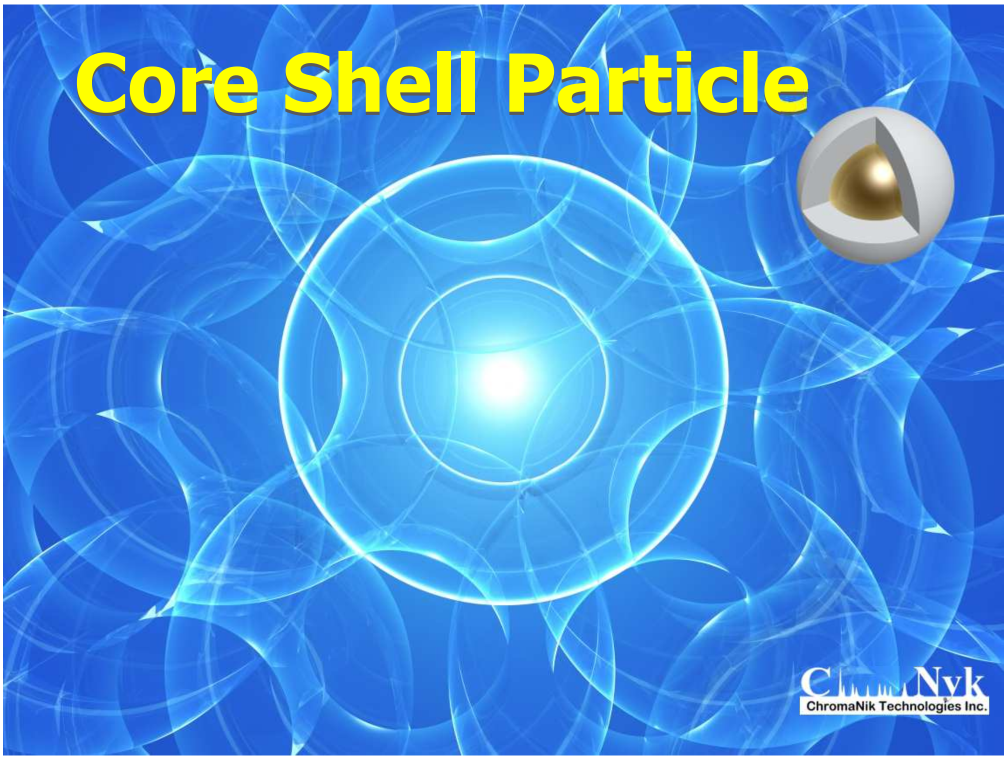
ChromaNik Technologies Inc.

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

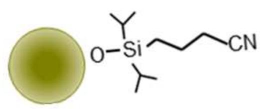
2 μm, 2.6 μm, 3.4 μm, 3.5 μm and 5 μm HPLC column




## New Product

## SunShell Cyano

Diisopropylcyanopropyl




ChromaNik Technologies Inc.

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***

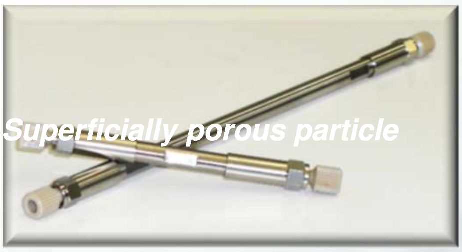
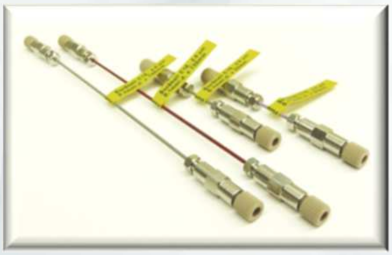
## Features of SunShell

* 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

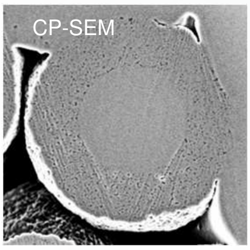

**※ Metal free columns and nano- and microcolumns are listed on page 24**

Superficially porous particle

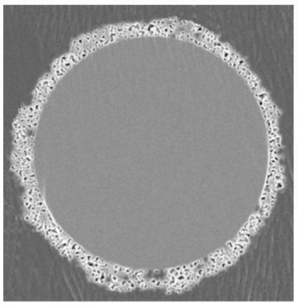




Superficially porous particle


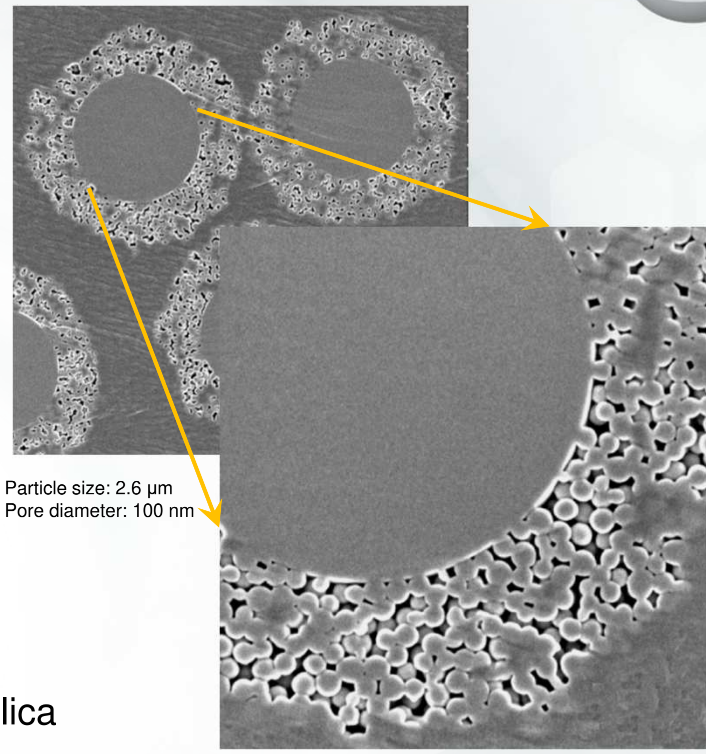
**※ SunShell guard cartridge columns are listed on page 25**




Particle size: 2.6 µm
Pore diameter: 16 nm



Particle size: 3.4 µm
Pore diameter: 30 nm

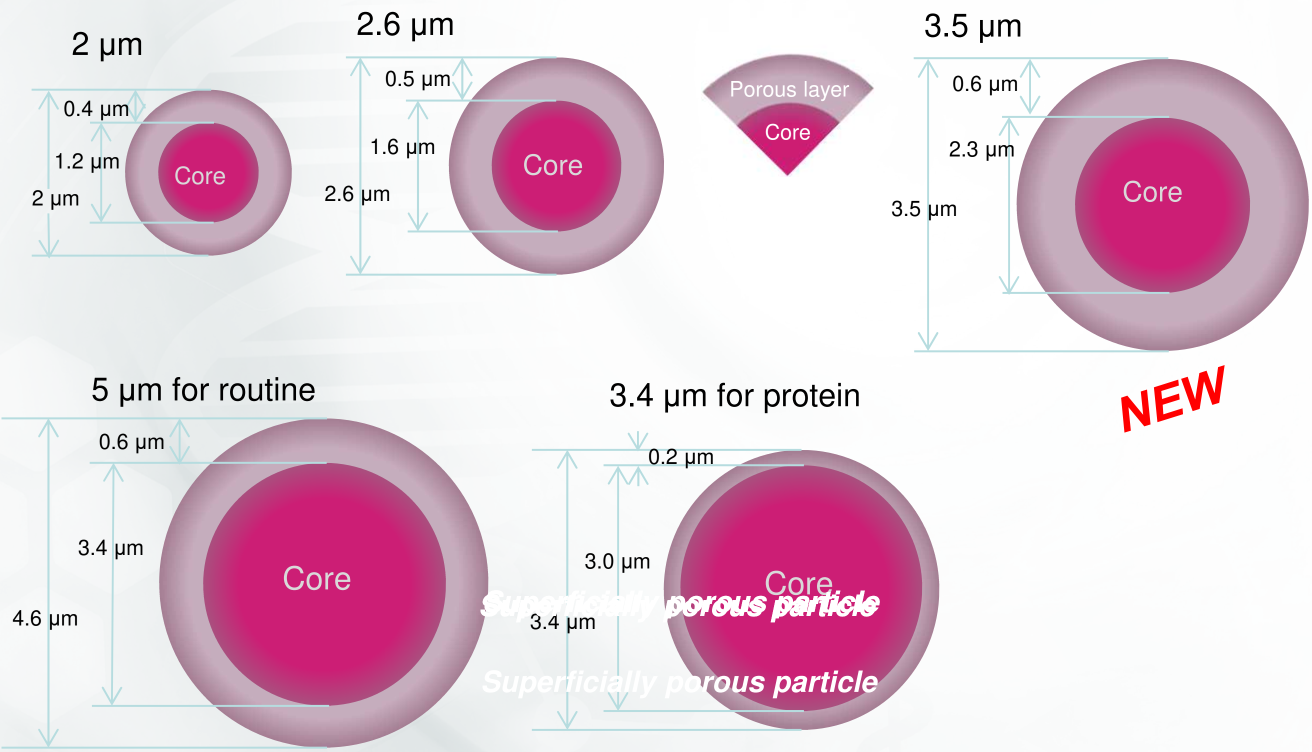


Particle size: 2.6 µm
Pore diameter: 100 nm

Electron micrograph of core shell silica

Core shell ... on treatment,
and obser







Superficially porous particle

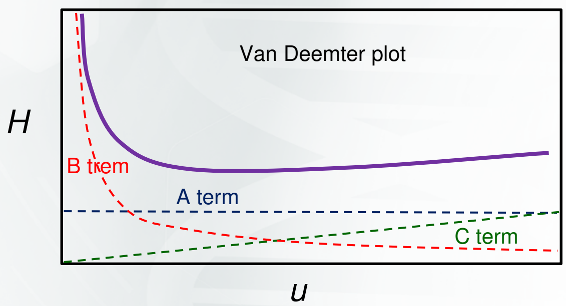
Schematic diagram of a core shell silica particle, 2.0, 2.6, 3.4 3.5 and 4.6 µm

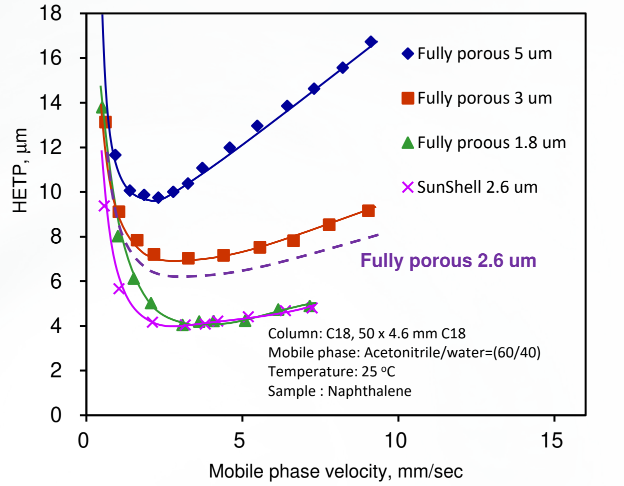
# Why does a 2.6 µm core shell particle show the same performance as a sub 2 µm particle?

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



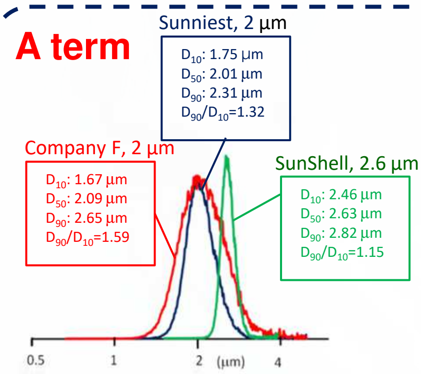




Comparison of plate height plots

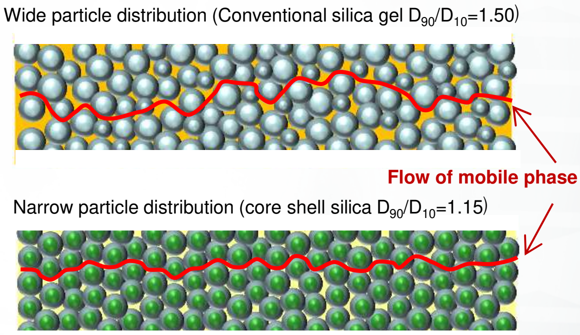
SunShell C18 shows same efficiency as a sub 2 µm C18. In comparison between fully porous 2.6 µm and core shell 2.6 µm (SunShell), SunShell shows lower values for A term, B term and C term of Van Deemter equation. The core shell structure leads higher performance to compare with the fully porous structure.

# All terms in Van Deemter Equation reduce.

## A term




Comparison of Particle Size Distribution

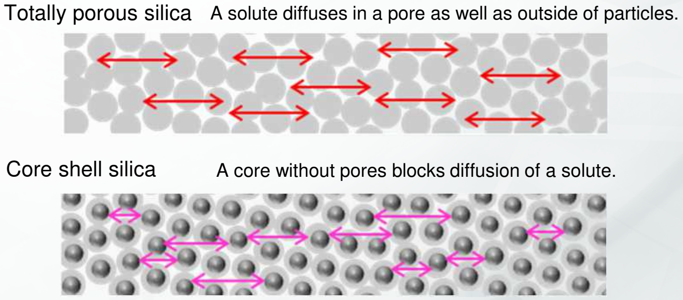



Packing state of core shell and fully porous silica

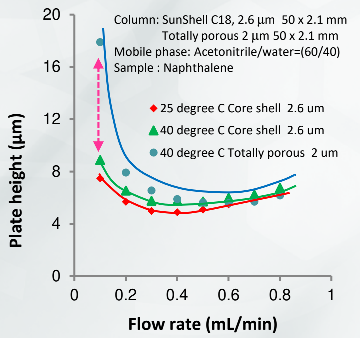
The size distribution of a core shell (SunShell) particle is much narrower than that of a conventional totally porous particle, so that the space among particles in the column reduces and efficiency increases by reducing Eddy Diffusion (multi-path diffusion) as the A term in Van Deemter Equation.

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.

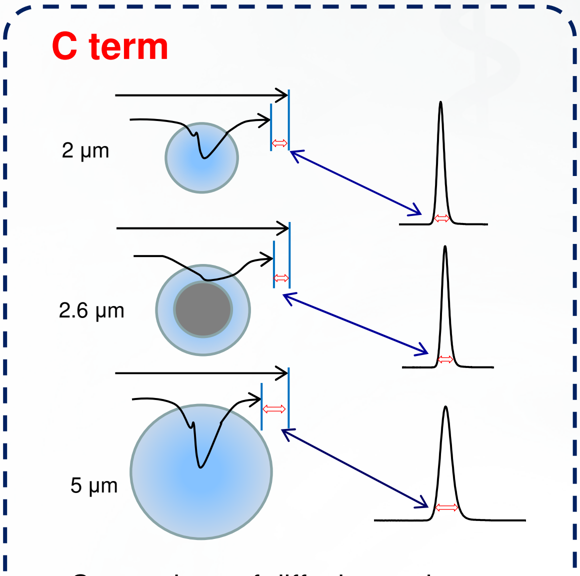
## B term




Difference of longitudinal diffusion



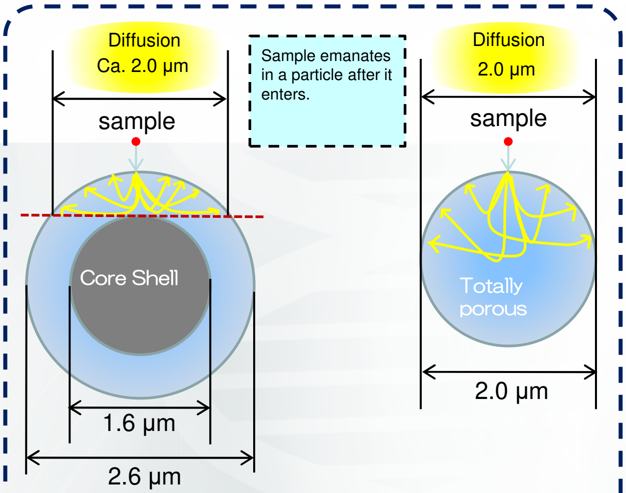

Plot of Flow rate and Plates height



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

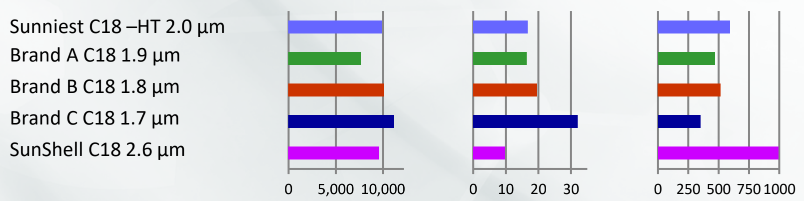


Diffusion of sample in core shell and totally porous silica

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 |




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

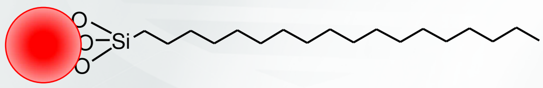
Back pressure and theoretical plate were compared for 2 µm and sub 2 µm C18 and 2.6 µm SunShell C18. All columns showed almost the same theoretical plate except for brand A C18 1.9 µm. However back pressure was not same. Especially Brand C C18 1.7 µm showed the highest back pressure. And SunShell C18 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.

# SUNSHELL

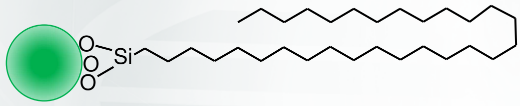
# STATIONARY PHASE

## Reversed phase

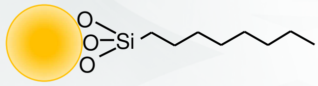
C18, C18-WP (7 page, 16 page, 20 page, SunShell Bio)



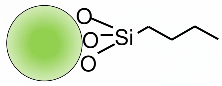
RP-AQUA, C30 (16 page, 19 page)



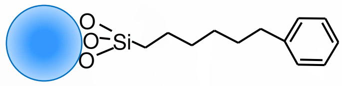
C8, C8-30HT (16 page, 20 page, 21 page)



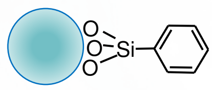
C4-100 (20 page, 21 page, SunShell Bio)



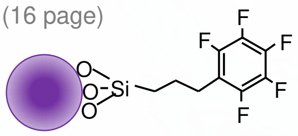
Phenyl (16 page)



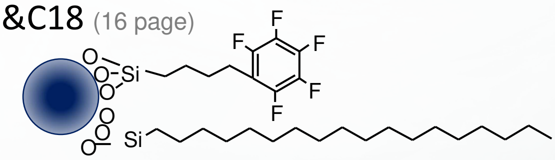
Phenyl (SunShell Bio)



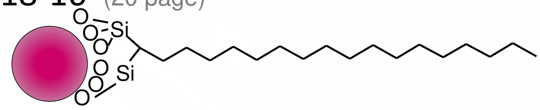
PFP (16 page)



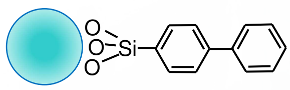
PFP&C18 (16 page)



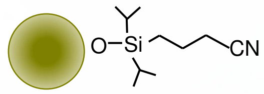
HFC18-16 (20 page)



Biphenyl (16 page)

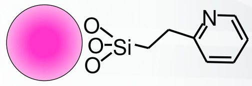


Cyano (16 page)

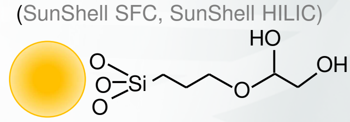



## HILIC and SFC

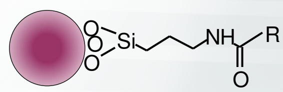
2EP (SunShell SFC)



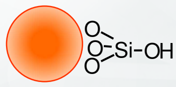
Diol (SunShell SFC, SunShell HILIC)




HILIC-Amide (23 page, SunShell HILIC)




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



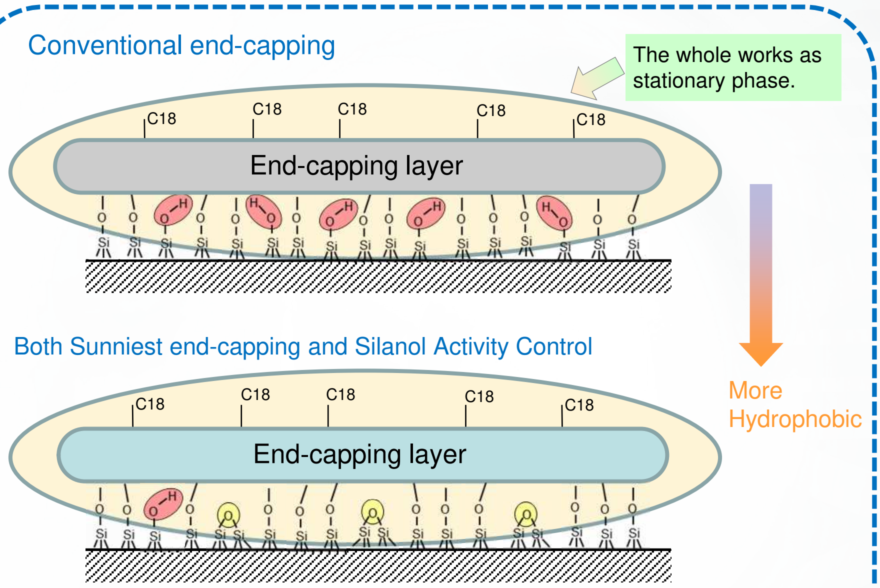

**All revered phases except for PFP and PFP&C18was end-capped at high temperature using Sunniest Endcapping technique.

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

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

# Unique end-capping by new concept

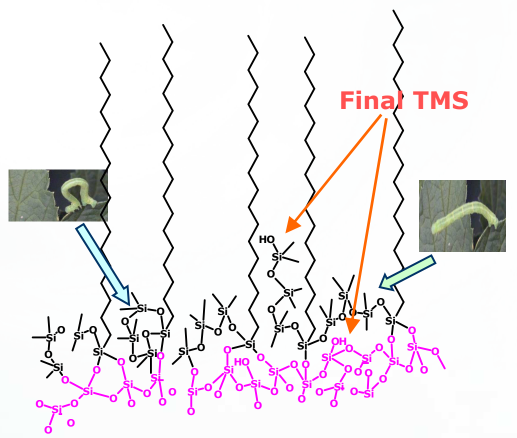
This figure shows comparison of hydrophobicity between two C18 stationary phases. We developed silanol activity control technique which was a reaction at extremely high temperature. This technique makes residual silanol groups change to siloxane bond. The upper one is a C18 phase with conventional end-capping 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.

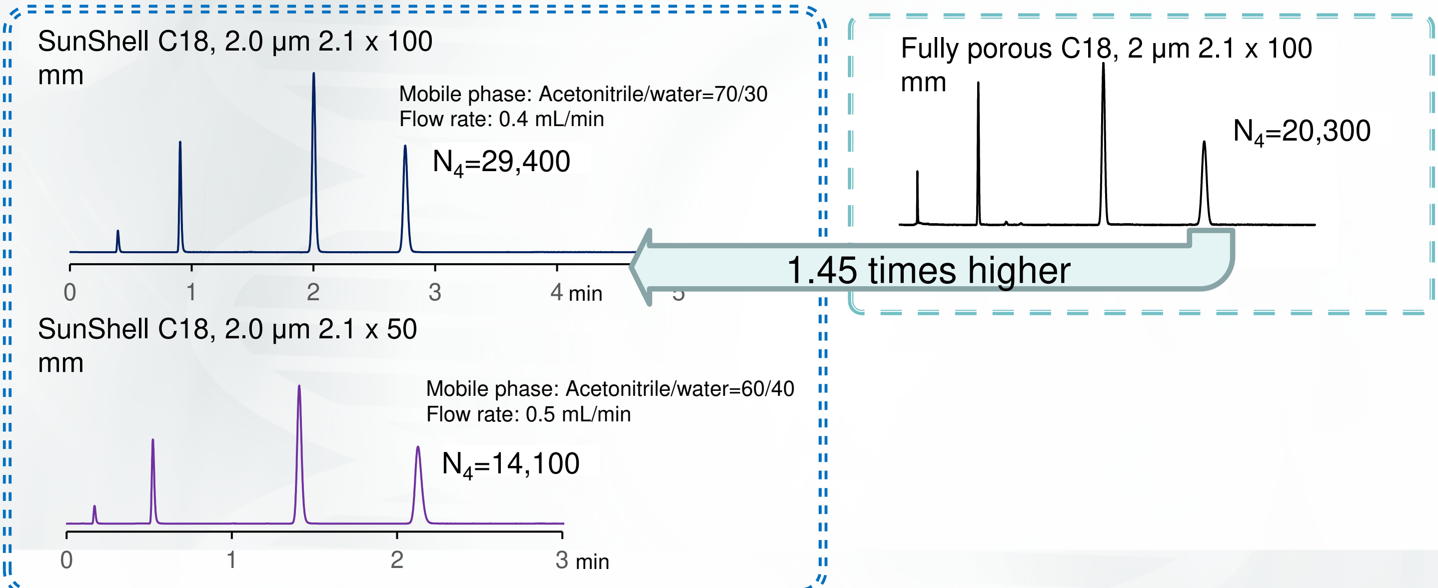
# SunShell C18, 2 µm, 2.6 µm, 3.5 µm, 5 µm

## 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 |

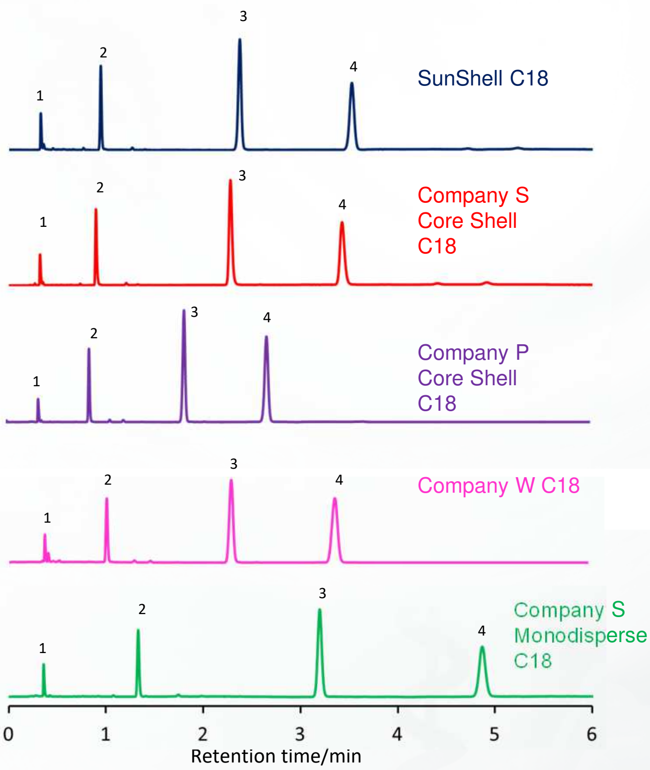
a) Unless otherwise specified in the column test report

## 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

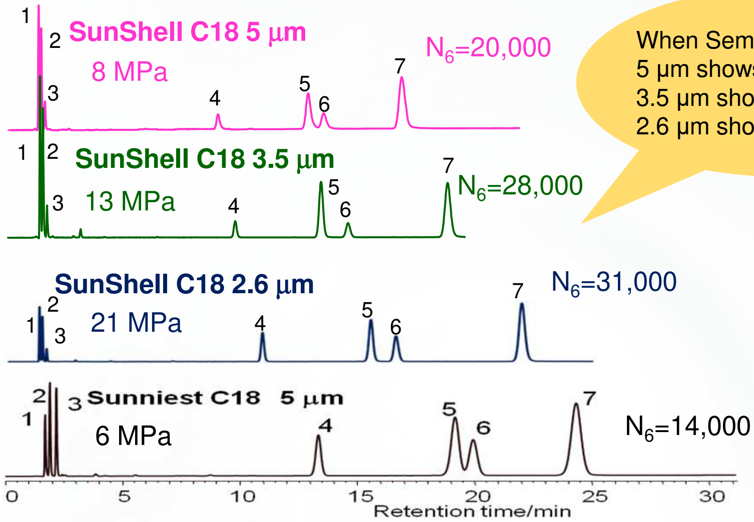



Column: SunShell C18, 2 µm 100 x 2.1 mm
Company S Core Shell C18, 2 µm 100 x 2.1 mm
Company P Core Shell C18, 1.7 µm 100 x 2.1 mm
Company W C18, 1.7 µm 100 x 2.1 mm
Company S Monodisperse C18, 1.9 µm 100 x 2.1 mm
Mobile phase: $CH_3CN/H_2O$=60/40
Flow rate: 0.5 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil,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

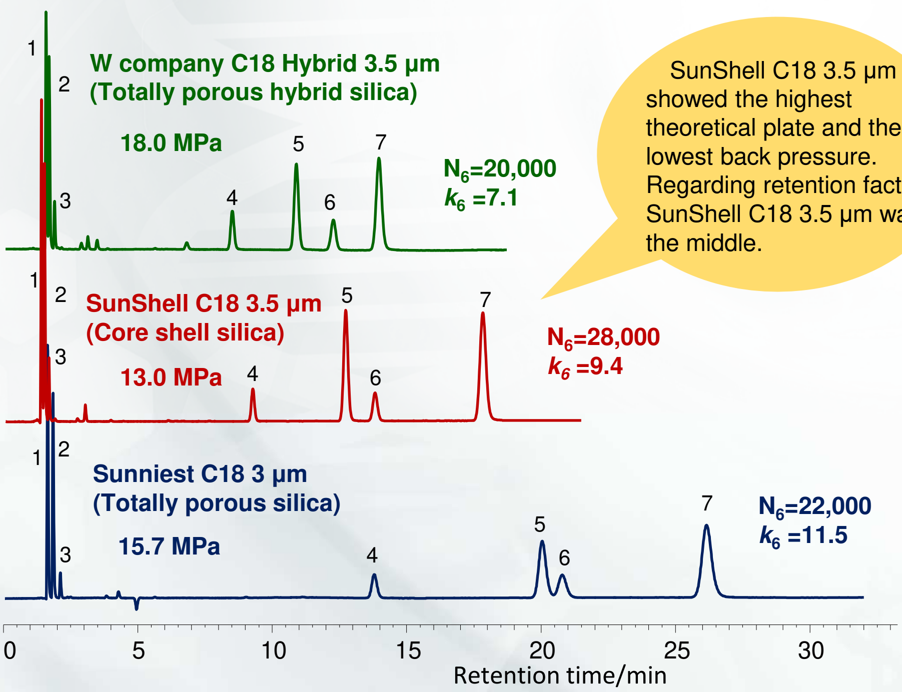



When Semi-Micro LC is used,
5 μm shows 24,000plates,
3.5 μm shows 31,000plates,
2.6 μm shows 38,000plates.

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.)

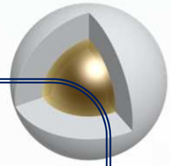
| | Totally porous silica Sunniest C18, 5 μm | | Core shell silica SunShell C18, 2.6 μm | | Core shell silica SunShell C18, 3.5 μm | | Core shell silica SunShell C18, 5 μm | |
|---|---|---|---|---|---|---|---|---|
| Specific surface area | 340 m²/g | | 150 m²/g | | 120 m²/g | | 90 m²/g | |
| Packings 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



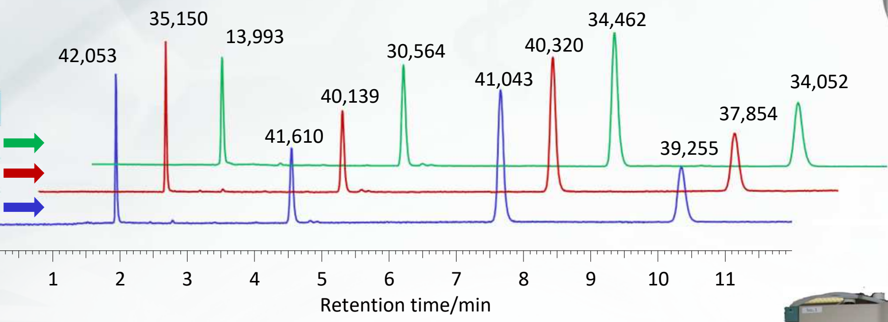

SunShell C18 3.5 μm showed the highest theoretical plate and the lowest back pressure. Regarding retention factor, SunShell C18 3.5 μm was the middle.

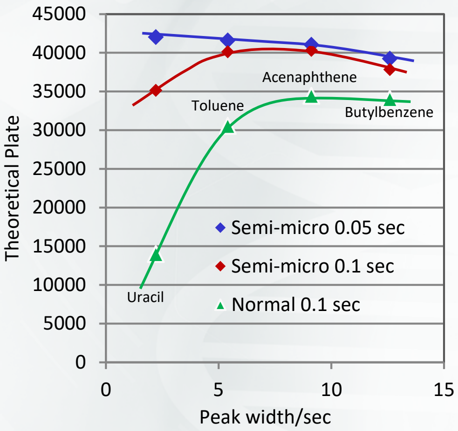
Column size: 150 x 4.6 mm
Mobile phase: $CH_3OH/H_2O$=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil
2 = Caffeine
3 = Phenol
4 = Butylbenzene
5 = o-Terphenyl
6 = Amylbenzene
7 = Triphenylene
HPLC: Conventional HPLC instrument
(Tubing, 0.25 mm i.d.)



## 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

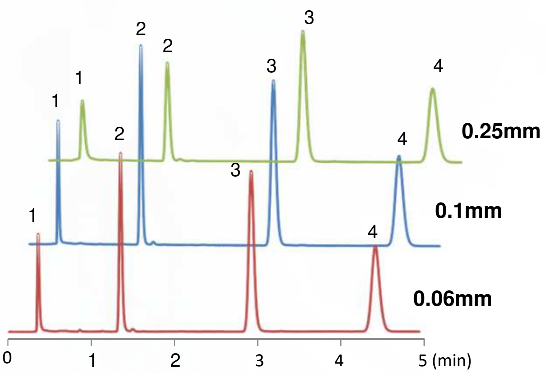
Comparison of chromatograms

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



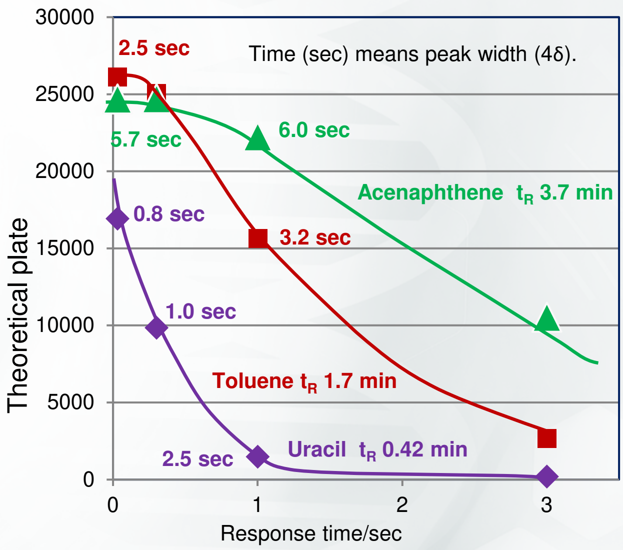

Average of theoretical plate (n=3)

| 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)

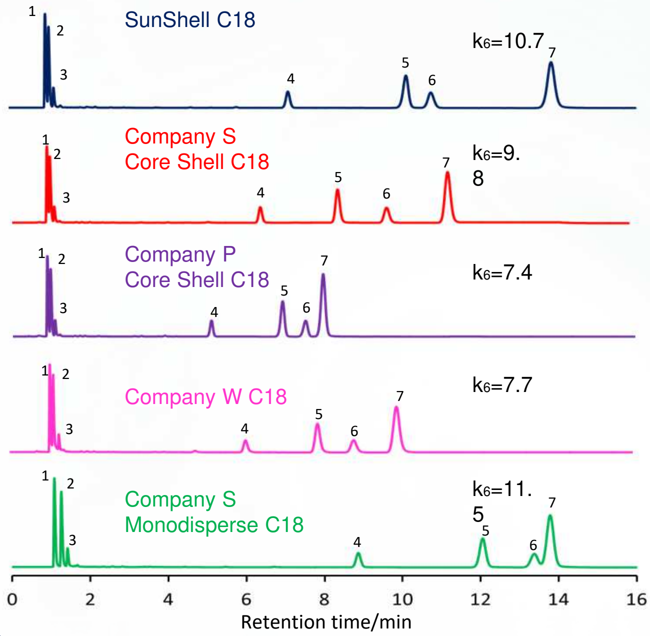
The response time of a detector is important. Regarding uracil, the real peak width is less than 0.8 sec. When the peak width is less than 1 sec, 0.03 sec of response time is needed. Furthermore, the sampling rate of an integrator should be set to be 0.1 sec.

## SunShell C18 2 µm

# 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

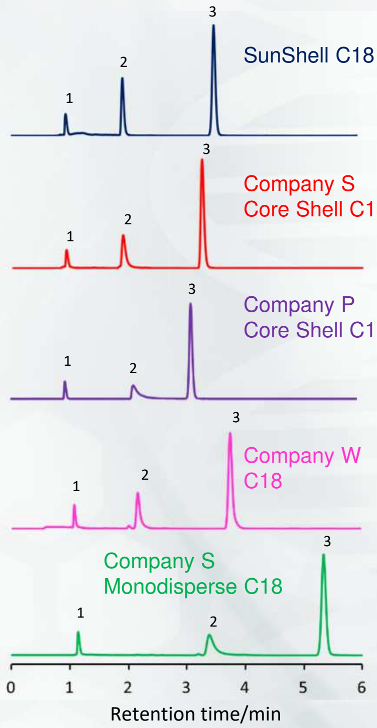
## Separation of standard samples




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

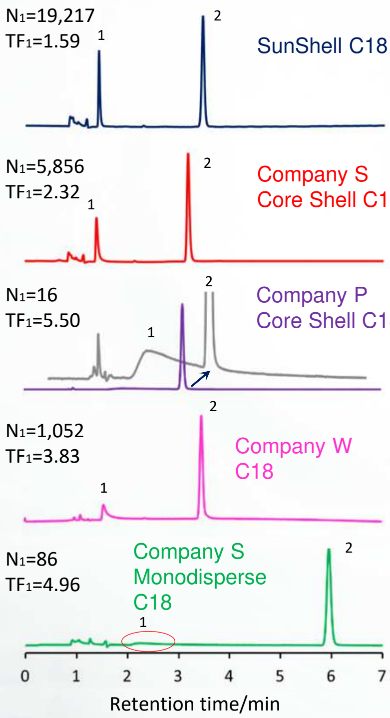
| | Hydrogen bonding (Caffeine/Phenol) | Hydrophobicity (Amylbenzene/Butylbenzene) | Steric selectivity (Triphenylene/o-Terphenyl) |
|---|---|---|---|
| SunShell C18 | 0.43 | 1.59 | 1.41 |
| Company S Core Shell C18 | 0.37 | 1.59 | 1.38 |
| Company P Core Shell C18 | 0.45 | 1.57 | 1.17 |
| Company W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



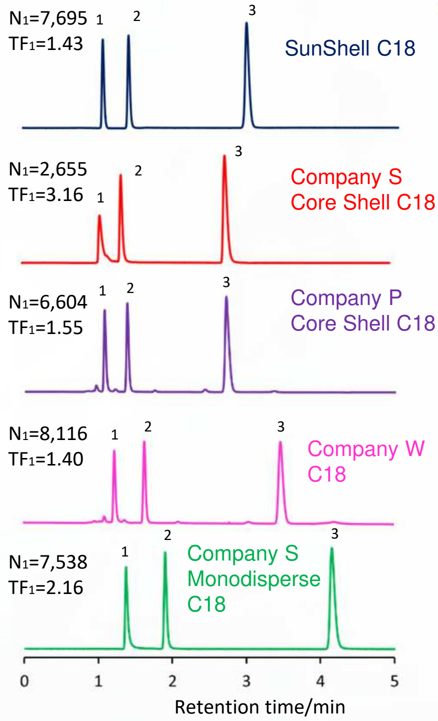

Column dimension: 100 x 2.1 mm
Mobile phase: $CH_3OH/H_2O$=30/70
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Detection: UV@250nm
Sample: 1 = Uracil
2 = Pyridine
3 = Phenol

## 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

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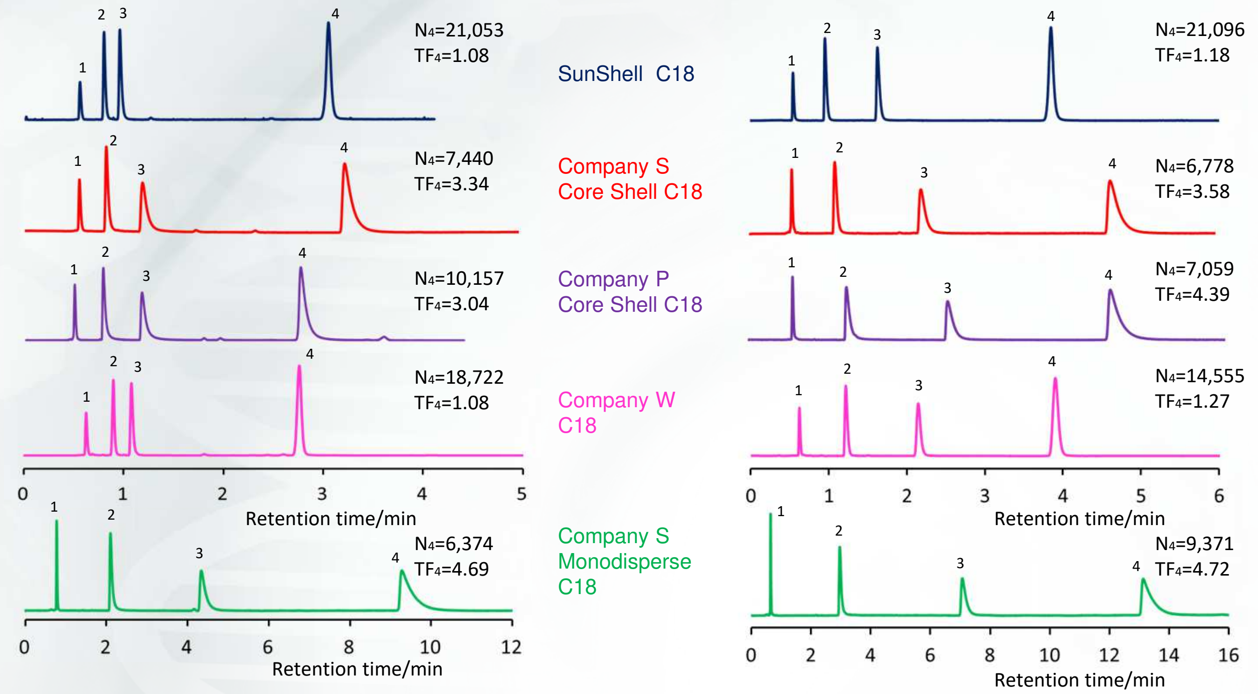
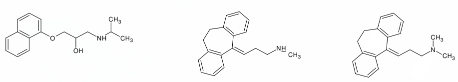
# SunShell C18 2 µm

## Comparison of Amitriptyline (4) as a strong basic compound

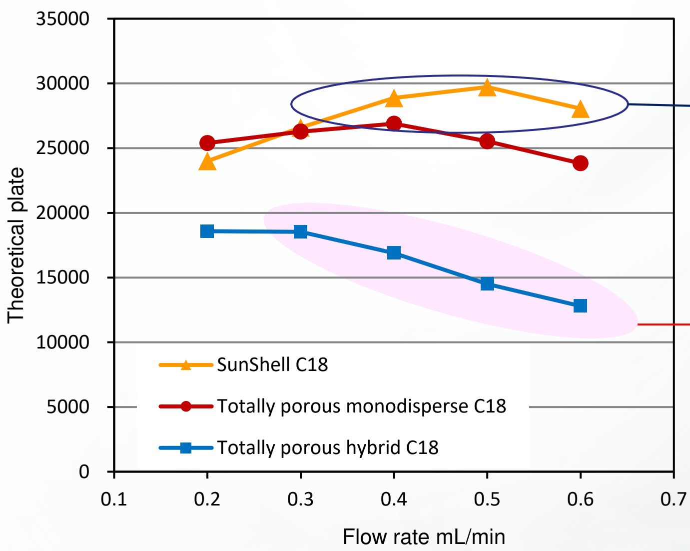



Column dimension: 100 x 2.1 mm
Mobile phase: $CH_3CN$/20 mM Phosphate buffer pH 7.0=60/40
Flow rate: 0.3 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1 = Uracil, 2 = Propranolol, 3 = Nortriptyline, 4 = Amitriptyline



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.

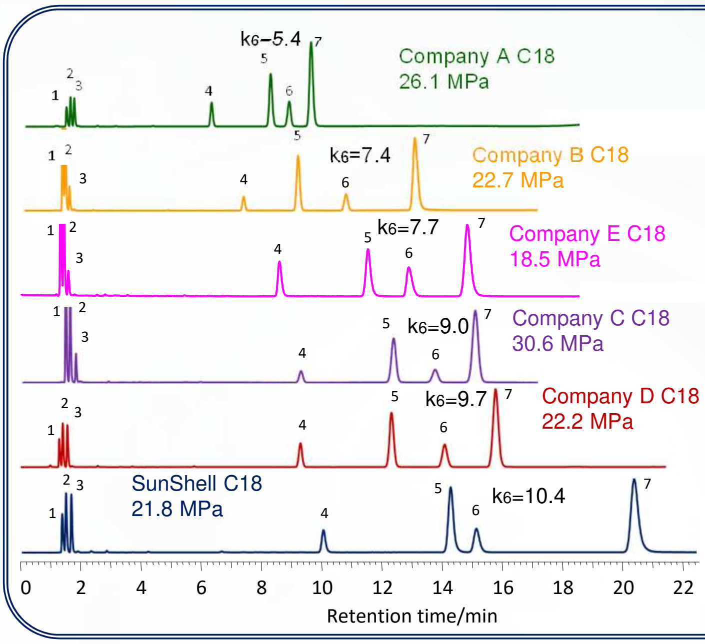
Regarding totally porous hybrid silica, not only totally porous structure but also including ethylene groups make thermal conductivity be low in the column. It is considered that frictional heating deflects thermal distribution in the column and theoretical plate decreases..

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



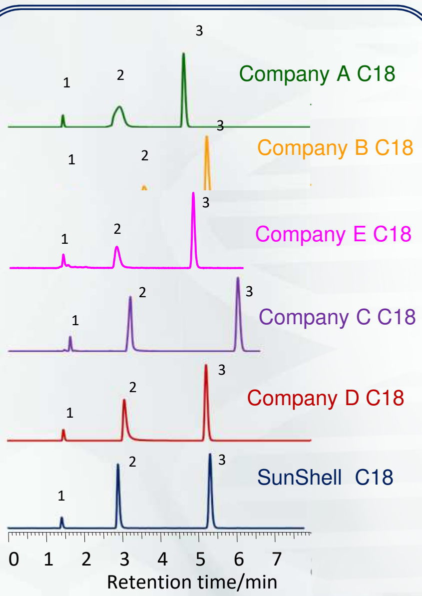

Column: Company A C18, 2.6 µm 150 x 4.6 mm (26.1 Mpa, 30,800 plate)
Company B C18, 2.6 µm 150 x 4.6 mm (22.7 MPa , 31,600 plate)
Company W C18, 2.7 µm 150 x 4.6 mm (18.5 MPa , 23,300 plate)
Company C C18, 2.7 µm 150 x 4.6 mm (30.6 MPa , 30,200 plate)
Company D C18, 2.7 µm 150 x 4.6 mm (22.2 MPa , 31,800 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.

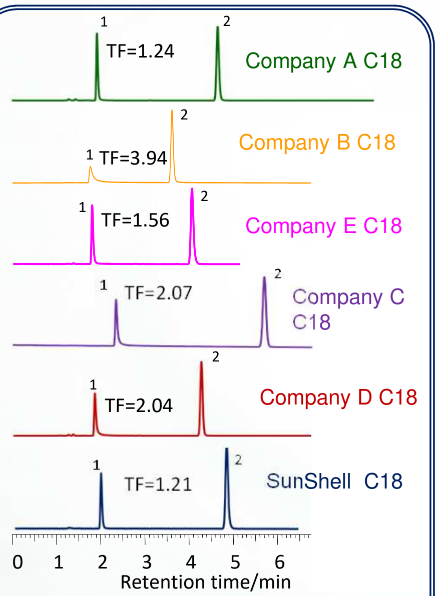
## Comparison of pyridine




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.

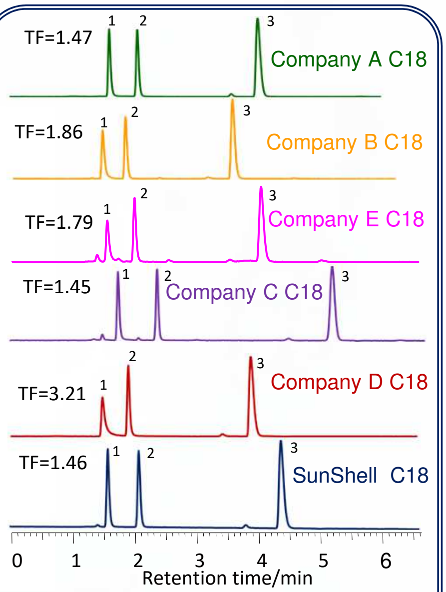
## Comparison of Oxine




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.

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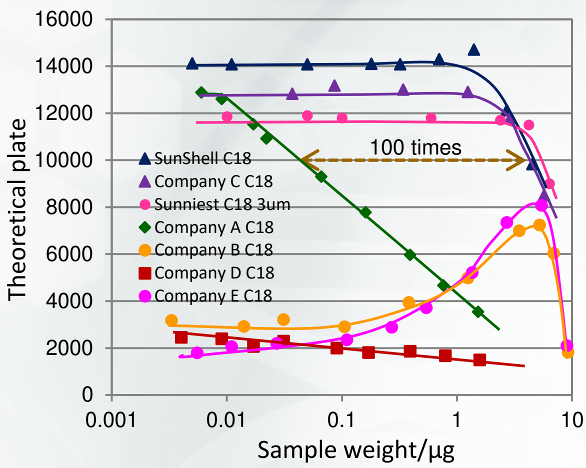
## Loading capacity of amitriptyline as a basic compound

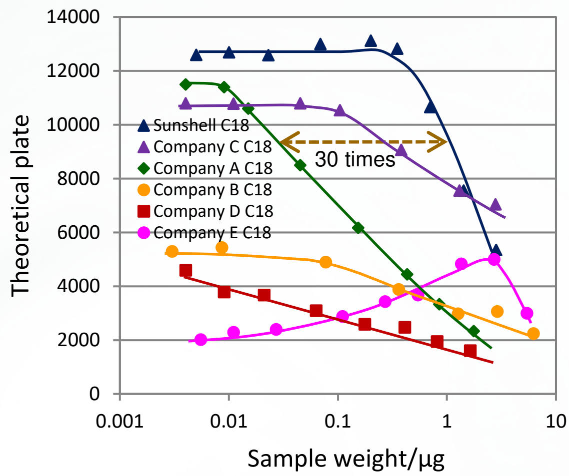
Amitriptyline overlords much more at acetonitrile/buffer mobile phase than methanol/buffer. Three kinds of core shell C18s were compared loading capacity of amitriptyline at three different mobile phases.

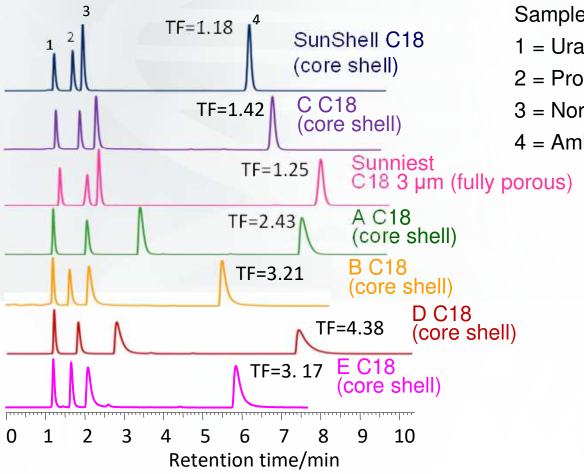
Common condition: Column dimension,150 x 4.6 mm, flow rate; 1.0 mL/min, temperature; 40 ºC

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

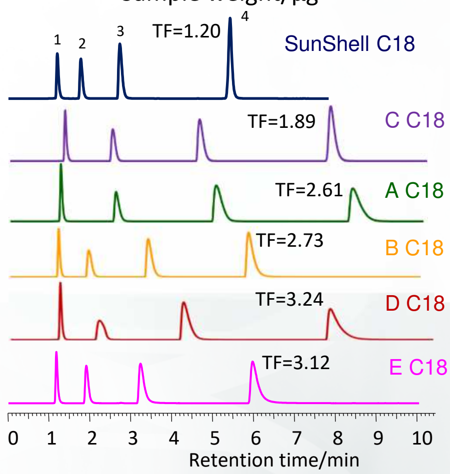



Mobile phase: Acetonitrile/**10mM acetate ammonium pH6.8**=(40:60)

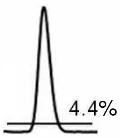



Sample:
1 = Uracil (0.07µg)
2 = Propranolol (1.53µg)
3 = Nortriptyline (0.32µg)
4 = Amitriptyline (0.32µg)




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




## Physical properties

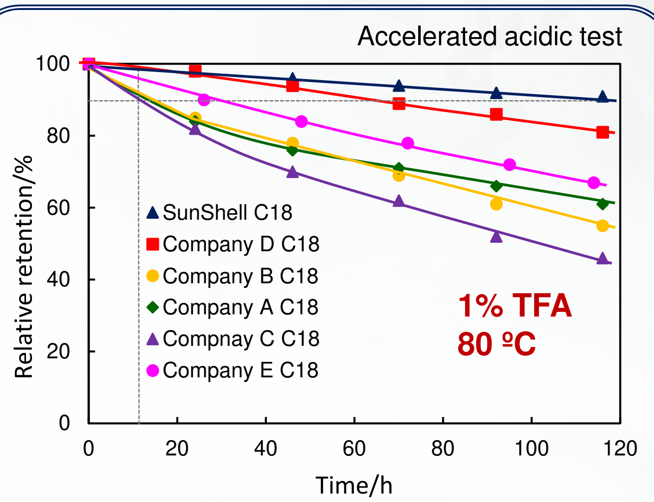
| | Carbon loading (%) | Specific surface area [a] (m²/g) | Pore volume [a] (mL) | Pore diameter [a] (nm) |
|---|---|---|---|---|
| SunShell C18 | 7.3 (7)[b] | 125 (150)[b] | 0.261 | 8.34 (9)[b] |
| Ascentis Express C18 | 8.0 | 133 (150)[b] | 0.278 | 8.20 (9)[b] |
| PoroShell C18 EC | 8.5 (8)[b] | 135 (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] |

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

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

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**

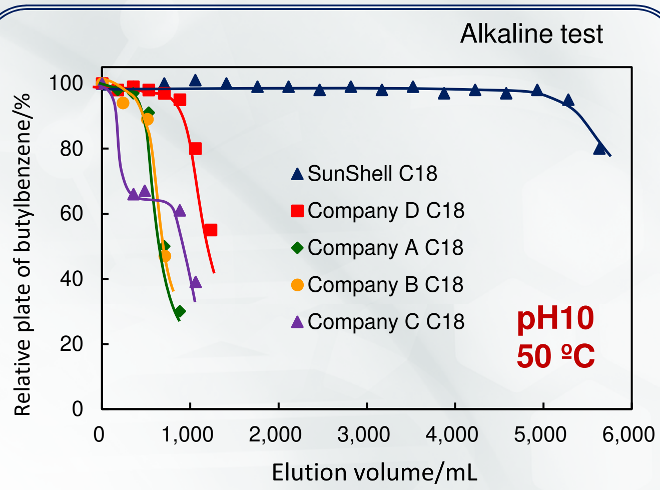
Column size: 50 x 2.1 mm
Mobile phase: $CH_3CN$/1.0% TFA, pH1=10/90
Flow rate: 0.4 mL/min
Temperature: 80 ºC

**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

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.




**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**

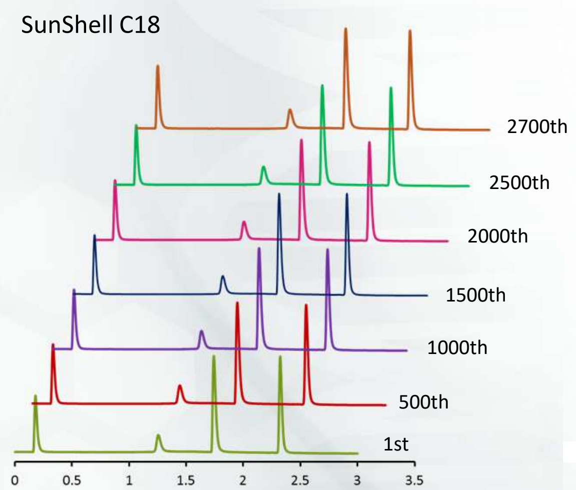
Column Size: 50 x 2.1 mm
Mobile phase: $CH_3CN/H_2O$=60/40
Flow rate: 0.4 mL/min
Temperature: 40 ºC
Sample: 1 = Butylbenzene

Stability under 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

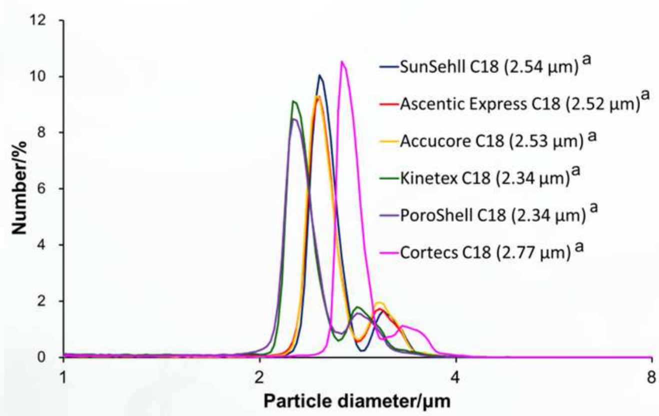



Column: SunShell C18, 2.6 µm 50 x 2.1 mm
Mobile phase: A) 10 mM Ammonium bicarbonate pH 9.5
B) Acetonitrile
Gradient program:

| 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

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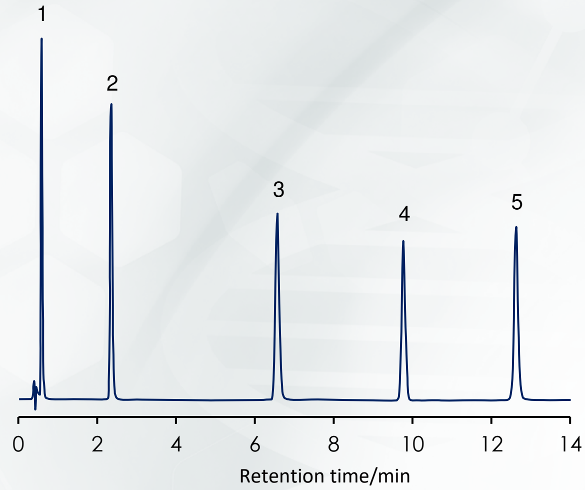
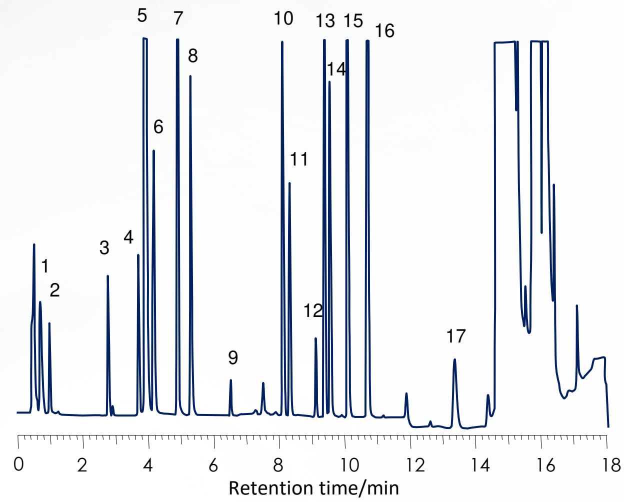
# SunShell

## 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 ºC
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

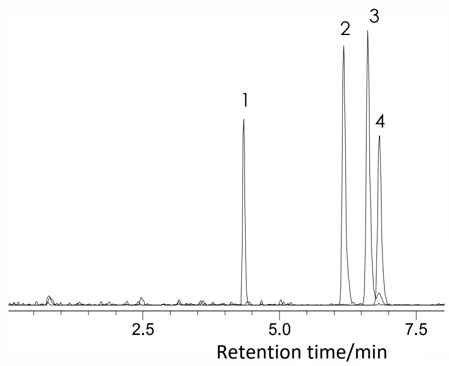


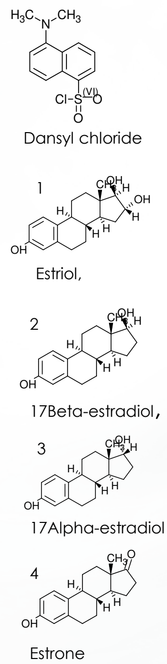

Column: SunShell C18 2.6 µm, 150 x 2.1 mm
Mobile phase: A) 10mM $Na_2PO_4$ + 10mM $Na_2B_4O_7$ + 0.5mM $NaN_3$ (pH7.8)
B) Acetonitrile/Methanol/Water (45/45/10 %V)

| 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



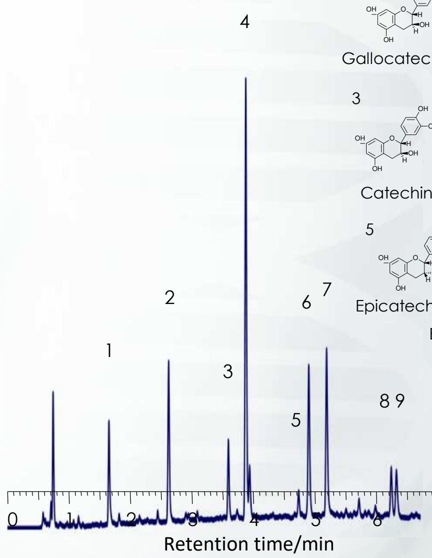



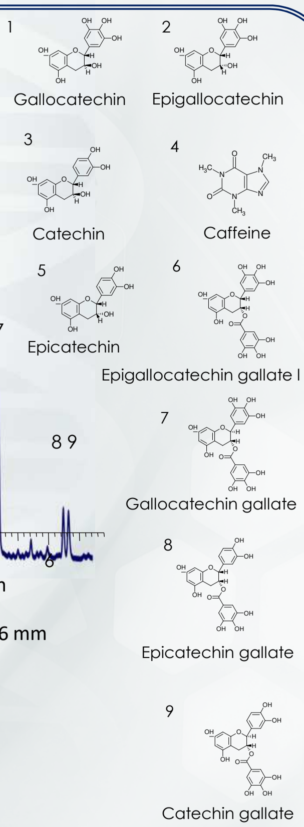

Column: SunShell C18 2.6 µm, 100 x 2.1 mm
Mobile phase:
A) $H_2O$ with 0.1% formic acid.
B) $CH_3CN$ with 0.1% formic acid.
Gradient program:
0 - 0.5 min: 10% B
0.51 – 3.0 min: 10 - 72% B
3.01 - 6.0 min: 72% B
6.01 - 7.0 min: 72 - 100% B
7.01 - 10.0 min: 100% B

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




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

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# SunShell C18-WP, RP-AQUA, C8, Phenyl, PFP, PFP&C18, Cyano, 2.6 µm

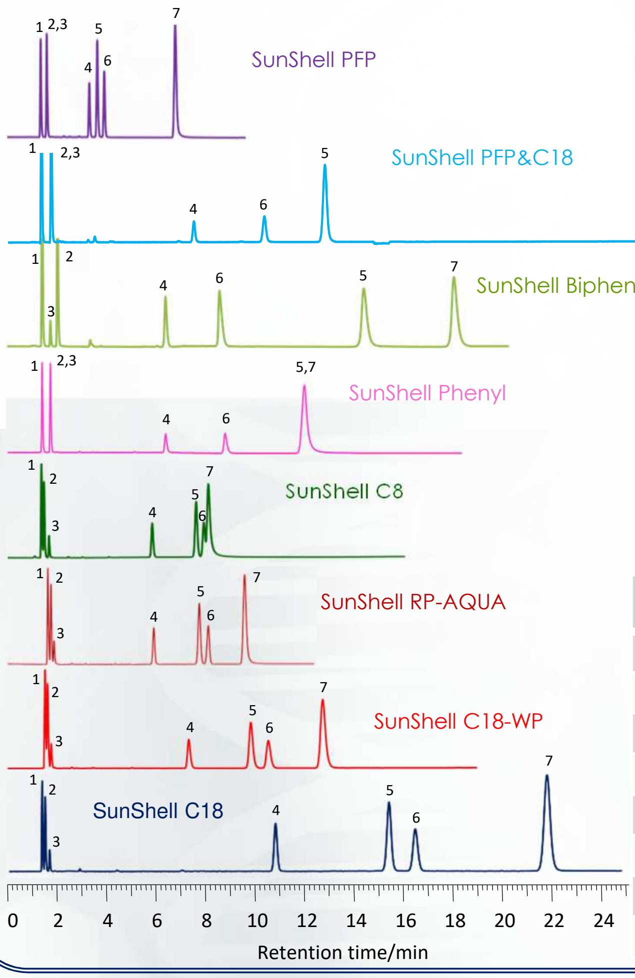
*(Pentafluorophenyl)*

## ◆ Characteristics of SunShell

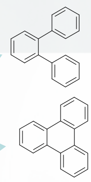
| | Core shell silica | | | Bonding phase | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Particle size | Pore diameter | Specific surface area | Carbon content | Bonded phase | USP L code | End-capping | Maximum operating pressure [a] | Available pH range |
| SunShell C18 | 2.6 µm | 9 nm | 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

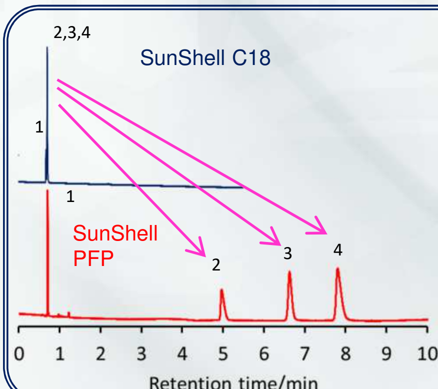



Column: SunShell C18, C18-WP, RP-AQUA, C8, Biphenyl, Phenyl, PFP, PFP&C18, 2.6 µm 150 x 4.6 mm
Mobile phase: $CH_3OH/H_2O$=75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Sample: 1 = Uracil
2 = Caffeine
3 = Phenol
4 = Butylbenzene
5 = o-Terphenyl
6 = Amylbenzene
7 = Triphenylene



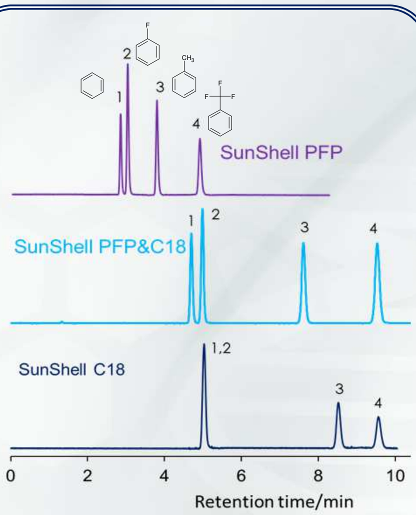
| | 水素結合性 (Caffeine/Phenol) | 疎水性 (Amylbenzene/Butylbenzene) | 立体選択性 (Triphenylene/o-Terphenyl) |
|---|---|---|---|
| PFP | 1.00 | 1.31 | 2.38 |
| PFP&C18 | 1.00 | 1.47 | 2.64 |
| Biphenyl | 1.82 | 1.44 | 1.28 |
| Phenyl | 1.00 | 1.48 | 1.01 |
| C8 | 0.32 | 1.46 | 1.08 |
| RP-AQUA | 0.52 | 1.52 | 1.30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

## Separation of basic compounds



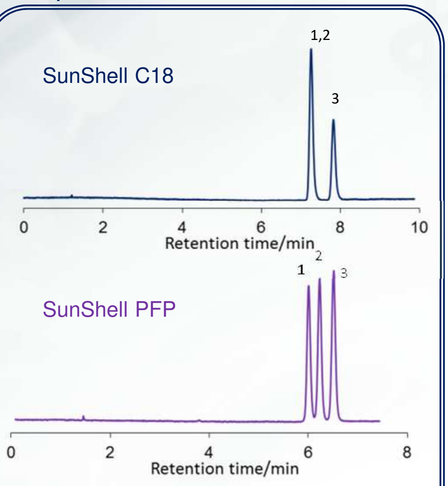

Column: SunShell C18, 2.6 µm 150 x 4.6 mm
SunShell PFP, 2.6 µm 150 x 4.6 mm
Mobile phase:
$CH_3CN$/10mM phosphate buffer pH7.0=80/20
Flow rate: 1.8 mL/min
Temperature: 25 ºC
Sample: 1 = Uracil, 2 = Propranolol,
3 = Nortriptyline, 4 =Amitriptyline

## Separation of fluorobenzene



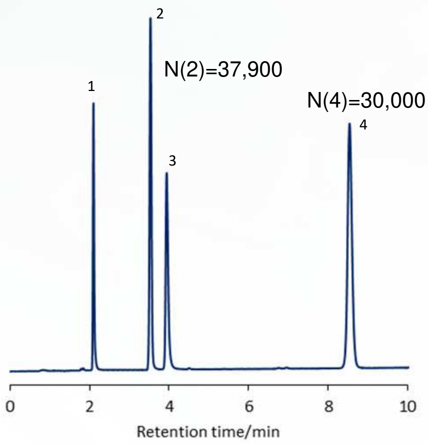

Column: SunShell PFP、PFP&C18, C18, 2.6 µm, 4.6 x 150 mm
Mobile phase: Methanol/water = 60/40
Flow rate: 1.0 mL / min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1 = Benzene, 2 = Fluorobenzene, 3 = Toluene, 4 = α,α,α-Trifluorotoluene

## Separation of cresol isomers



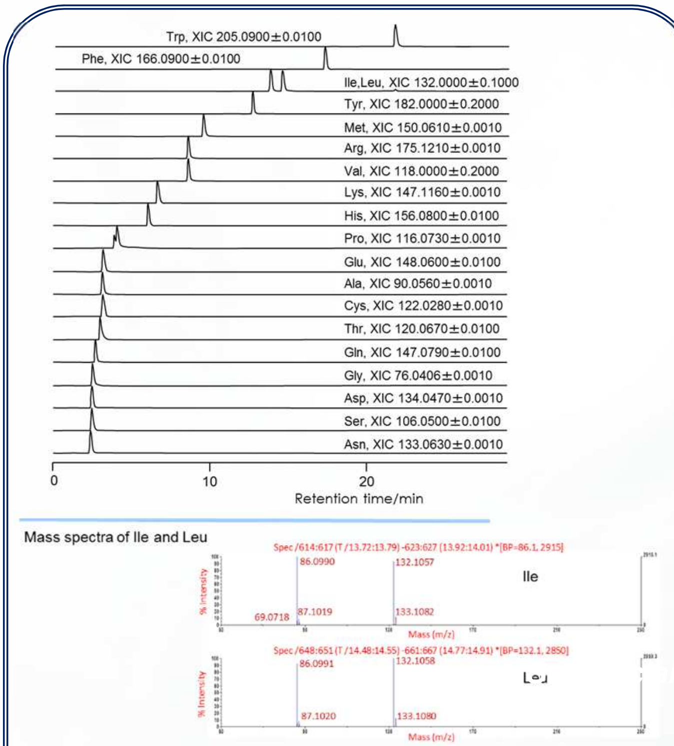

Column: SunShell C18, PFP, 2.6 µm 150 x 4.6 mm
Mobile phase: $CH_3OH/H_2O$=40/60
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV@250nm
Sample: 1 = p-Cresol
2 = m-Cresol
3 = o-Cresol

## Separation of nucleotides



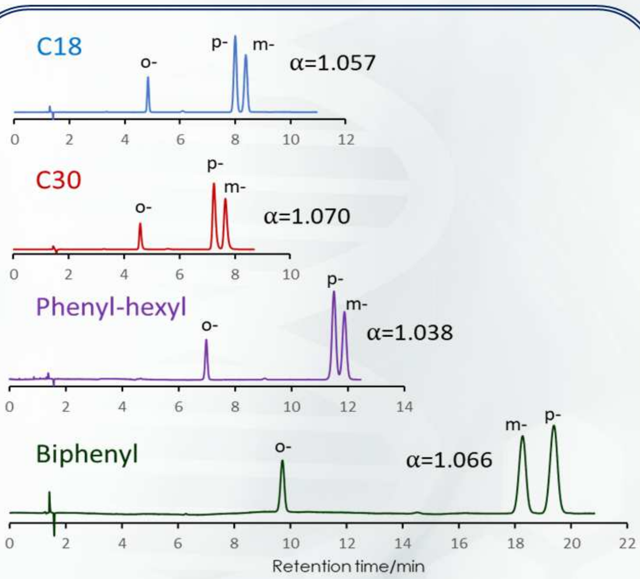

Column:
SunShell RP-AQUA, 2.6 µm 150 x 4.6 mm
Mobile phase: 20mM Phosphate buffer pH6.0
Flow rate: 1.0 mL/min
Temperature: 25 ºC
Detection: UV@250nm
Sample: 1 = 5'-GDP
2 = 5'-ATP
3 = 5'-ADP
4 = 5'-AMP

## Separation of amino acids (LC/MS)



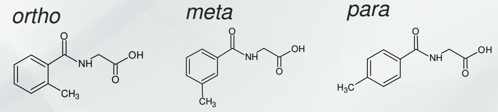

Column: SunShell RP-AQUA, 2.6 µm, 150 x 2.1 mm
Mobile phase: A) 5 mM HFBA, B) 5 mM HFBA in $CH_3CN$ / $H_2O$ (9/1)
%B 0% to 20% in 20 min (HFBA: Heptafluorobutyric acid)
Flow rate: 0.2 mL / min
Temperature: 40 °C
Detection: MS (NanoFrontier LD) ESI Positive,
Extracted ion chromatogram (EIC)

## Separation of *m*ethylhippuric acid isomers



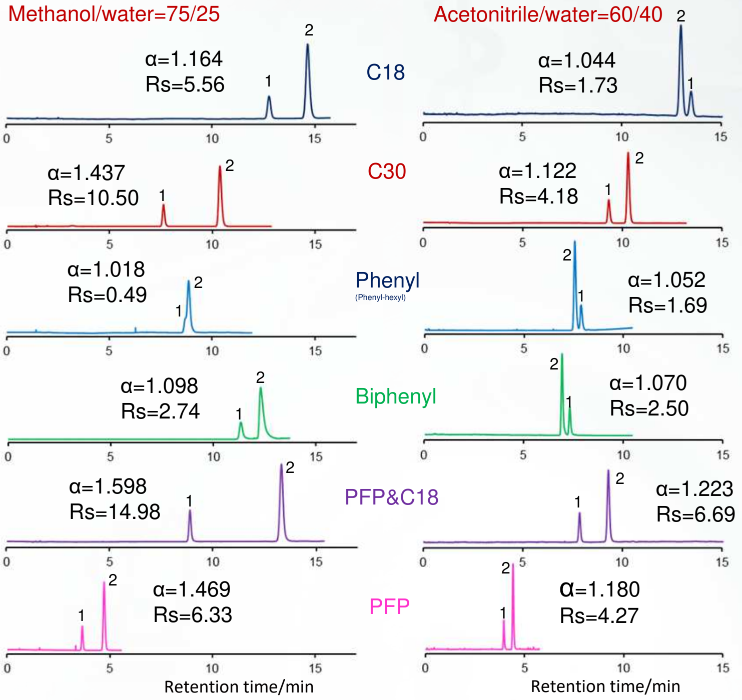

Column: SunShell C18 2.6 µm, 150 x 4.6 mm
SunShell C30 2.6 µm, 150 x 2.1 mm
SunShell Phenyl 2.6 µm, 150 x 4.6 mm
SunShell Biphenyl 2.6 µm, 150 x 4.6 mm
Mobile phase: 2-Propanol/25 mM Phosphate buffer pH 3.0 = 7/93
Flow rate: 1.0 mL/min, 0.2 mL/min for only C30
Temperature: 40 °C
Detection: UV@230 nm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

*ortho* *meta* *para*

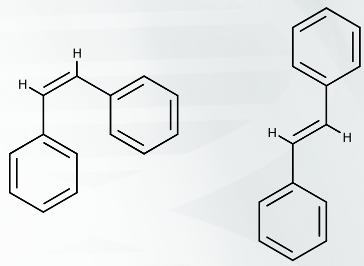


ChromaNik Technologies Inc.

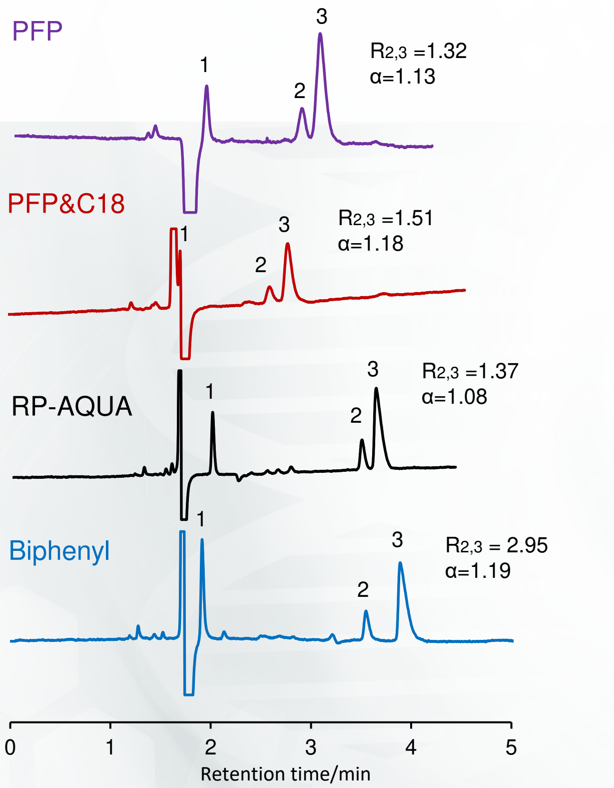
## Separation of cis, trans-stilbene



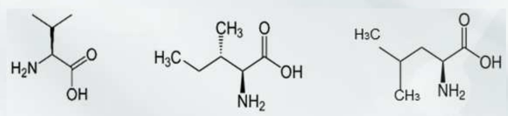

Column: SunShell C18 2.6 µm, 150 x 4.6 mm i.d.
SunShell C30 2.6 µm, 150 x 2,1 mm i.d.
SunShell Phenyl 2.6 µm, 150 x 4.6 mm i.d.
SunShell Biphenyl 2.6 µm, 150 x 4.6 mm i.d.
SunShell PFP&C18 2.6 µm, 150 x 4.6 mm i.d.
SunShell PFP 2.6 µm, 150 x 4.6 mm i.d.
Mobile phase: Methanol/water = 75/25
Acetonitrile/water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



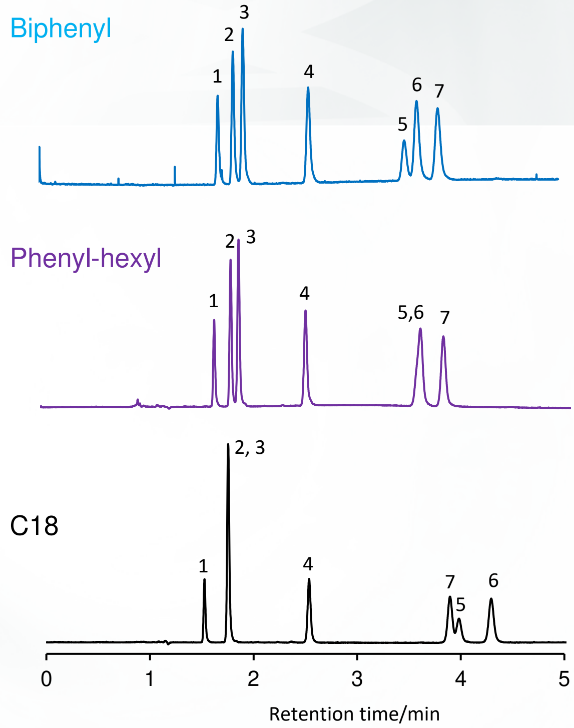
## Separation of branched-chain amino acids



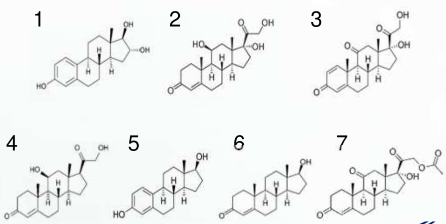

Column: SunShell PFP, PFP&C18, RP-AQUA, Biphenyl 2.6 µm, 150 x 4.6 mm
Mobile phase: 0.1% formic acid
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@205 nm
Sample: 1 = L-Valine 2 = L-Isoleucine 3 = L-Leucine



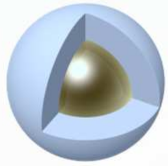
## Separation of steroids




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 °C
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

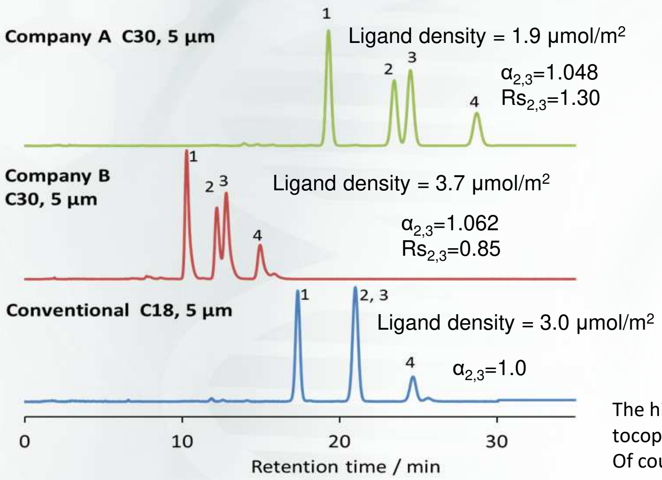


## Specification of SunShell C30

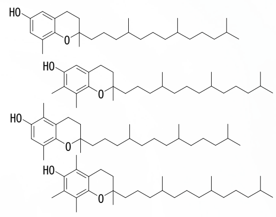
| | Core shell silica | | | | Bonding phase | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Particle size (µm) | Core size (µm) | Pore size (nm) | Specific surface area ($m^2$/g) | Carbon loading (%) | Ligand | USP L category | End-capping | Maximum pressure[a)] | pH range |
| SunShell 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

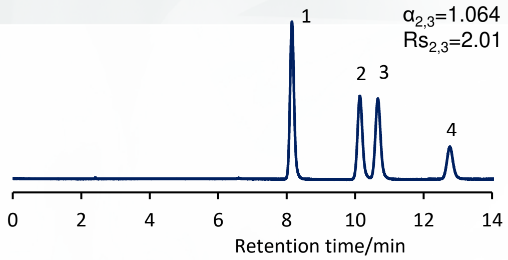



Column dimension: 250 x 4.6 mm
Mobile phase: methanol/water = 97/3
Flow rate: 1.0 mL/min
Temperature: 30 °C
Detection: UV@295 nm
Sample,
1 = δ-tocopherol
2 = γ-tocopherol
3 = β-tocopherol
4 = α-tocopherol



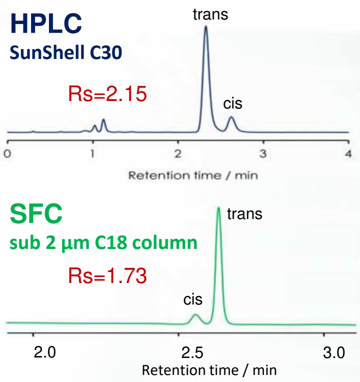
The higher a ligand density, the larger a separation factor of β-tocopherol and γ-tocopherol. Too high ligand density causes low theoretical plate and large tailing of a peak. Of course C18 columns can't separate β-tocopherol and γ-tocopherol.

## 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 °C
Detection: UV@295 nm
Sample: 1 = δ-tocopherol, 2 = γ-tocopherol, 3 = β-tocopherol, 4 = α-tocopherol

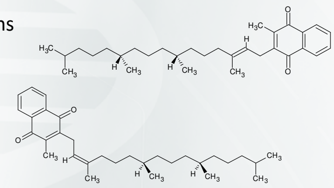
## Fast separation of vitamin K1 isomers




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

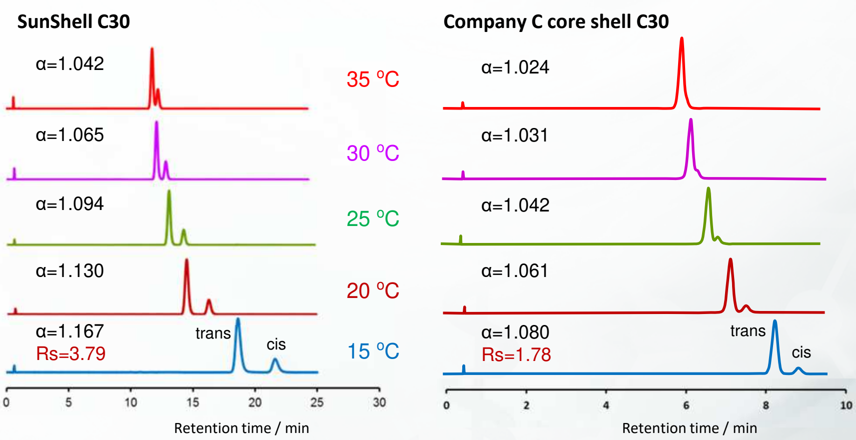
trans

cis



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

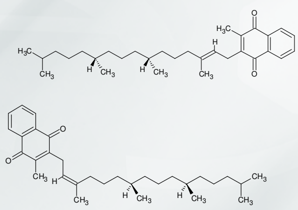
## Comparison of isomers separation of Vitamin k1




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

## Characteristics of SunShell

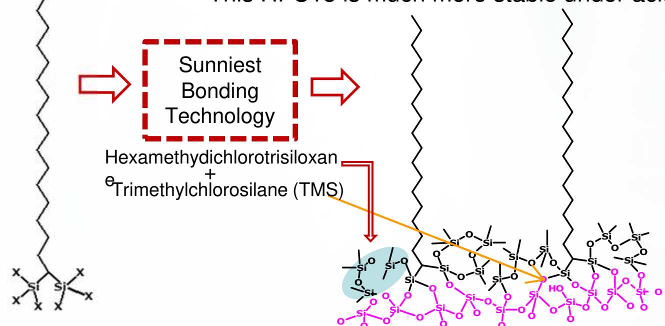
For separation of peptides and proteins

| | 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 $m^2$/g | C18 | 5 % | 2.5 µmol/$m^2$ | Sunniest endcapping | 60 MPa or 8,570 psi | 1.5 - 10 | L1 |
| SunShell HFC18-16 | 2.6 µm | 16 nm | 90 $m^2$/g | C18 | 2.5% | 1.2 µmol/$m^2$ | Sunniest endcapping | 60 MPa or 8,570 psi | 1.5 – 9 | L1 |
| SunShell C8-30HT | 3.4 µm | 30 nm | 15 $m^2$/g | C8 | 0.5% | 2.5 µmol/$m^2$ | Sunniest endcapping | 60 MPa[a] or 8,570 psi[a] | 1.5 – 9 | L7 |
| SunShell C4-100 | 2.6 µm | 100 nm | 22 $m^2$/g | C4 | 0.6% | 3 µmol/$m^2$ | 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.

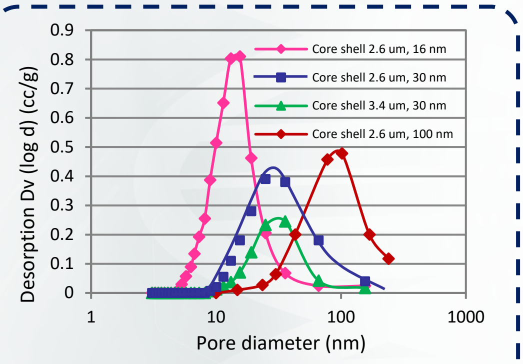
a) Unless otherwise specified in the column test report
b) 50MPa, 7141psi for 4.6 mm i.d. column

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

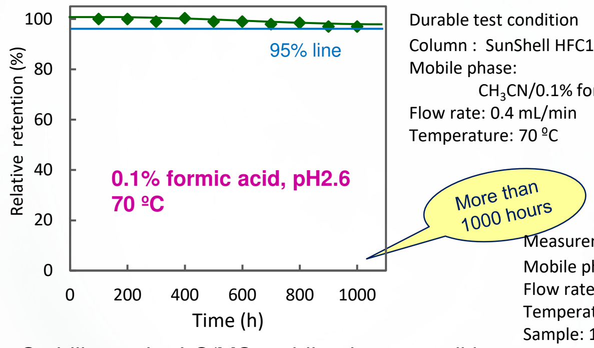



Schematic diagram of reagent

Schematic diagram of the state of bonding on silica surface




Pore distribution of core shell particle

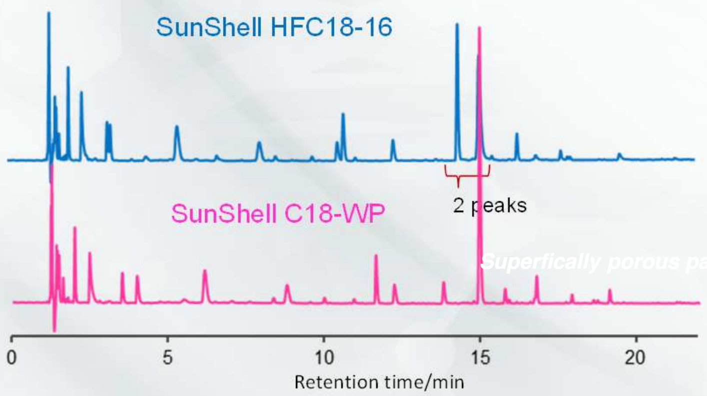



Stability under LC/MS mobile phase condition

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

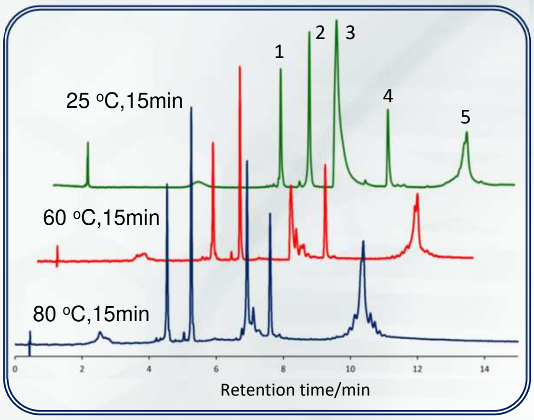
| Time | 0 min | 5 min | 40 min |
|---|---|---|---|
| %B | 5% | 5% | 50% |

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

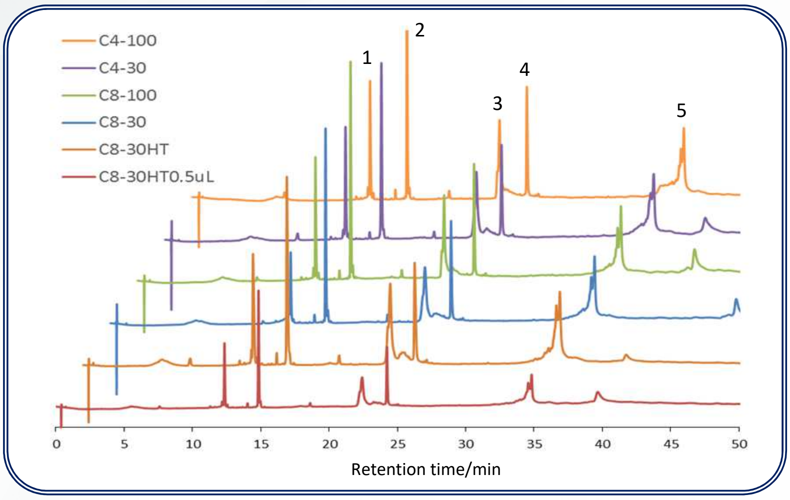
## Comparison of column temperature




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



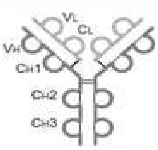

Column dimension: 100 x 2.1 mm,
Mobile phase: A) 0.1% TFA in water, B) 0.1 % TFA in Acetonitrile
Gradient program: Time 0 min 60 min
%B 20% 65%
Flow rate: 0.5 mL/min, Temperature: 80 °C, Detection: UV@215 nm, Injection volume: 1.0 µL
Sample:1 = Cytochrome C, 2 = Lysozyme, 3 = BSA, 4 = Myoglobin, 5 =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

Comparison of peak width (W0.5, min)

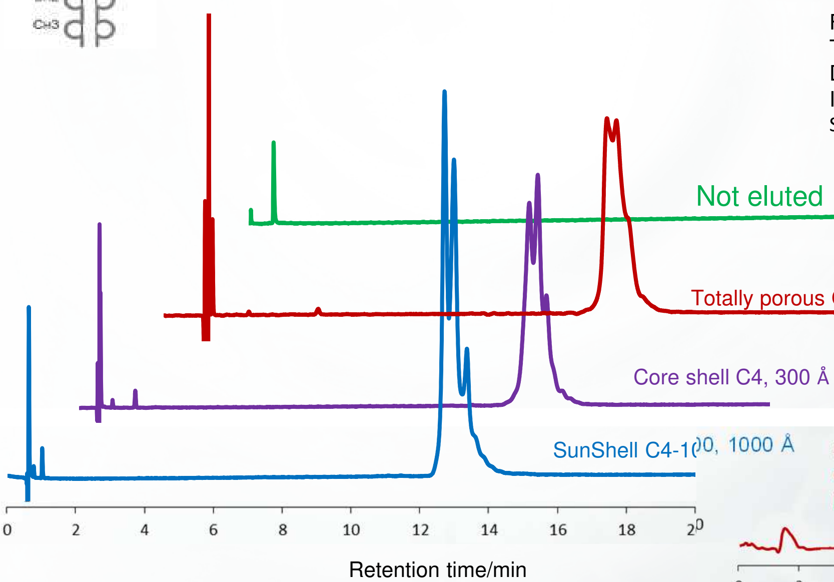
| | C4-100 | C4-30 | C8-100 | C8-30 | C8-30HT | C8-30HT 0.5µL | Sample concentration |
|---|---|---|---|---|---|---|---|
| Cytochrome C | 0.167 | 0.177 | 0.160 | 0.155 | 0.212 | 0.144 | 0.050% |
| Lysozyme | 0.164 | 0.180 | 0.153 | 0.166 | 0.196 | 0.145 | 0.050% |
| BSA | 0.308 | 0.410 | 0.276 | 0.514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

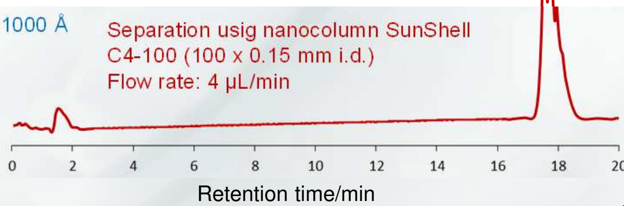
The above table indicated that C4-100 with 1000Å of pore showed a sharper peak than the other. C8-30HT has a thin porous layer and low surface area, so that low sample loadnig made a peak sharper.

## 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

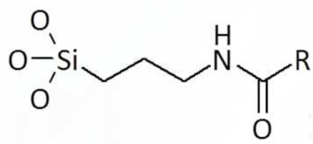
### For Hydrophilic Interaction Chromatography

## 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 |

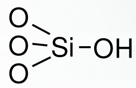
a) Unless otherwise specified in the column test report

Stationary phase of HILIC-Amide



R: Hydrophilic group

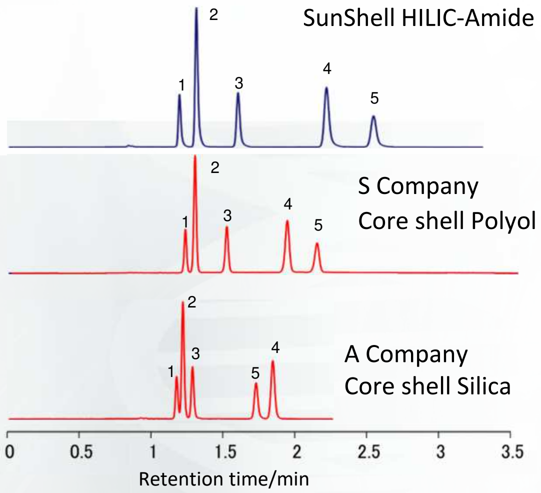
Stationary phase of HILIC-S



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.

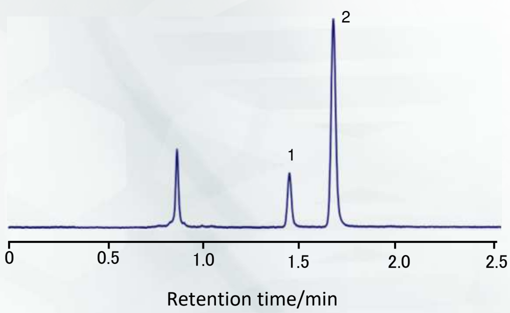
## Separation of Nucleic acid bases: Comparison of the other core shell hilic columns




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 ºC
Detection: UV@250 nm
Sample: 1 = Thymine, 2 = Uracil, 3 = Uridine, 4 = Cytosine, 5 = Cytidine

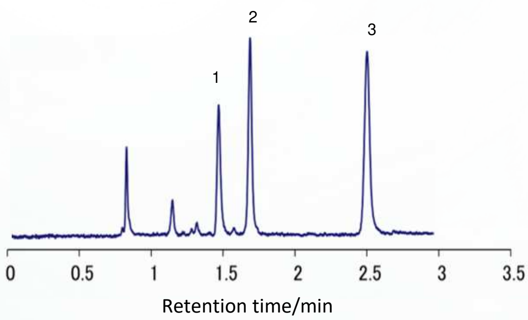
Regarding retention of cytidine, SunShell HILIC-Amide showed 30% higher retention factor than S core shell polyol.

## Separation of Cyanuric acid and Melamine



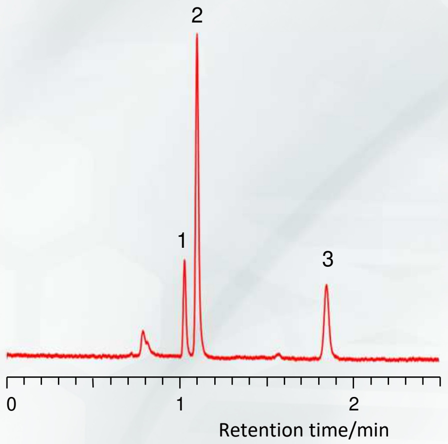

Column: SunShell HILIC-Amide, 2.6 µm 100 x 4.6 mm
Mobile phase:
Acetonitrile/5 mM phosphate Buffer (pH6.9) =75/25
Flow rate: 1.0 mL/min
Temperature: 40 ºC
Detection: UV@220 nm,
Sample: 1 = Cyanuric acid, 2 = Melamine

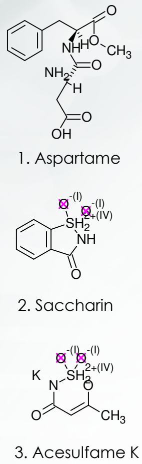
## Separation of water- soluble vitamins




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 ºC
Detection: UV@250 nm,
Sample: 1 = Nicotinic acid, 2 = Ascorbic acid, 3 = Pyridoxine

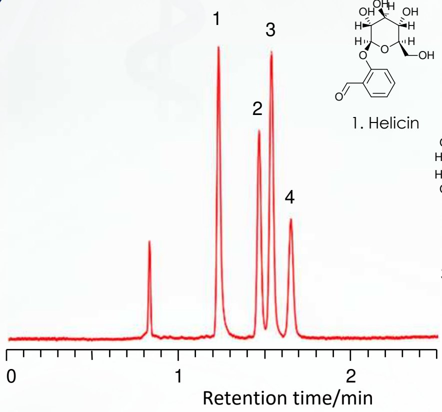
## Artificial sweeteners

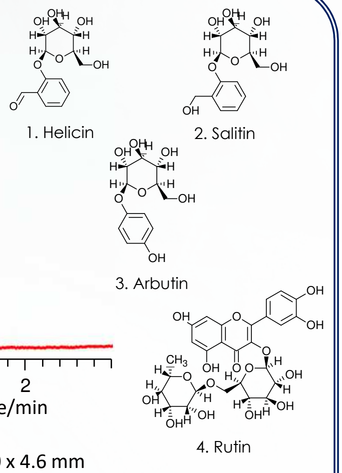



Column:
SunShell HILIC-Amide, 2.6 µm, 100 x 4.6 mm
Mobile phase:
Acetonitrile: 25 mM phosphate buffer (pH2.5) =8:2
Flow rate: 1.0 mL/min ,
Temperature: Ambient
Detection: UV@215 nm
Sample: 1 = Aspartame, 2 = Saccharin, 3 = Acesulfame K

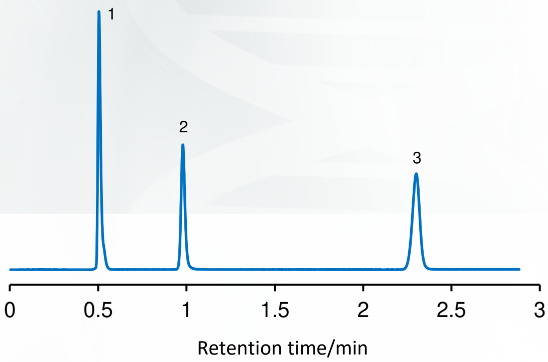
## Glycoside



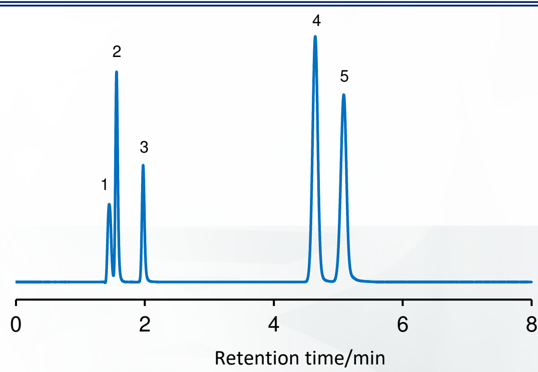

Column:
SunShell HILIC-Amide, 2.6 µm, 100 x 4.6 mm
Mobile phase:
Acetonitrile:25 mM phosphate Ammonium (pH4.9) =8:2
Flow rate: 1.0 mL/min
Temperature: Ambient
Detection: UV@215 nm
Sample: 1 = Helicin, 2 = Salicin, 3,= Arbutin, 4 = Rutin

## 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 °C
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 °C
Detection: UV@250 nm
Sample: 1 = Thymine, 2 = Uracil, 3 = Uridine, 4 = Cytosine, 5 = Cytidine

# Metal Free Column

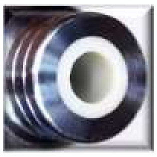
PEEK clad SUS column

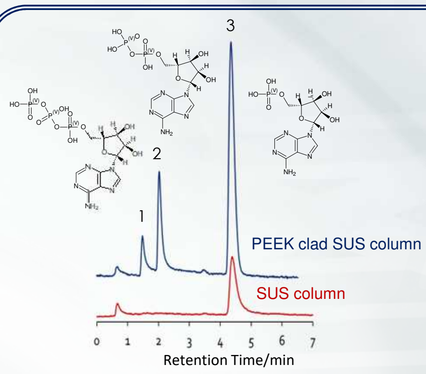
**Metal-free column**

- 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 HCOONH4
Flow rate: 0.2 mL/min
Temperature: 25 °C
Detection: UV at 250 nm
Sample: 1 = 5'-ATP
2 = 5'-ADP
3 = 5'-AMP
Injection: 1 µL
(each concentarion 25 µg/mL)

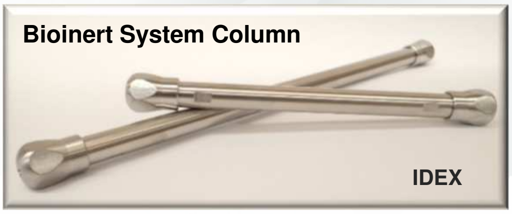
【Effect of column hardware against metal-chelating compounds】

**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.**

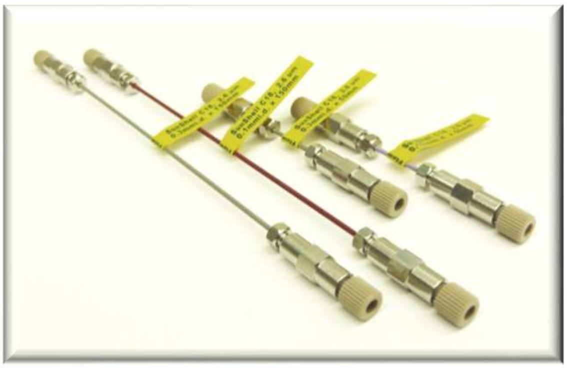
**Micro column: 0.3 mm i.d., 0.5 mm i.d.**

**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**



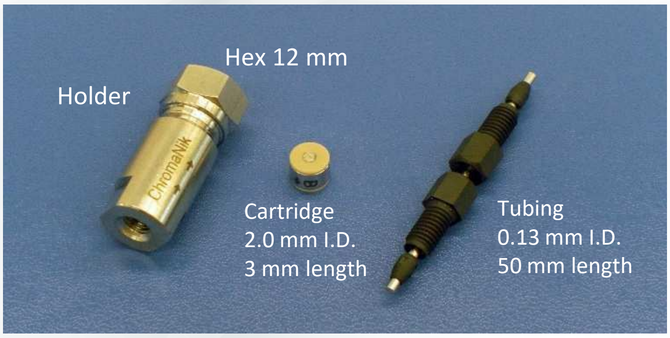
## Example of prices

| | 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.

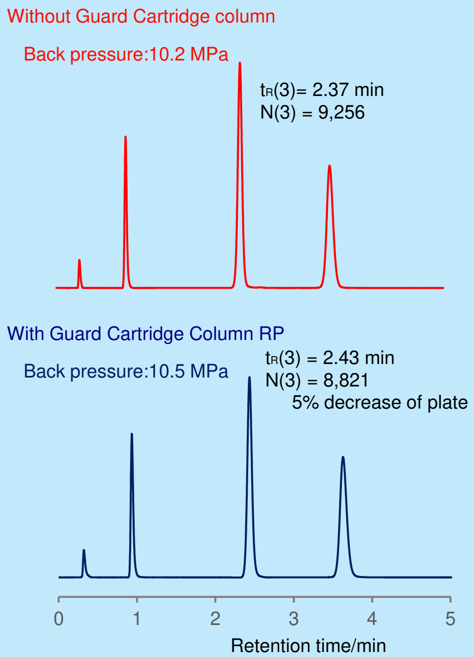
# SunShell Guard Cartridge Column

## RP & S GUARD CARTRIDGE COLUMN



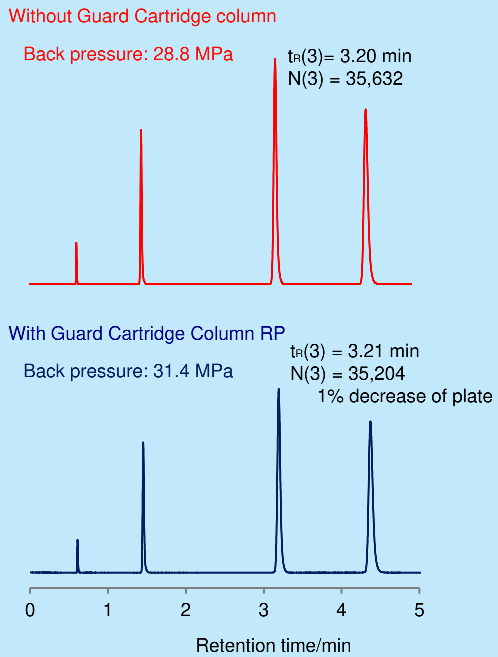

- ⋆ The cartridge column is packed with SunShell C18 (RP) and Core shell silica (S) into a cartridge sized 3 x 2 mm i.d.
- ⋆ RP guard cartridge is used for all reversed phases and S guard cartridge for hilic phases.
- ⋆ Low dead volume structure
- ⋆ Upper pressure limit is more than 60 Mpa
- ⋆ Availablr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

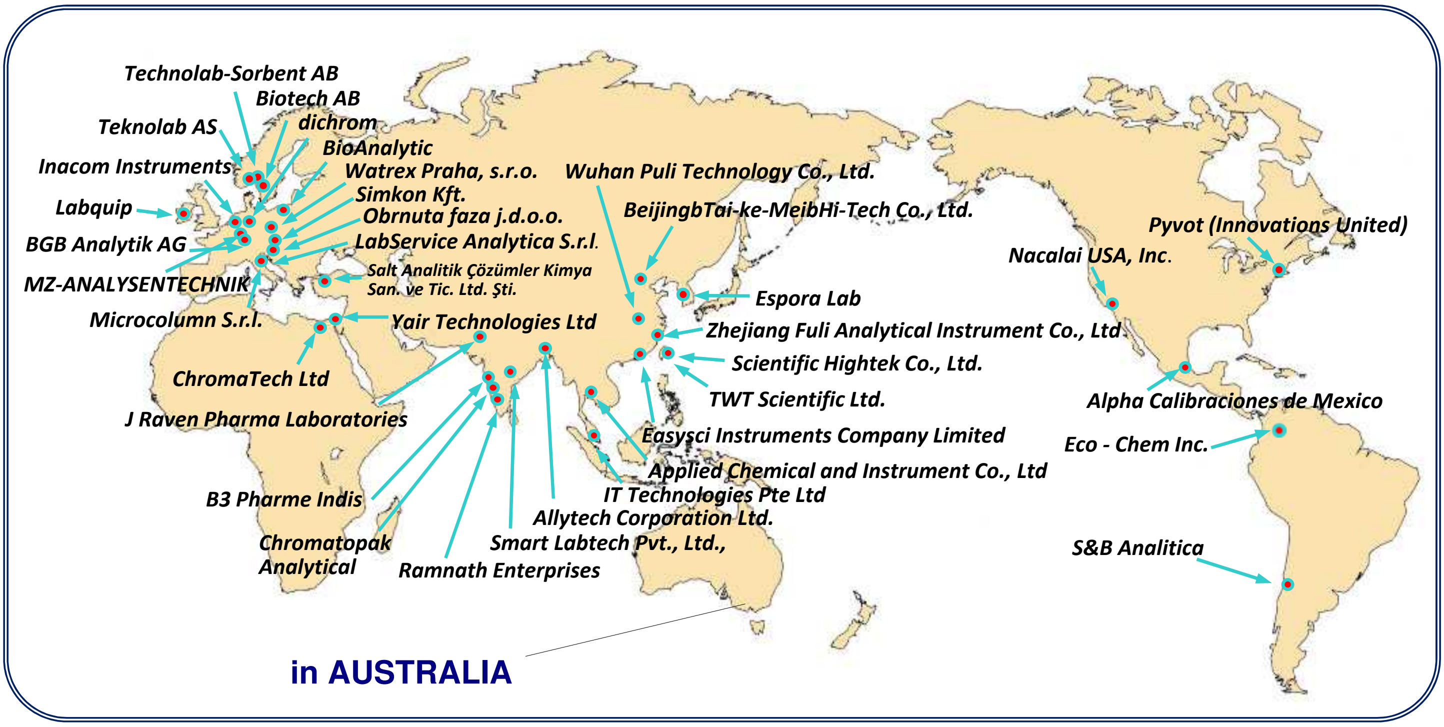
## Ordering information of SunShell

| | 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 | ------ | ------ | |

＊Distributors




**Manufacturer**
**ChromaNik Technologies Inc.**

2307