.1% formic acid.
B) CH_3CN with 0.1% formic acid.
Gradient program:
0 - 0.5 min: 10% B
0.51 – 3.0 min: 10 - 72% B
3.01 - 6.0 min: 72% B
6.01 - 7.0 min: 72 - 100% B
7.01 - 10.0 min: 100% B

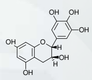
Flow rate: 0.45 mL/min.
Temperature: 40 ºC
Detection: MS(sim), m/z, 522.20, 506.20, 504.20
Samples: 1. Dansylated estriol, 2. Dansylated 17beta-estradiol,
3. Dansylated 17alpha-estradiol , 4. Dansylated estrone

Courtesy of Department of Chemistry & Biochemistry, The University of Texas at Arlington

Oolong tea

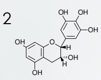


1



Gallocatechin

2

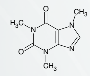


Epigallocatechin

3

Catechin

4

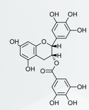


Caffeine

5

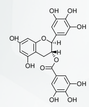
Epicatechin

6



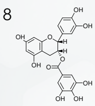
Epigallocatechin gallate I

7



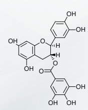
Gallocatechin gallate

8



Epicatechin gallate

9



Catechin gallate

Column: SunShell C18 2.6 µm, 75 x 4.6 mm
Mobile phase:
A) 0.1% Phosphoric acid
B) CH_3CN
Gradient program

Flow rate: 1.0 mL/min,
Temperature: 25 ºC
Detection: UV@250 nm
Sample: Oolong tea

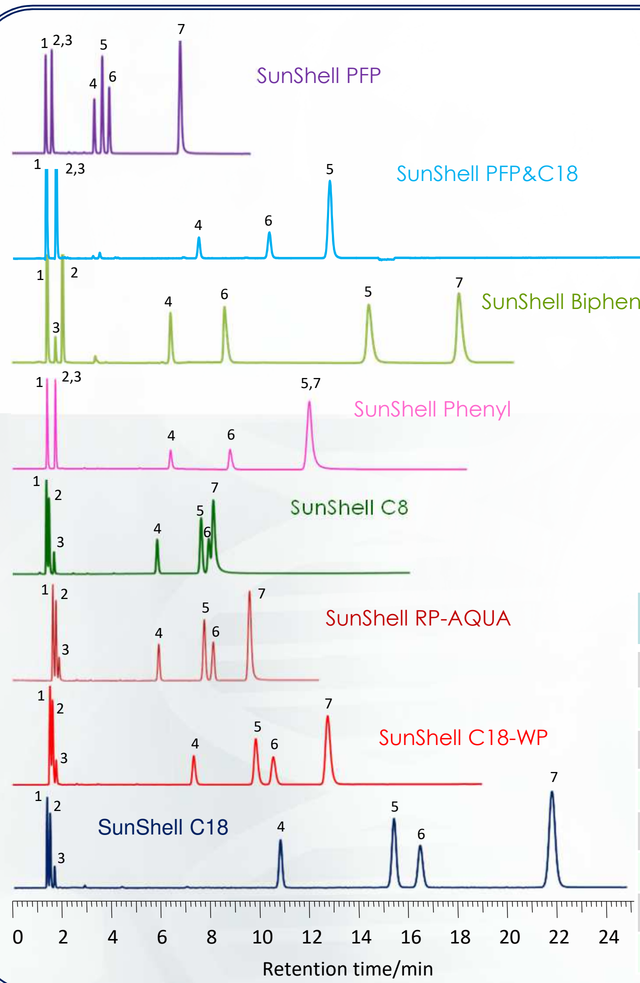
SunShell C18-WP, RP-AQUA, C8, Phenyl, PFP, PFP&C18, Cyano, 2.6 µm
(Pentafluorophenyl)

◆ Characteristics of SunShell

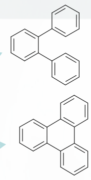
	Core shell silica			Bonding phase					
	Particle size	Pore diameter	Specific surface area	Carbon content	Bonded phase	USP L code	End-capping	Maximum operating pressure [a]	Available pH range
SunShell C18	2.6 µm	9 nm	150 m^2/g	7%	C18	L1	Sunniest endcapping	60 MPa	1.5 - 10
SunShell C18-WP	2.6 µm	16 nm	90 m^2/g	5%	C18	L1	Sunniest endcapping	60 MPa	1.5 - 10
SunShell RP-AQUA	2.6 µm	16 nm	90 m^2/g	4%	C30	L62	Sunniest endcapping	60 MPa	2 – 8 [b]
SunShell C8	2.6 µm	9 nm	150 m^2/g	4.5%	C8	L7	Sunniest endcapping	60 MPa	1.5 - 9
SunShell Phenyl	2.6 µm	9 nm	150 m^2/g	5%	Phenylhexyl	L11	Sunniest endcapping	60 MPa	1.5 - 9
SunShell Biphenyl	2.6 µm	9 nm	150 m^2/g	5%	Biphenyl	L11	Sunniest endcapping	60 MPa	1.5 - 9
SunShell PFP	2.6 µm	9 nm	150 m^2/g	4.5%	Pentafluorophenyl	L43	TMS endcapping	60 MPa	2 - 8
SunShell PFP&C18	2.6 µm	9 nm	150 m^2/g	6%	Pentafluorophenyl + C18	L43	TMS endcapping	60 MPa	2 - 8
NEW SunShell Cyano	2.6 µm	9 nm	150 m^2/g	2.5%	Diisopropylcyanopropyl	L10	No	60 MPa	2 - 8

a) Unless otherwise specified in the column test report b) Under 100% aqueous condition

◆ Separation of standard samples

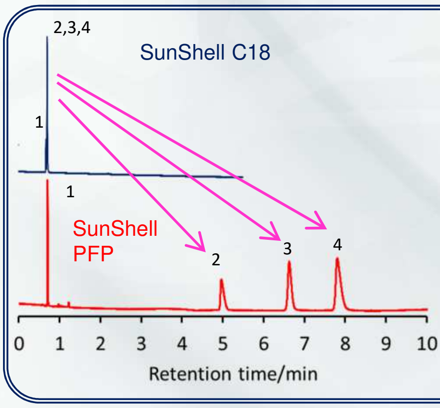


Column: SunShell C18, C18-WP, RP-AQUA, C8, Biphenyl, Phenyl, PFP, PFP&C18, 2.6 µm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil
2 = Caffeine
3 = Phenol
4 = Butylbenzene
5 = o-Terphenyl
6 = Amylbenzene
7 = Triphenylene



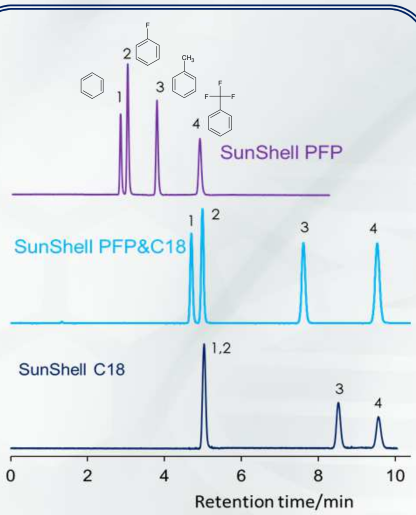
	水素結合性 (Caffeine/Phenol)	疎水性 (Amylbenzene/Butylbenzene)	立体選択性 (Triphenylene/o-Terphenyl)
PFP	1.00	1.31	2.38
PFP&C18	1.00	1.47	2.64
Biphenyl	1.82	1.44	1.28
Phenyl	1.00	1.48	1.01
C8	0.32	1.46	1.08
RP-AQUA	0.52	1.52	1.30
C18-WP	0.40	1.55	1.35
SunShell C18	0.39	1.60	1.46

Separation of basic compounds



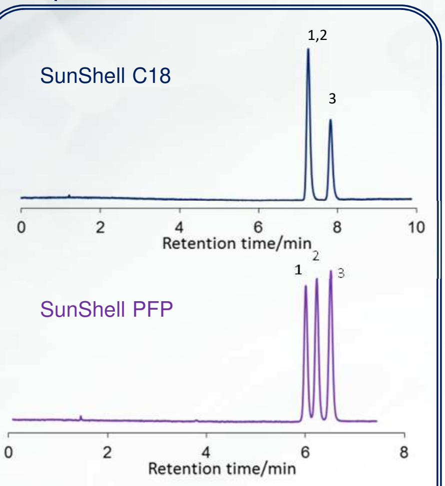
Column: SunShell C18, 2.6 µm 150 x 4.6 mm
SunShell PFP, 2.6 µm 150 x 4.6 mm
Mobile phase:
CH_3CN/10mM phosphate buffer pH7.0=80/20
Flow rate: 1.8 mL/min
Temperature: 25 ºC
Sample: 1 = Uracil, 2 = Propranolol,
3 = Nortriptyline, 4 =Amitriptyline

Separation of fluorobenzene



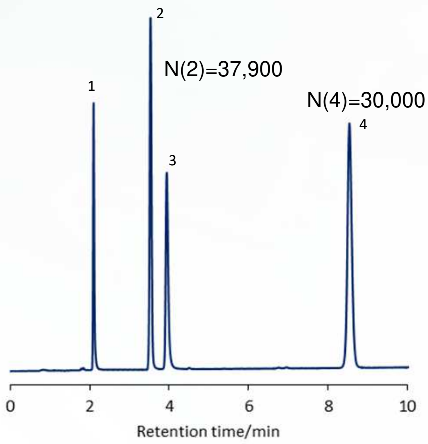
Column: SunShell PFP、PFP&C18, C18, 2.6 µm, 4.6 x 150 mm
Mobile phase: Methanol/water = 60/40
Flow rate: 1.0 mL / min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1 = Benzene, 2 = Fluorobenzene, 3 = Toluene, 4 = α,α,α-Trifluorotoluene

Separation of cresol isomers



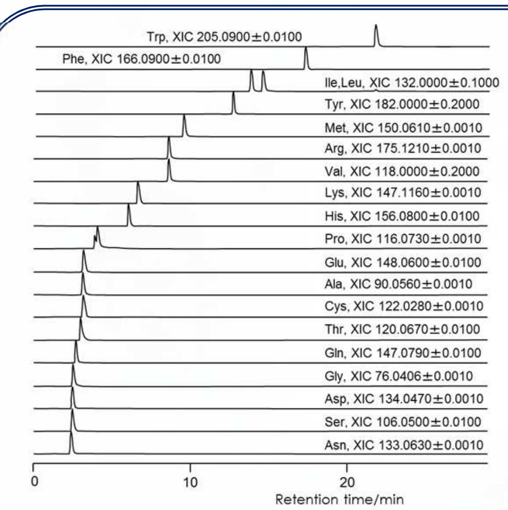
Column: SunShell C18, PFP, 2.6 µm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=40/60
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV@250nm
Sample: 1 = p-Cresol
2 = m-Cresol
3 = o-Cresol

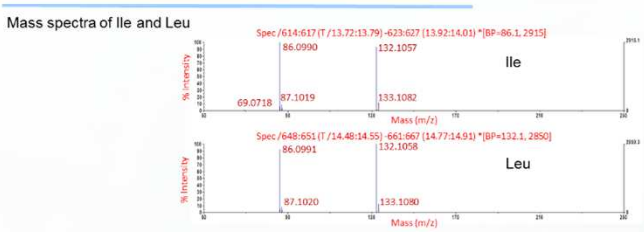
Separation of nucleotides



Column:
SunShell RP-AQUA, 2.6 µm 150 x 4.6 mm
Mobile phase: 20mM Phosphate buffer pH6.0
Flow rate: 1.0 mL/min
Temperature: 25 ºC
Detection: UV@250nm
Sample: 1 = 5'-GDP
2 = 5'-ATP
3 = 5'-ADP
4 = 5'-AMP

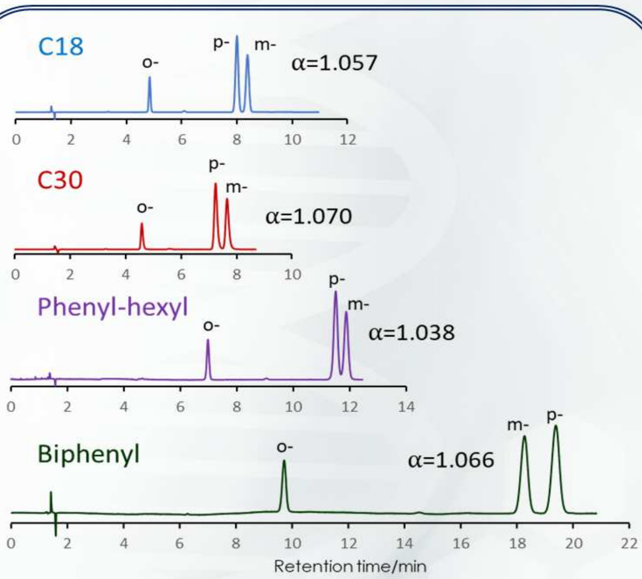
Separation of amino acids (LC/MS)





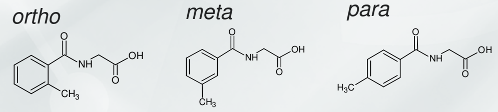
Column: SunShell RP-AQUA, 2.6 µm, 150 x 2.1 mm
Mobile phase: A) 5 mM HFBA, B) 5 mM HFBA in CH_3CN / H_2O (9/1)
%B 0% to 20% in 20 min (HFBA: Heptafluorobutyric acid)
Flow rate: 0.2 mL / min
Temperature: 40 °C
Detection: MS (NanoFrontier LD) ESI Positive, Extracted ion chromatogram (EIC)

Separation of *m*ethylhippuric acid isomers

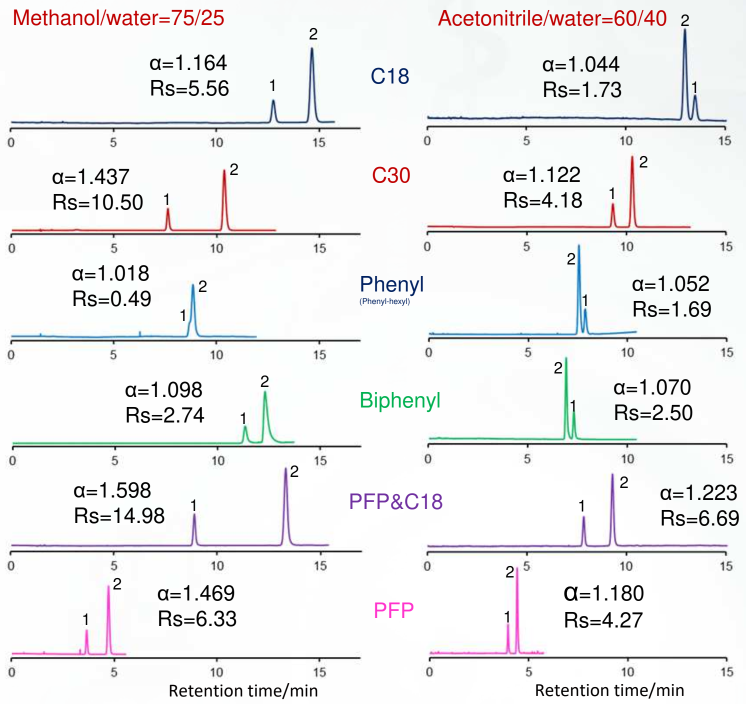


Column: SunShell C18 2.6 µm, 150 x 4.6 mm
SunShell C30 2.6 µm, 150 x 2.1 mm
SunShell Phenyl 2.6 µm, 150 x 4.6 mm
SunShell Biphenyl 2.6 µm, 150 x 4.6 mm
Mobile phase: 2-Propanol/25 mM Phosphate buffer pH 3.0 = 7/93
Flow rate: 1.0 mL/min, 0.2 mL/min for only C30
Temperature: 40 °C
Detection: UV@230 nm
Sample: *o*-, *m*-, *p*-Methylhippuric acid

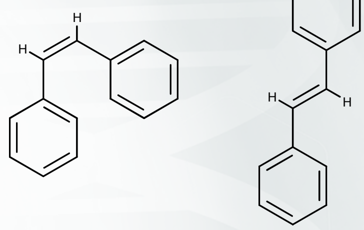
ortho *meta* *para*



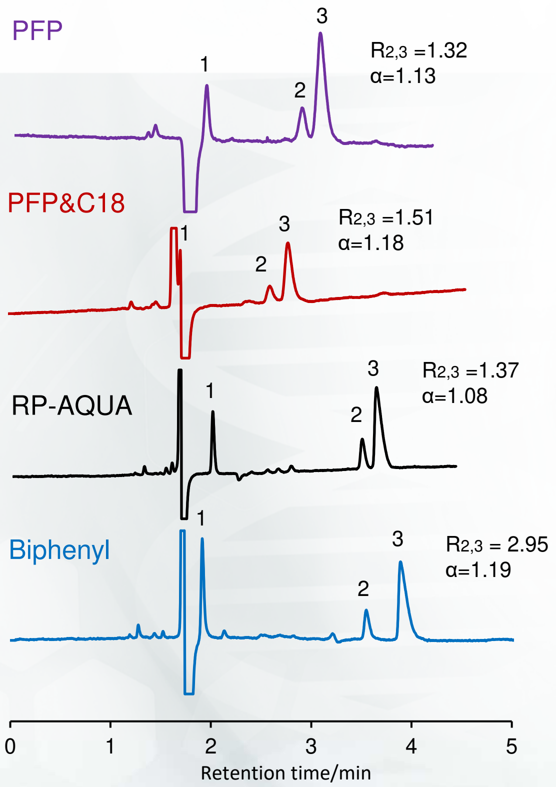
Separation of cis, trans-stilbene



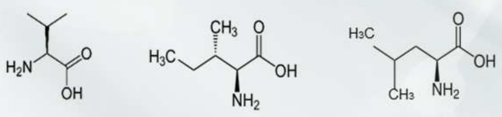
Column: SunShell C18 2.6 µm, 150 x 4.6 mm i.d.
SunShell C30 2.6 µm, 150 x 2,1 mm i.d.
SunShell Phenyl 2.6 µm, 150 x 4.6 mm i.d.
SunShell Biphenyl 2.6 µm, 150 x 4.6 mm i.d.
SunShell PFP&C18 2.6 µm, 150 x 4.6 mm i.d.
SunShell PFP 2.6 µm, 150 x 4.6 mm i.d.
Mobile phase: Methanol/water = 75/25
Acetonitrile/water = 60/40
Flow rate: 1.0 mL/min and 0.2 mL/min for only C30
Temperature: 40 ºC
Detection: UV@230 nm
Sample: 1 = cis-Stilbene, 2 = trans- Stilbene



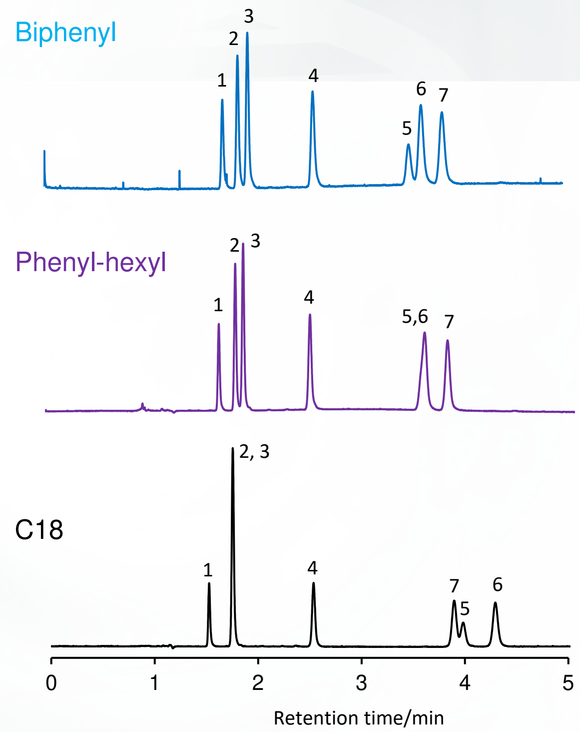
Separation of branched-chain amino acids



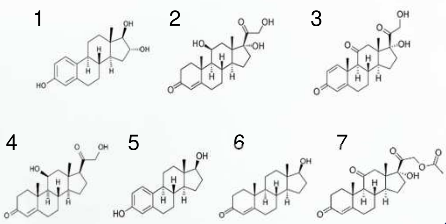
Column: SunShell PFP, PFP&C18, RP-AQUA, Biphenyl 2.6 µm, 150 x 4.6 mm
Mobile phase: 0.1% formic acid
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@205 nm
Sample: 1 = L-Valine 2 = L-Isoleucine 3 = L-Leucine



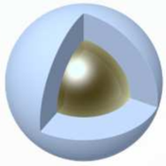
Separation of steroids



Column: SunShell Biphenyl, Phenyl and C18 2.6 µm, 150 x 4.6 mm
Mobile phase: Acetonitrile/water = 45/55
Flow rate: 1 mL/min
Temperature: 25 ºC
Detection: UV@230 nm
Peak
1. Estriol
2. Hydrocortisone
3. Prednisone
4. Corticosterone
5. β-Estradiol
6. Testosterone
7. Cortisonacetate



SunShell C30, 2.6 µm

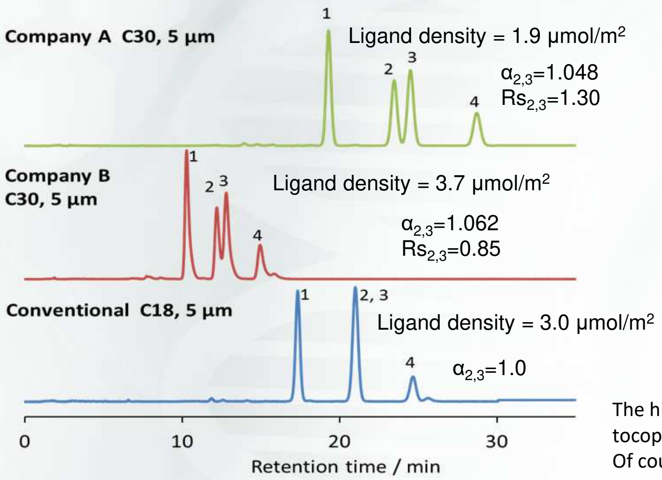


Specification of SunShell C30

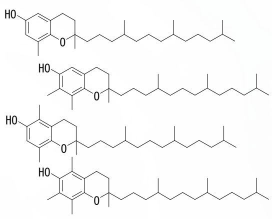
	Core shell silica				Bonding phase					
	Particle size (µm)	Core size (µm)	Pore size (nm)	Specific surface area (m²/g)	Carbon loading (%)	Ligand	USP L category	End-capping	Maximum pressure[a)]	pH range
SunShell C30	2.6	1.6	12	95	7	C30	L62	TMS	60 MPa	1.5 - 9

a) Unless otherwise specified in the column test report

Problem of C30 column

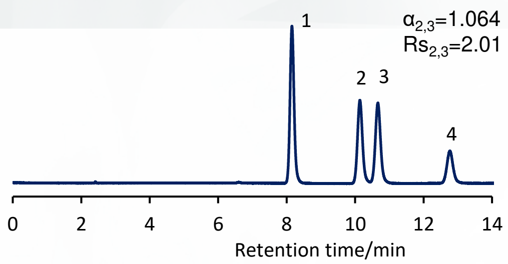


Column dimension: 250 x 4.6 mm
Mobile phase: methanol/water = 97/3
Flow rate: 1.0 mL/min
Temperature: 30 ºC
Detection: UV@295 nm
Sample,
1 = δ-tocopherol
2 = γ-tocopherol
3 = β-tocopherol
4 = α-tocopherol



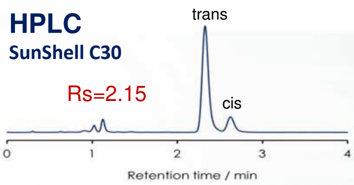
The higher a ligand density, the larger a separation factor of β-tocopherol and γ-tocopherol. Too high ligand density causes low theoretical plate and large tailing of a peak. Of course C18 columns can't separate β-tocopherol and γ-tocopherol.

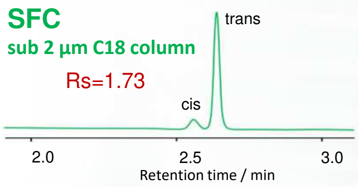
Separation of tocopherols



Column: SunShell C30, 2.6 µm 150 x 3.0 mm
Mobile phase: Methanol/water = 97/3
Flow rate: 0.43 mL/min
Temperature: 25 ºC
Detection: UV@295 nm
Sample: 1 = δ-tocopherol, 2 = γ-tocopherol, 3 = β-tocopherol, 4 = α-tocopherol

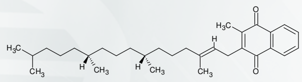
Fast separation of vitamin K1 isomers



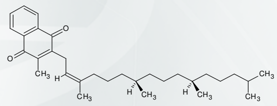


HPLC condition
Column: SunShell C30, 2.6 µm 50 x 3.0 mm
Mobile phase: Methanol
Flow rate: 0.80 mL/min
Temperature: 15 ºC
Detection: UV@250 nm
Sample : Vitamin K1 isomers (trans and cis)

trans

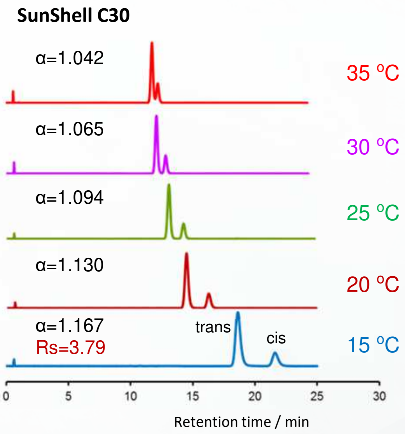


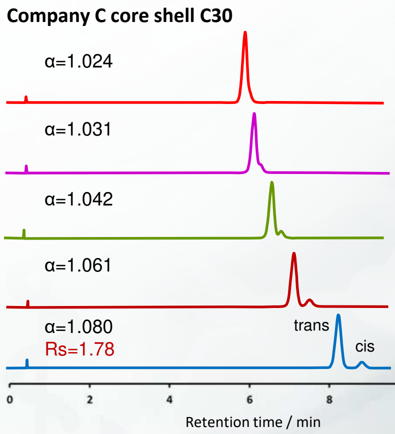
cis



Both HPLC and SFC separations were finished within 3 minute.
Regarding resolution of isomers, HPLC won SFC.

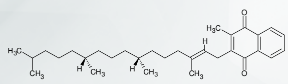
Comparison of isomers separation of Vitamin k1



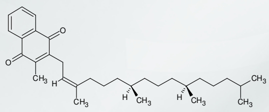


Column: SunShell C30, 2.6 µm 100 x 2.1 mm
Company C core shell C30, 2.6 µm 100 x 2.1 mm
Mobile phase: methanol/water = 96/4
Flow rate: 0.35 mL/min
Detection: UV@250 nm
Sample: vitamin K1 isomers (trans and cis).

trans



cis



SunShell 2.6 µm C18-WP, HFC18-16, C8-30HT, C4-100

For separation of peptides and proteins

Characteristics of SunShell

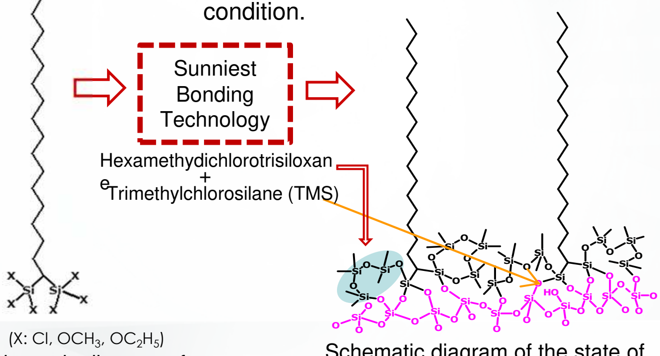
	Core shell silica			Bonding phase						
	Particle size	Pore diameter	Specific surface area	Stationary phase	Carbon content	Ligand density	End-capping	Maximum operating pressure [a]	Available pH range	USP L line
SunShell C18-WP	2.6 µm	16 nm	90 m²/g	C18	5 %	2.5 µmol/m²	Sunniest endcapping	60 MPa or 8,570 psi	1.5 - 10	L1
SunShell HFC18-16	2.6 µm	16 nm	90 m²/g	C18	2.5%	1.2 µmol/m²	Sunniest endcapping	60 MPa or 8,570 psi	1.5 – 9	L1
SunShell C8-30HT	3.4 µm	30 nm	15 m²/g	C8	0.5%	2.5 µmol/m²	Sunniest endcapping	60 MPa[a] or 8,570 psi[a]	1.5 – 9	L7
SunShell C4-100	2.6 µm	100 nm	22 m²/g	C4	0.6%	3 µmol/m²	Sunniest endcapping	60 MPa[a] or 8,570 psi[a]	1.5 – 8	L26

Note: The SunShell HFC18-30, C8-30, and C4-30 columns will be discontinued once the packaging materials are out of stock.

a) Unless otherwise specified in the column test report

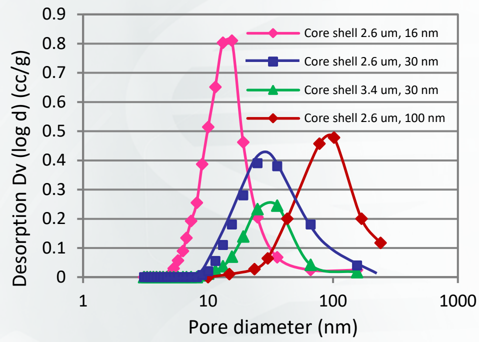
b) 50MPa, 7141psi for 4.6 mm i.d. column

What is HFC18? Hexa-Functional C18 has six functional groups. This HFC18 is much more stable under acidic condition.

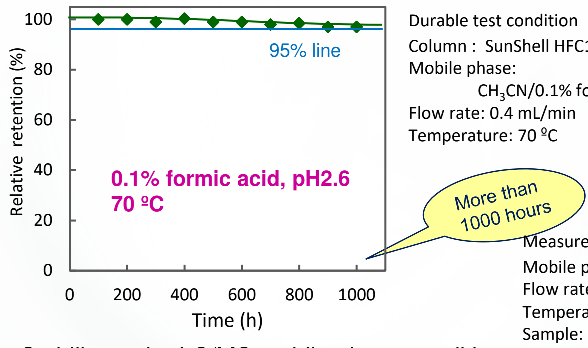


Schematic diagram of reagent

Schematic diagram of the state of bonding on silica surface



Pore distribution of core shell particle



Stability under LC/MS mobile phase condition

Durable test condition

Column : SunShell HFC18-16 2.6 µm, 50 x 2.1 mm

Mobile phase: CH_3CN/0.1% formic acid, pH2.6=40/60

Flow rate: 0.4 mL/min

Temperature: 70 ºC

Measurement condition

Mobile phase: CH_3CN/H_2O=60/40

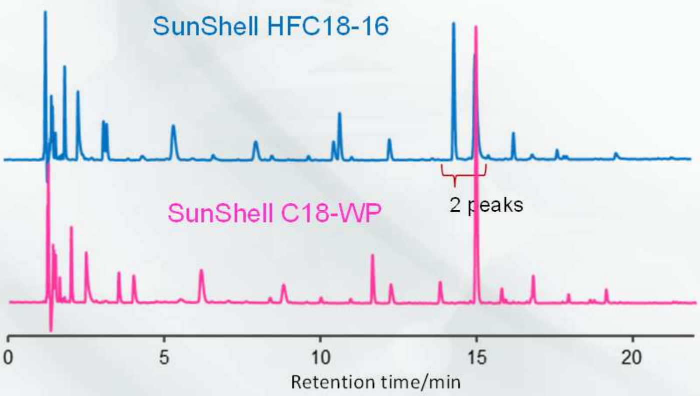
Flow rate: 0.4 mL/min

Temperature: 40 ºC

Sample: 1 = Uracil

2 = Butylbenzene

Separation of peptides



Column: SunShell HFC18-16, 2.6 µm (16 nm) 150 x 4.6 mm

SunShell C18-WP, 2.6 µm (16 nm) 150 x 4.6 mm

Mobile phase: A) 0.1% TFA in Acetonitrile/water(10:90)

B) 0.1 % TFA in Acetonitrile

Gradient program:

Time	0 min	5 min	40 min
%B	5%	5%	50%

Flow rate: 1.0 mL/min

Temperature: 25 ºC

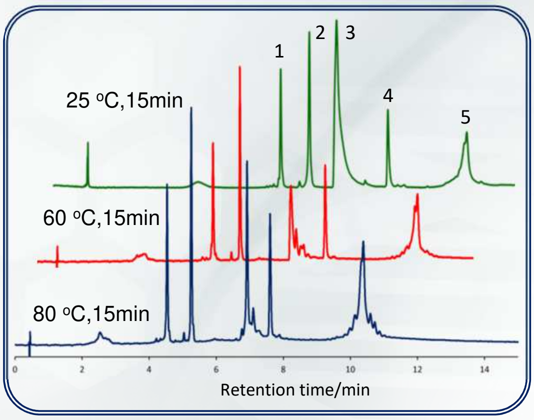
Detection: UV@210 nm

Sample: Tryptic digest of cytochrome C

SunShell 2.6 μm C8-30HT, C4-100

For separation of peptides and proteins

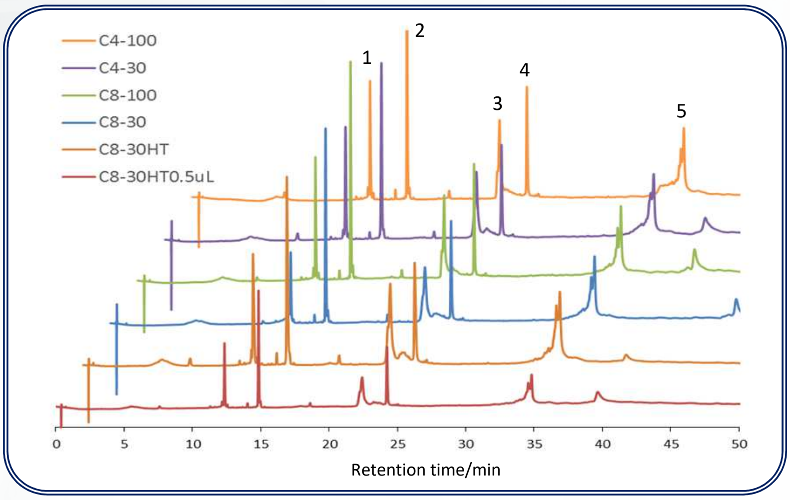
Comparison of column temperature



Column: SunShell C8-30, 2.6 μm (30 nm) 100 x 2.1 mm
Mobile phase: A) 0.1% TFA in water
B) 0.08 % TFA in acetonitrile
Gradient program: Time 0 min 15 min
%B 20% 65%
Flow rate: 0.5 mL/min ,
Temperature: 25 °C 60 °C or 80 °C
Detection: UV@215 nm,
Sample:1 = Cytochrome C, 2 = Lysozyme, 3 = BSA,
4 = Myoglobin, 5 = Ovalbumin

A macromolecule compound like a protein diffuses very slowly, so that an elevated temperature makes a peak be shaper and improves separation. BSA peak seemed to be tailing at 25 degree Celsius. BSA, however, was separated several peaks at 80 degree Celsius.

Comparison of SunShell stationary phase



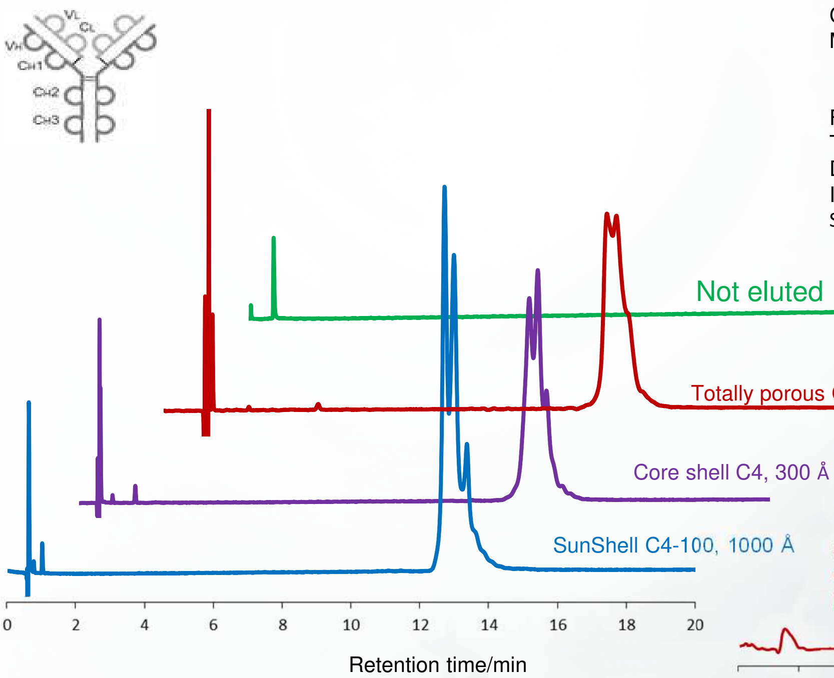
Column dimension: 100 x 2.1 mm,
Mobile phase: A) 0.1% TFA in water, B) 0.1 % TFA in Acetonitrile
Gradient program: Time 0 min 60 min
%B 20% 65%
Flow rate: 0.5 mL/min, Temperature: 80 °C, Detection: UV@215 nm, Injection volume: 1.0 μL
Sample:1 = Cytochrome C, 2 = Lysozyme, 3 = BSA, 4 = Myoglobin, 5 = Ovalbumin,
UHPLC instrument: HITACIHI Chromaster

Comparison of peak width (W0.5, min)

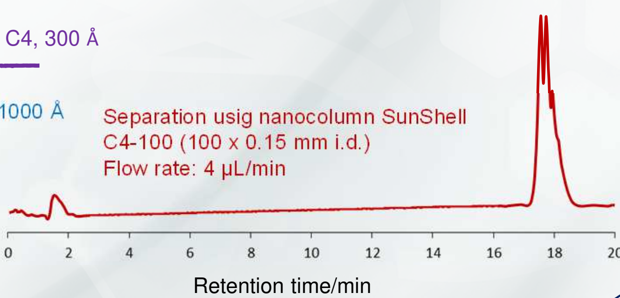
	C4-100	C4-30	C8-100	C8-30	C8-30HT	C8-30HT 0.5μL	Sample concentration
Cytochrome C	0.167	0.177	0.160	0.155	0.212	0.144	0.050%
Lysozyme	0.164	0.180	0.153	0.166	0.196	0.145	0.050%
BSA	0.308	0.410	0.276	0.514	0.422	0.330	0.100%
Myoglobin	0.197	0.221	0.180	0.199	0.238	0.176	0.050%
Ovalbmin	0.391	0.889	0.247	0.428	0.184	0.176	0.050%

The above table indicated that C4-100 with 1000Å of pore showed a sharper peak than the other. C8-30HT has a thin porous layer and low surface area, so that low sample loadnig made a peak sharper.

Separation of monoclonal antibody



Column dimension: 100 x 2.1 mm i.d.
Mobile phase: A) water/TFA (100/0.1)
B) acetonitrile/TFA (100/0.085)
30-45%B (0-30 min)
Flow rate: 0.4 mL/min
Temperature: 80 ºC
Detection: UV at 215 nm
Injection: 5 μL
Sample: : Monoclonal antibody purified from cell culture using Protein G



Regarding reversed phase separation of monoclonal antibody (IgG), not only core shell C4 with 30 nm pore showed the better separation than totally porous C4, but also 100 nm of pore leaded the best separation. Nano column showed almost the same separation of IgG as semi-micro column.

SunShell HILIC-Amide, HILIC-S, 2.6 µm

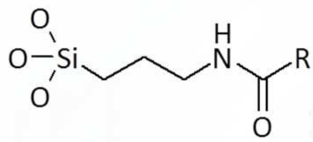
For Hydrophilic Interaction Chromatography

Characteristics of SunShell HILIC-Amide

	Core shell silica				Bonded phase					
	Particle size	Core size	Pore diameter	Specific surface area	Carbon content	Bonded phase	End-capping	Maximum operating pressure [a]	USP category	Available pH range
SunShell HILIC-Amide	2.6 µm	1.6 µm	9 nm	150 m^2/g	3%	Amide	No	60 MPa or 8,570 psi	L68	2 - 8
SunShell HILIC-S	2.6 µm	1.6 µm	9 nm	150 m^2/g	0%	Bare silica	No	60 MPa or 8,570 psi	L3	1 - 5

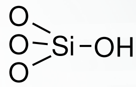
a) Unless otherwise specified in the column test report

Stationary phase of HILIC-Amide



R: Hydrophilic group

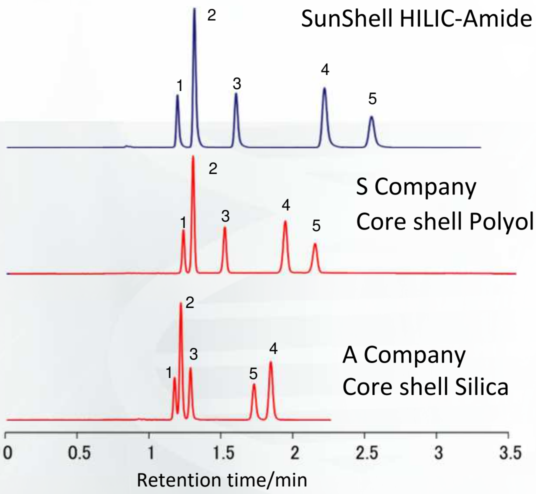
Stationary phase of HILIC-S



Bare silica

Stationary phase of SunShell HILIC-Amide consists of AMIDE and HYDROPHILIC GROUP, so that this stationary phase is more polar than an individual group. High speed separation is leaded by core shell structure that derives high efficiency and fast equilibration. HILIC-S is recommended for separation using LC/MS.

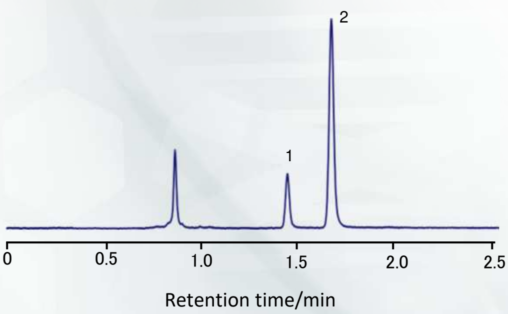
Separation of Nucleic acid bases: Comparison of the other core shell hilic columns



Column:
SunShell HILIC-Amide, 2.6 µm 100 x 4.6 mm,
Coreshell polyol, 2.7 µm 100 x 4.6 mm,
Core shell Silica, 2.7 µm 100 x 4.6 mm
Mobile phase:
Acetonitrile/20 mM ammonium acetate(pH4.7) = 8/2
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1 = Thymine, 2 = Uracil, 3 = Uridine, 4 = Cytosine, 5 = Cytidine

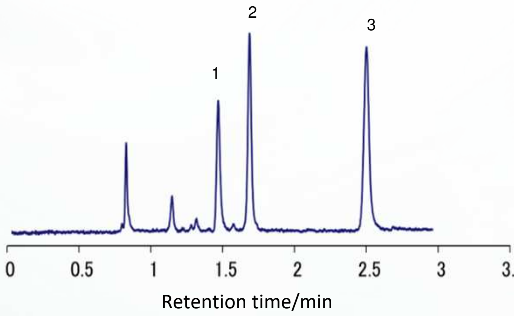
Regarding retention of cytidine, SunShell HILIC-Amide showed 30% higher retention factor than S core shell polyol.

Separation of Cyanuric acid and Melamine



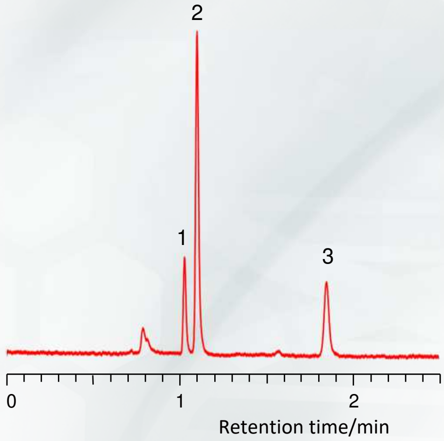
Column: SunShell HILIC-Amide, 2.6 µm 100 x 4.6 mm
Mobile phase:
Acetonitrile/5 mM phosphate Buffer (pH6.9) =75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@220 nm,
Sample: 1 = Cyanuric acid, 2 = Melamine

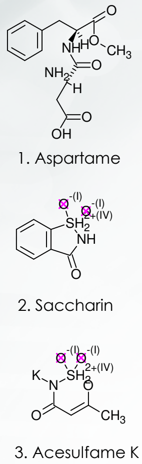
Separation of water- soluble vitamins



Column: SunShell HILIC-Amide, 2.6 µm 100 x 4.6 mm
Mobile phase:
Acetonitrile/25 mM phosphate buffer (pH2.5) =8/2
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm,
Sample: 1 = Nicotinic acid, 2 = Ascorbic acid, 3 = Pyridoxine

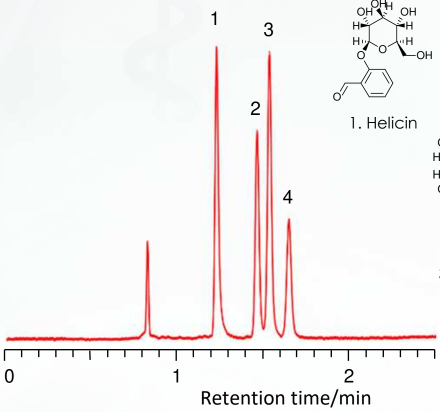
Artificial sweeteners

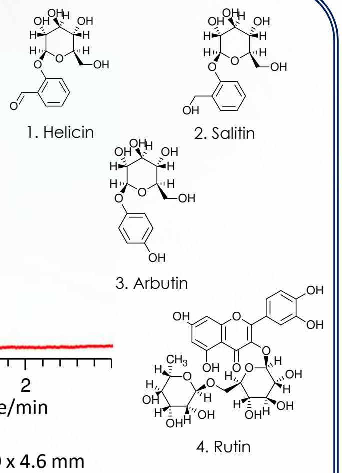




Column:
SunShell HILIC-Amide, 2.6 µm, 100 x 4.6 mm
Mobile phase:
Acetonitrile: 25 mM phosphate buffer (pH2.5) =8:2
Flow rate: 1.0 mL/min ,
Temperature: Ambient
Detection: UV@215 nm
Sample: 1 = Aspartame, 2 = Saccharin, 3 = Acesulfame K

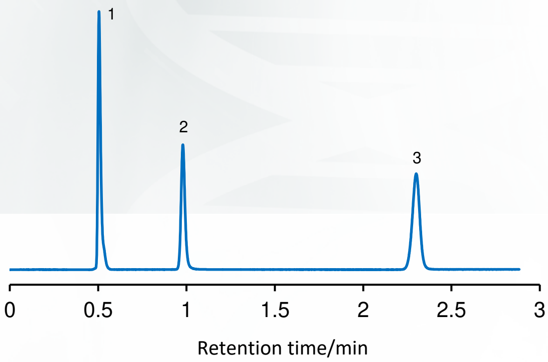
Glycoside





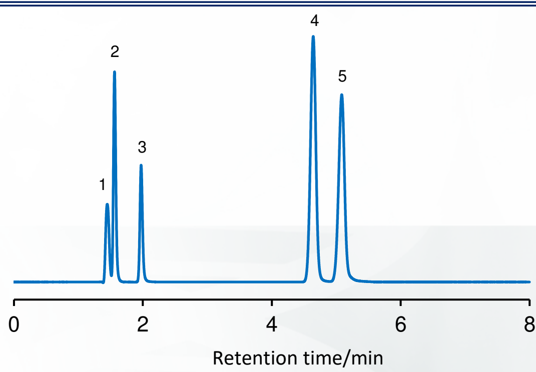
Column:
SunShell HILIC-Amide, 2.6 µm, 100 x 4.6 mm
Mobile phase:
Acetonitrile:25 mM phosphate Ammonium (pH4.9) =8:2
Flow rate: 1.0 mL/min
Temperature: Ambient
Detection: UV@215 nm
Sample: 1 = Helicin, 2 = Salicin, 3,= Arbutin, 4 = Rutin

Nucleic acid base



Column: SunShell HILIC-S, 2.6 µm 100 x 2.1 mm
Mobile phase: 100 mM ammonium acetate (pH3.0) /acetonitrile = 1/9
Flow rate: 0.4 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1 = Acenaphthene, 2 = Uridine, 3 = Cytosine

Nucleic acid bases



Column: SunShell HILIC-S, 2.6 µm 100 x 2.1 mm
Mobile phase: 100 mM ammonium acetate (pH3.0) /acetonitrile = 1/9
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1 = Thymine, 2 = Uracil, 3 = Uridine, 4 = Cytosine, 5 = Cytidine

Metal Free Column

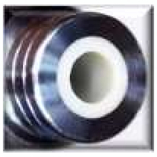
PEEK clad SUS column

Metal-free column

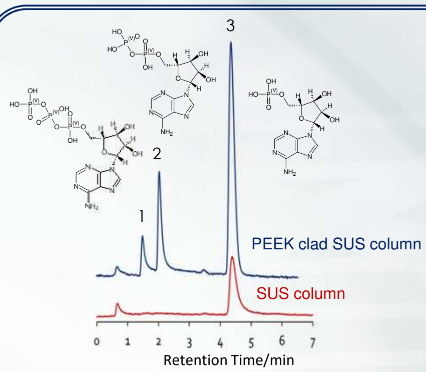
- Standard metal-free columns with high chemical stability.
- Column hardware has a pressure resistance of 100 MPa.
- Metal-free columns supplied by two companies.
- Can be packed with all SunShell packing materials.

Filter

Fitting



Body



Column: Sunniest RP-AQUA
3 µm, 50 X 2.1 mmI.D.
Mobile phase: 10 mM $HCOONH_4$
Flow rate: 0.2 mL/min
Temperature: 25 ºC
Detection: UV at 250 nm
Sample: 1 = 5'-ATP
2 = 5'-ADP
3 = 5'-AMP
Injection: 1 µL
(each concentartion 25 µg/mL)

【Effect of column hardware against metal-chelating compounds】

High pressure-resistant PEEK columns manufactured by Tomoe

*I.D. 2.1 mm, length 50 mm, 100 mm, 150 mm

*The catalog number, change the last digit "1" to "MTF".

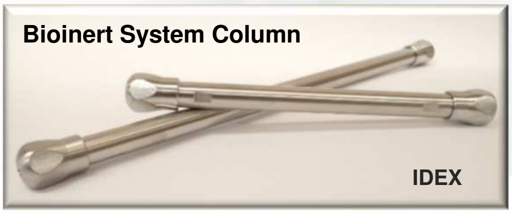
For example, for SunShell C18 2.6 µm, 100 x 2.1 mm columns, the model number CB6961 for the standard columns becomes CB696MTF.

IDEX Bioinert System Column

*2.1 and 4.6 mm i.d., lengths 50 mm, 100 mm and 150 mm.

*The catalog number, change the last digit "1" to "M".

For example, for a SunShell C18 2.6 µm, 150 x 4.6 mm column, the catalog number CB6371 of the normal column becomes CB637M.



Nanocolumn, Microcolumn

Nano column: 0.075 mm i.d., 0.1 mm i.d., 0.15 mm i.d.

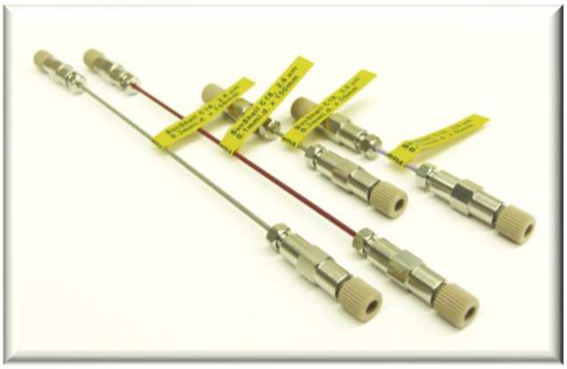
Micro column: 0.3 mm i.d., 0.5 mm i.d.

Column length: 50 mm, 150 mm

Column tube material:

0.075mm i.d., 0.10 mm i.d., 0.15 mm i.d.; PEEKSIL

0.3 mm i.d., 0.5 mm i.d.; Glass Llined SUS Tubing



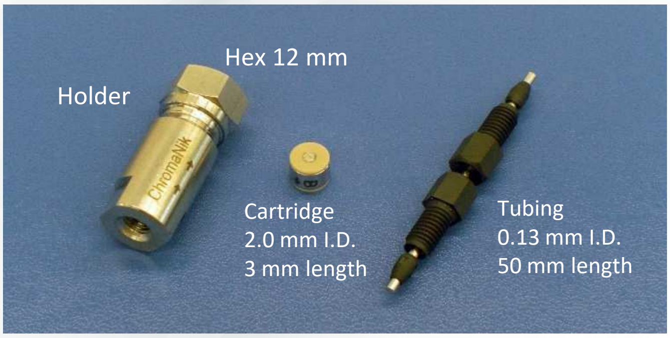
Example of prices

	Inner diameter (mm)	0.075	0.1	0.15	0.3	0.5	USP L code
	Length (mm)	Catalog number	Catalog number	Catalog number	Catalog number	Catalog number	
SunShell C18, 2 µm	50	CB1J4P	CB1H4P	CB1K4P	CB1G48	CB1F48	L1
	150	CB1J7P	CB1H7P	CB1K7P	CB1G78	CB1F78	
SunShell C18, 2.6 µm	50	CB6J4P	CB6H4P	CB6K4P	CB6G48	CB6F48	
	150	CB6J7P	CB6H7P	CB6K7P	CB6G78	CB6F78	
SunShell C18, 5 µm	50	------	------	------	CB3G4L	CB3F4L	
	150	------	------	------	CB3G7L	CB3F7L	
SunShell Phenyl, 2.6 µm	50	CP6J4P	CP6H4P	CP6K4P	CP6G48	CP6F48	L11
	150	CP6J7P	CP6H7P	CP6K7P	CP6G78	CP6F78	
SunShell C8-30HT, 3.4 µm	50	C56J4P	C56H4P	C56K4P	C56G48	C56F48	L7
	150	C56J7P	C56H7P	C56K7P	C56G78	C56F78	
SunShell C4-100, 2.6 µm	50	C66J4P	C66H4P	C66K4P	C66G48	C66F48	L26
	150	C66J7P	C66H7P	C66K7P	C66G78	C66F78	

※ Packings (stationary phase) and column sizes other than those listed above can also be manufactured. For details, please contact ChromanNik Technologies.
※ The end-fitting of the column is Parker type.
※ The P, L or 8 at the end of the catalog number indicates the material of the column tubing: P is PEEKSIL, L and 8 are glass-lined tubing. Only L has an upper limit of back pressure of 45 MPa, but the others have an upper limit of back pressure of 80 MPa.

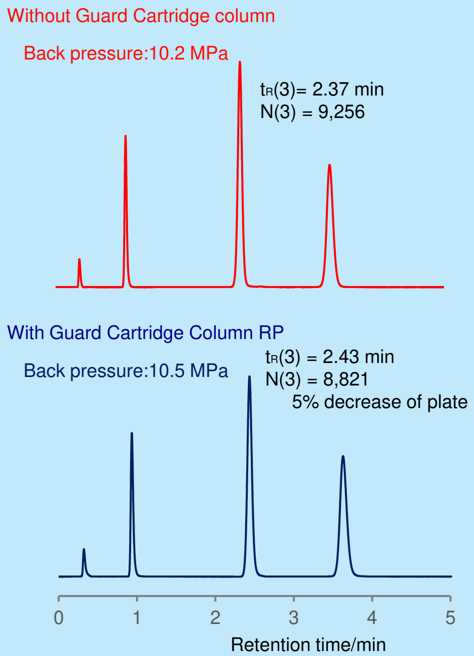
SunShell Guard Cartridge Column

RP & S GUARD CARTRIDGE COLUMN



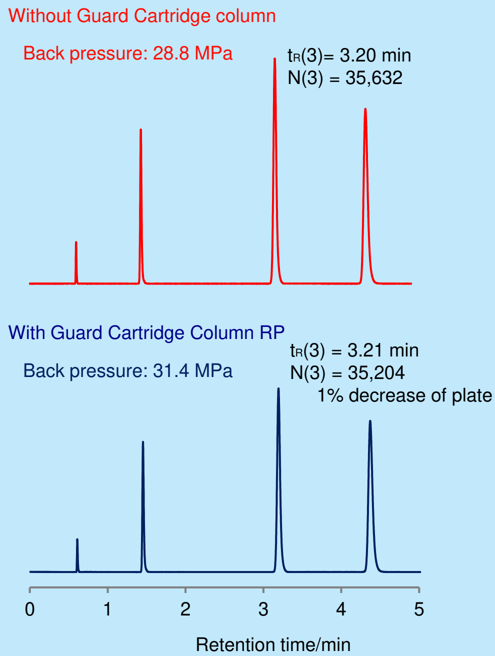
- ⋆ The cartridge column is packed with SunShell C18 (RP) and Core shell silica (S) into a cartridge sized 3 x 2 mm i.d.
- ⋆ RP guard cartridge is used for all reversed phases and S guard cartridge for hilic phases.
- ⋆ Low dead volume structure
- ⋆ Upper pressure limit is more than 60 Mpa
- ⋆ Availablr for 2.1 mm i.d. to 4.6 mm i.d. columns

SunShell C18, 2.6 µm 50 x 2.1 mm



Mobile phase:
CH_3CN/H_2O=60/40 for 2.1 mm i.d.
CH_3CN/H_2O=70/30 for 4.6 mm i.d.
Flow rate:
0.3 mL/min for 2.1 mm i.d.
1.8 mL/min for 4.6 mm i.d.
Temperature: 25 ºC
Detection: UV@250nm
Sample: 1 = Uracil
2 = Ethylbenzoate
3 = Acenaphthene
4 = Butylbenzene

SunShell C18, 2.6 µm 150 x 4.6 mm



Ordering Information of SunShell Guard Cartridge Column

Description	Part number
SunShell Guard Cartridge RP Starter Kit (holder, cartridge, tubing)	CB32CK
SunShell Guard Cartridge RP for exchange (2 PCS)	CB32CC
SunShell Guard Cartridge S Starter Kit (holder, cartridge, tubing)	CS32CK
SunShell Guard Cartridge S for exchange (2 PCS)	CS32CC
SunShell Guard Cartridge holder	HOL2CC

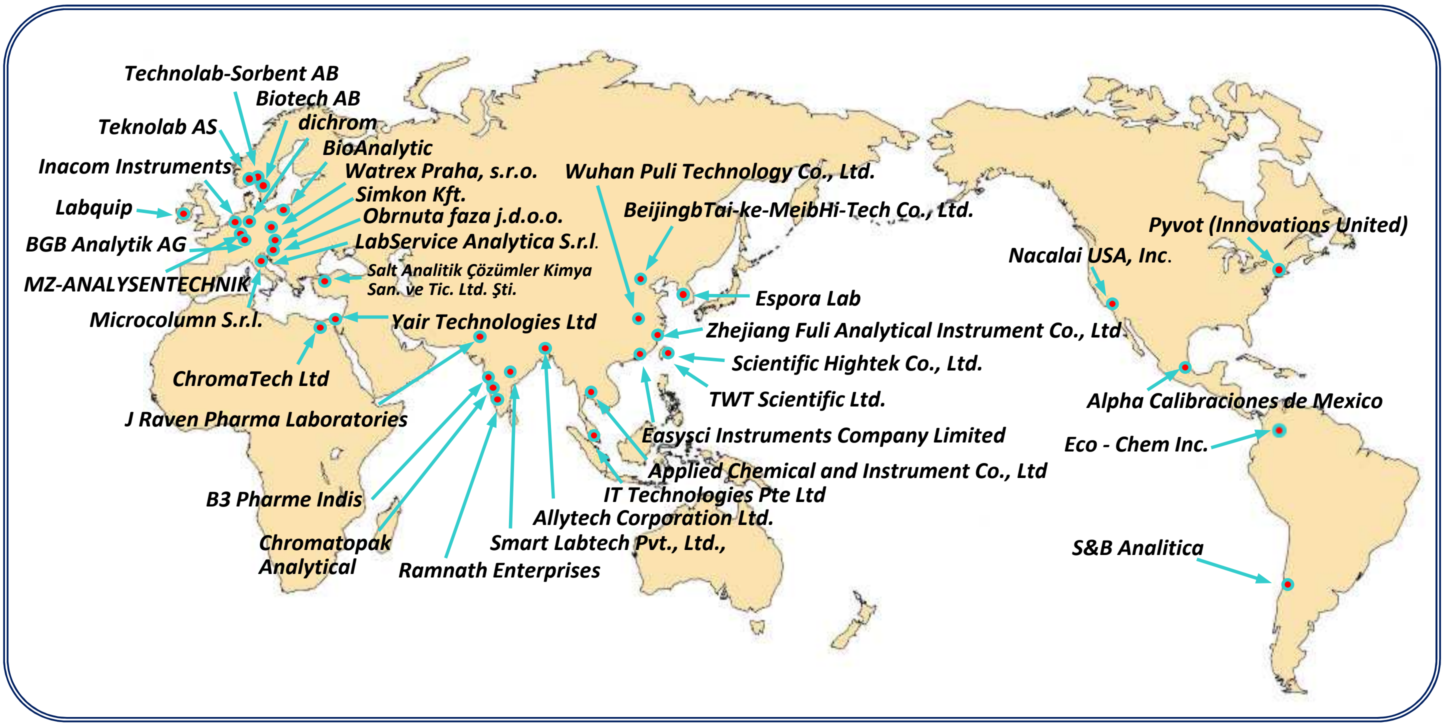
Ordering information of SunShell

	Inner diameter (mm)	1.0	2.1	3.0	4.6	USP category
	Length (mm)	Catalog number	Catalog number	Catalog number	Catalog number	
SunShell C18, 2 µm	50	------	CB1941	------	------	L1
	100	------	CB1961	------	------	
	150	------	CB1971	------	------	
SunShell C18, 2.6 µm	30	------	CB6931	CB6331	CB6431	
	50	CB6141	CB6941	CB6341	CB6441	
	75	------	CB6951	CB6351	CB6451	
	100	CB6161	CB6961	CB6361	CB6461	
	150	CB6171	CB6971	CB6371	CB6471	
	250	------	------	CB6381	CB6481	
SunShell C18 3.5 µm	50	------	CB9941	------	------	
	100	------	CB9961	CB9361	CB9461	
	150	------	CB9971	CB9371	CB9471	
	250	------	------	CB9381	CB9481	
SunShell C18, 5 µm	150	------	------	CB3371	CB3471	
	250	------	------	CB3381	CB3481	
SunShell C8, 2.6 µm	30	------	CC6931	CC6331	CC6431	L7
	50	------	CC6941	CC6341	CC6441	
	75	------	CC6951	CC6351	CC6451	
	100	------	CC6961	CC6361	CC6461	
	150	------	CC6971	CC6371	CC6471	
SunShell PFP, 2.6 µm	30	------	CF6931	CF6331	CF6431	L43
	50	------	CF6941	CF6341	CF6441	
	75	------	CF6951	CF6351	CF6451	
	100	------	CF6961	CF6361	CF6461	
	150	------	CF6971	CF6371	CF6471	
SunShell C18-WP, 2.6 µm	30	------	CW6931	CW6331	CW6431	L1
	50	------	CW6941	CW6341	CW6441	
	75	------	CW6951	CW6351	CW6451	
	100	------	CW6961	CW6361	CW6461	
	150	------	CW6971	CW6371	CW6471	
SunShell RP-AQUA, 2.6 µm	30	------	CR6931	CR6331	CR6431	L62
	50	CR6141	CR6941	CR6341	CR6441	
	75	------	CR6951	CR6351	CR6451	
	100	CR6161	CR6961	CR6361	CR6461	
	150	CR6171	CR6971	CR6371	CR6471	
SunShell Phenyl, 2.6 µm	30	------	CP6931	CP6331	CP6431	L11
	50	------	CP6941	CP6341	CP6441	
	75	------	CP6951	CP6351	CP6451	
	100	------	CP6961	CP6361	CP6461	
	150	------	CP6971	CP6371	CP6471	
SunShell Biphenyl, 2.6 µm	30	------	C86931	C86331	C86431	L11
	50	------	C86941	C86341	C86441	
	75	------	C86951	C86351	C86451	
	100	------	C86961	C86361	C86461	
	150	------	C86971	C86371	C86471	
SunShell C30, 2.6 µm	30	------	CT6931	CT6331	------	L62
	50	------	CT6941	CT6341	CT6441	
	75	------	CT6951	CT6351	------	
	100	------	CT6961	CT6361	CT6461	
	150	------	CT6971	CT6371	CT6471	
SunShell PFP&C18, 2.6 µm	30	------	CV6931	CV6331	CV6431	L43
	50	------	CV6941	CV6341	CV6441	
	75	------	CV6951	CV6351	CV6451	
	100	------	CV6961	CV6361	CV6461	
	150	------	CV6971	CV6371	CV6471	
SunShell Cyano, 2.6 µm	50	------	CJ6941	CJ6341	CJ6441	L10
	100	------	CJ6961	CJ6361	CJ6461	
	150	------	CJ6971	CJ6371	CJ6471	

Added 4.6 mm i.d. for C30 phase

	Inner diameter (mm)	1.0	2.1	3.0	4.6	USP category
	Length (mm)	Catalog number	Catalog number	Catalog number	Catalog number	
SunShell HILIC-Amide, 2.6 µm	30	------	CH6931	CH6331	CH6431	L68
	50	------	CH6941	CH6341	CH6441	
	75	------	CH6951	CH6351	CH6451	
	100	------	CH6961	CH6361	CH6461	
	150	------	CH6971	CH6371	CH6471	
SunShell HILIC-S, 2.6 µm	50	------	CU6941	------	------	L3
	100	------	CU6961	------	------	
	150	------	CU6971	------	------	
SunShell HFC18-16, 2.6 µm	50	------	CG6941	CG6341	CG6441	L1
	100	------	CG6961	CG6361	CG6461	
	150	------	CG6971	CG6371	CG6471	
SunShell C8-30HT, 3.4 µm	50	------	C55941	------	------	L7
	100	------	C55961	------	------	
	150	------	C55971	------	------	
SunShell C4-100, 2.6 µm	50	------	C66941	------	------	L26
	100	------	C66961	------	------	
	150	------	C66971	------	------	

＊Distributor



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Manufacturer

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