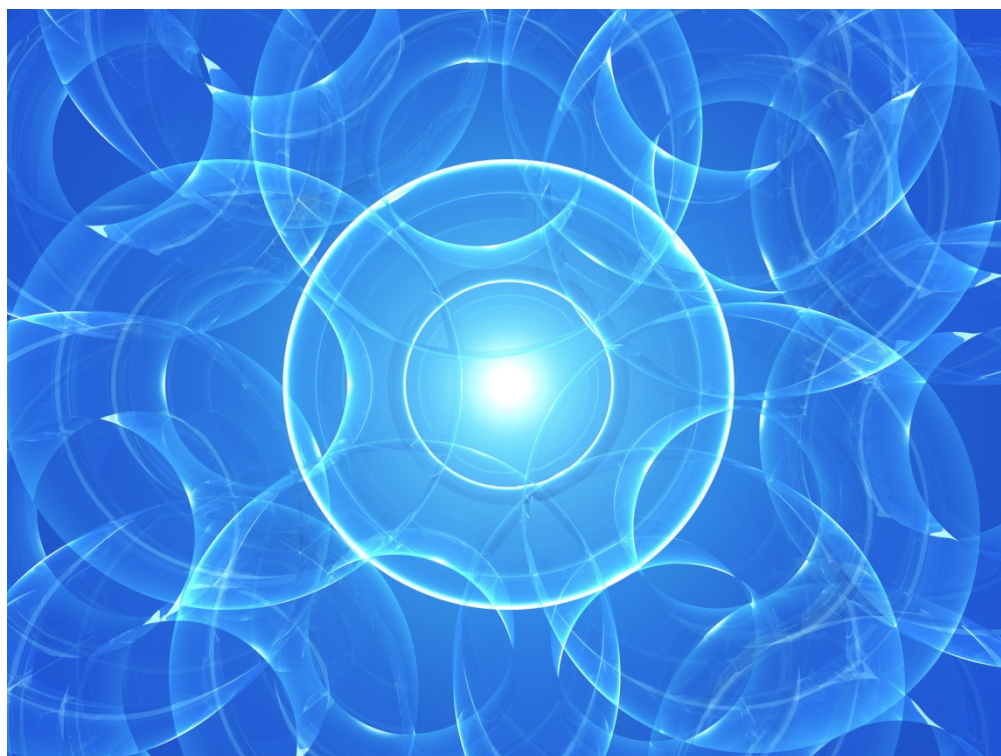




HPLC column C18 C8 PFP

SunShell



Core Shell Particle



ChromaNik Technologies Inc.

Website : www.chromtech.net.au E-mail : info@chromtech.net.au TelNo : 03 9762 2034 . . . in AUSTRALIA

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

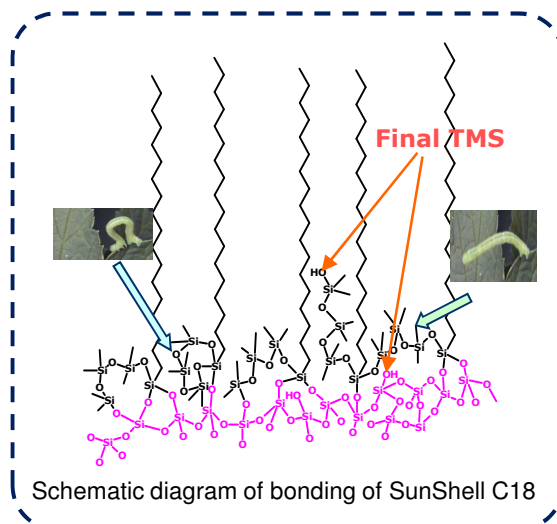
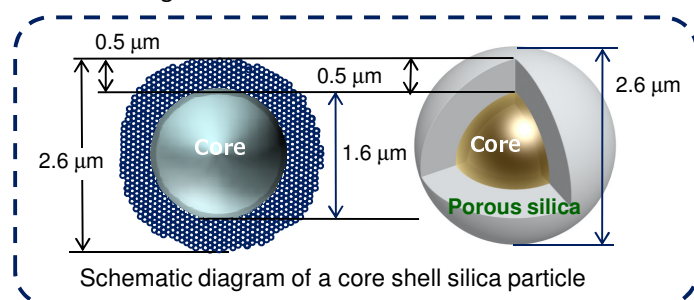


The next generation to Core Shell particle

Superficially porous silica

Features of SunShell

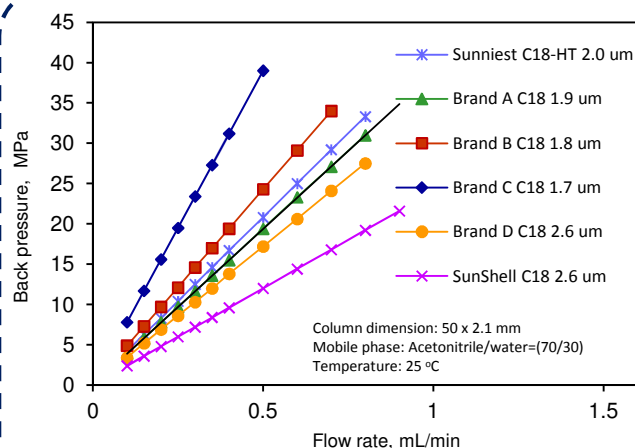
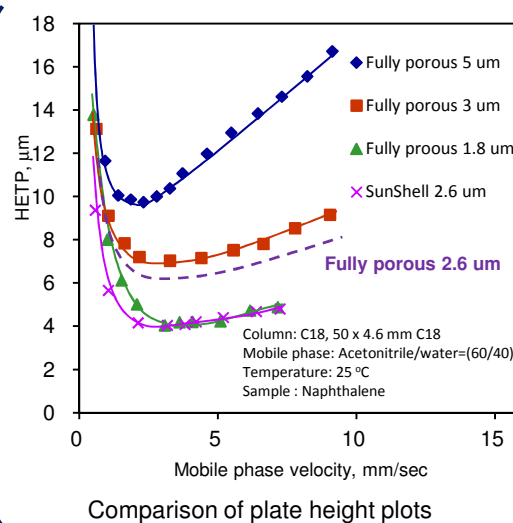
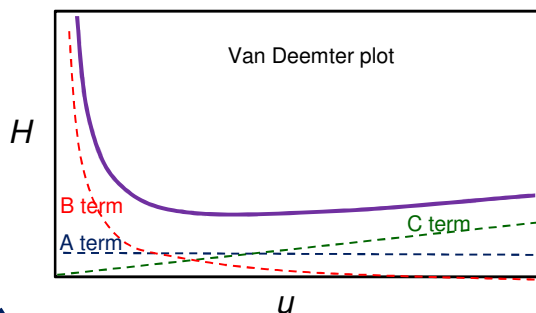
- *1.6 μm of core and 0.5 μm of superficially porous silica layer
- *Same efficiency and high throughput as a Sub 2 μm particle
- *Same pressure as a 3 μm particle (less than a half then a sub 2 μm particle)
- *Same chemistry as Sunniest technology (reference figure 1)
- *Good peak shape for all compounds such as basic, acidic and chelating compounds
- *High stability (pH range for SunShell C18, 1.5 to 10)
- *Low breeding



Van Deemter Equation

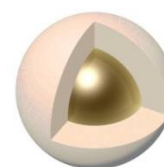
$$H = A d_p + B \frac{D_m}{u} + C \frac{d_p^2}{D_m} u$$

- A term : Eddy diffusion (d_p is particle diameter)
 B term : Longitudinal diffusion (D_m is diffusion coefficient)
 C term : Mass transfer

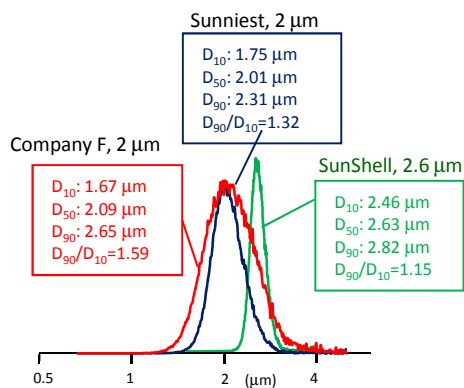


SunShell C18 shows same efficiency as a sub 2 μm C18. In comparison between fully porous 2.6 μm and core shell 2.6 μm (SunShell), SunShell shows lower values for A term, B term and C term of Van Deemter equation. The core shell structure leads higher performance to compare with the fully porous structure.

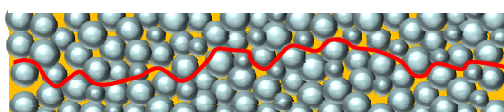
Furthermore back pressure of SunShell C18 is less than a half to compare with sub-2 μm C18s.



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

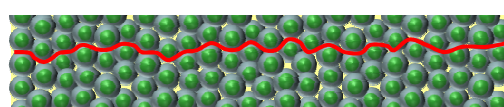


Wide particle distribution (Conventional silica gel D_{90}/D_{10} =1.50)



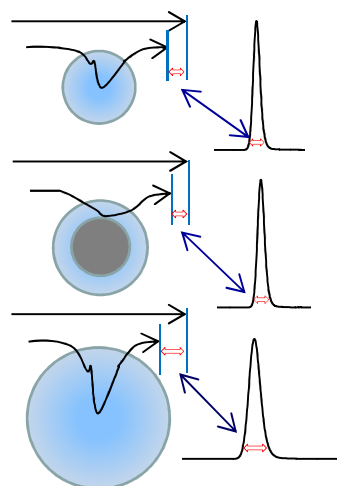
Flow of mobile phase

Narrow particle distribution (core shell silica D_{90}/D_{10} =1.15)



Packing state of core shell and fully porous silica

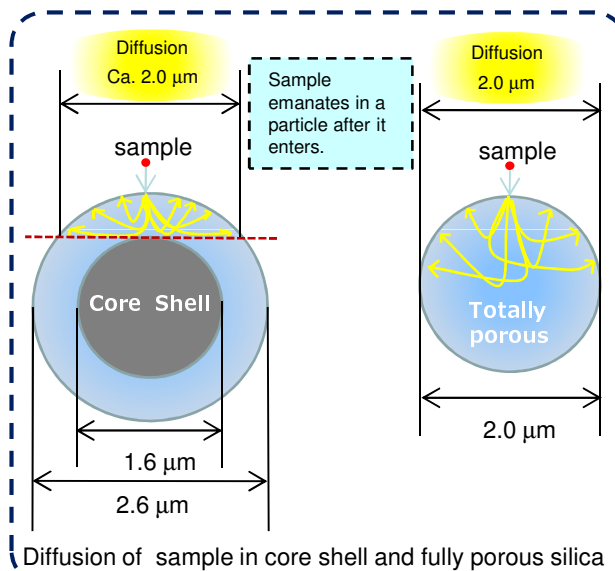
The size distribution of a core shell (SunShell) particle is much narrower than that of a conventional fully porous particle, so that the space among particles in the column reduces and efficiency increases by reducing Eddy Diffusion (multi-path diffusion) as the A term in Van Deemter Equation.



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 fully porous sub-2 μm particle.

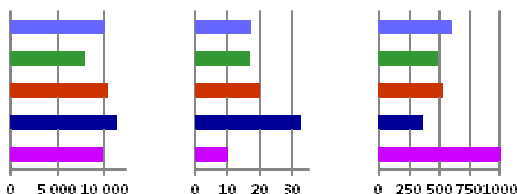
The right figure shows that a diffusion width of a sample in a 2.6 μm core shell particle and a 2 μm fully porous particle. Both diffusion widths are almost same. The 2.6 μm core shell particle is superficially porous, so that the diffusion width becomes narrower than particle size. Same diffusion means same efficiency.



Comparison of Performance by Plate/Pressure

	Plate	Back press. (MPa)	Plate/back press.
SunShell 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

SunShell C18 –HT 2.0 μm
 Brand A C18 1.9 μm
 Brand B C18 1.8 μm
 Brand C C18 1.7 μm
 SunShell C18 2.6 μm

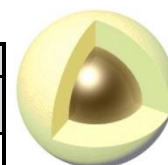


Column: 50 x 2.1 mm C18, Mobile phase: Acetonitrile/water=(70/30), Temperature: 25 $^{\circ}\text{C}$

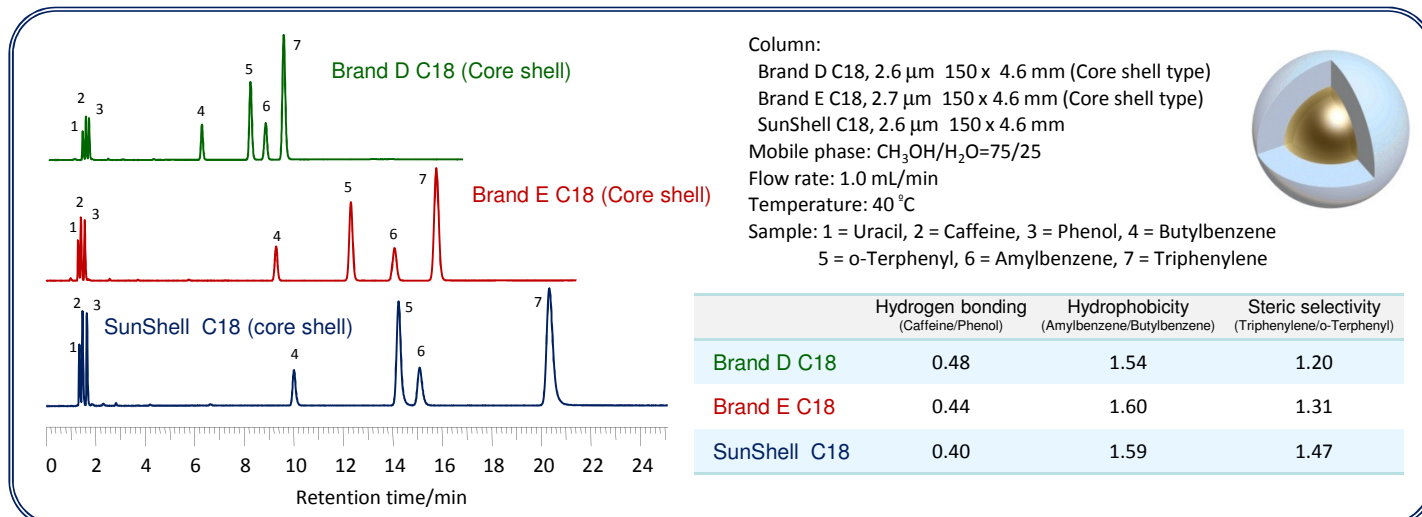
Under a constant back pressure condition, SunShell C18 showed more than 2 times higher performance to compare with fully sub-2 μm porous C18s.

Characteristics of SunShell C18

	Core shell silica			C18			
	Particle size (μm)	Pore diameter (nm)	Specific surface area (m ² /g)	Carbon content (%)	Bonded phase	Maximum operating pressure	Available pH range
SunShell C18	2.6	9	150	7	C18	60 MPa or 8,570 psi	1.5 - 10

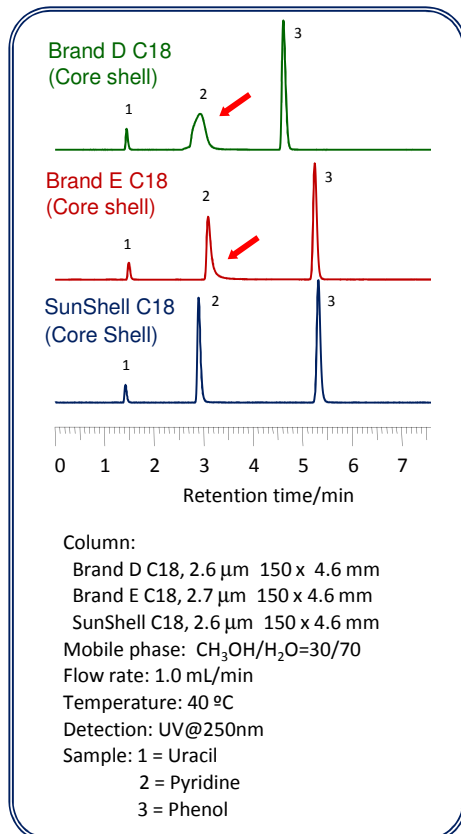


Comparison of standard samples between core shell C18s



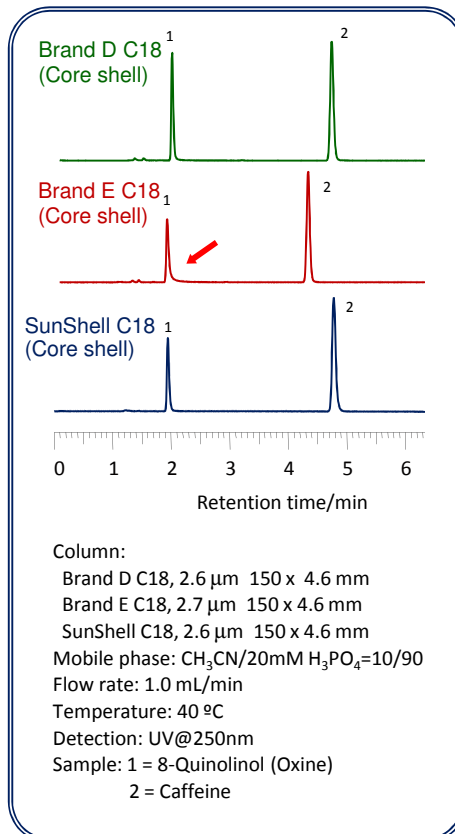
Retention of standard samples was compared for three kinds of core shell type C18s. Brand D C18 showed only a half retention to compare with SunShell C18. Steric selectivity becomes large when ligand density on the surface is high. SunShell C18 has the largest steric selectivity so that it has the highest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

Comparison of pyridine



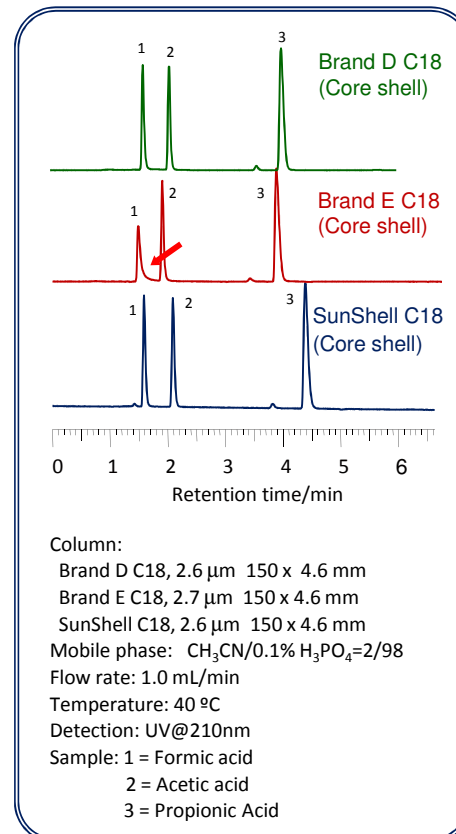
Residual silanol groups make pyridine be tailing under methanol/water mobile phase condition. Only SunShell C18 shows a sharp peak for pyridine.

Comparison of Oxine



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

Comparison of formic acid

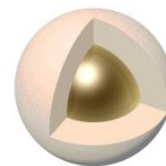


Formic acid is used as an indicator for a acidic inertness. SunShell and brand D C18 show a sharp peak.

Loading capacity of amitriptyline as a basic compound

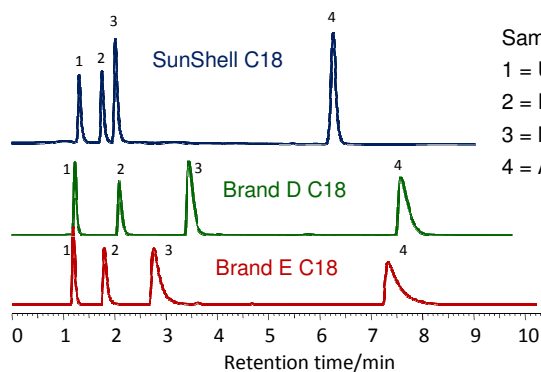
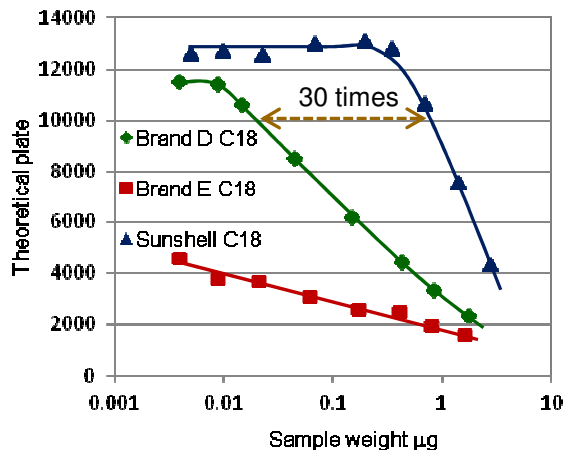
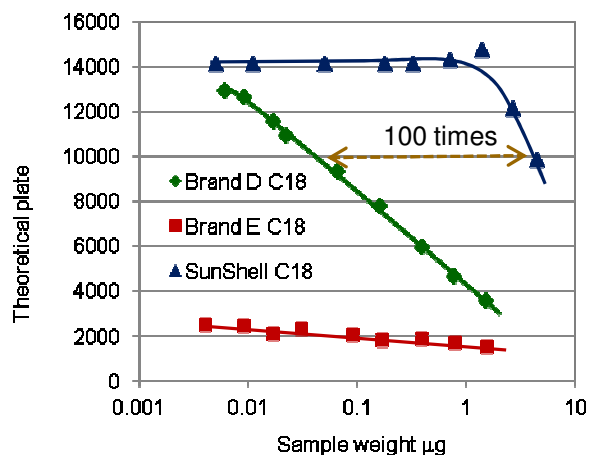
Amitriptyline overloads much more at acetonitrile/buffer mobile phase than methanol/buffer. Three kinds of core shell C18s were compared loading capacity of amitriptyline at three different mobile phases.

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

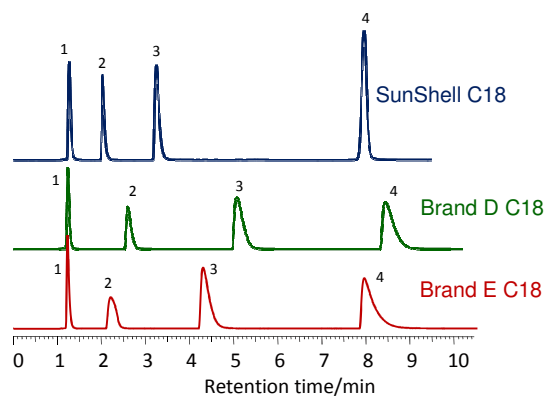


Mobile phase: Acetonitrile/**20mM phosphate buffer pH7.0**=(60:40)

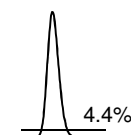
Mobile phase: Acetonitrile/**10mM acetate ammonium pH6.8**=(40:60)



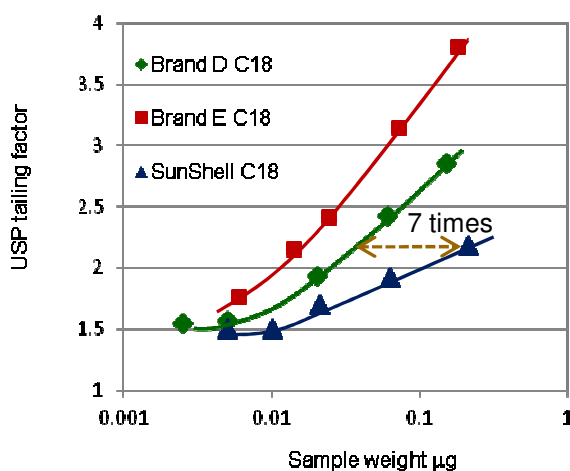
Sample:
1 = Uracil (0.07µg)
2 = Propranolol (1.53µg)
3 = Nortriptyline (0.32µg)
4 = Amitriptyline (0.32µg)



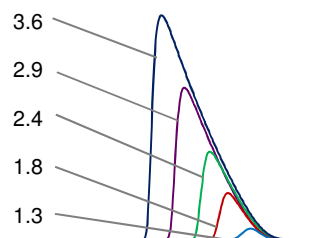
Theoretical plate was calculated by 5σ method using peak width at 4.4% of peak height.



Mobile phase: Acetonitrile/**0.1% formic acid**=(30:70)



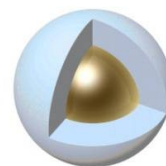
USP tailing factor



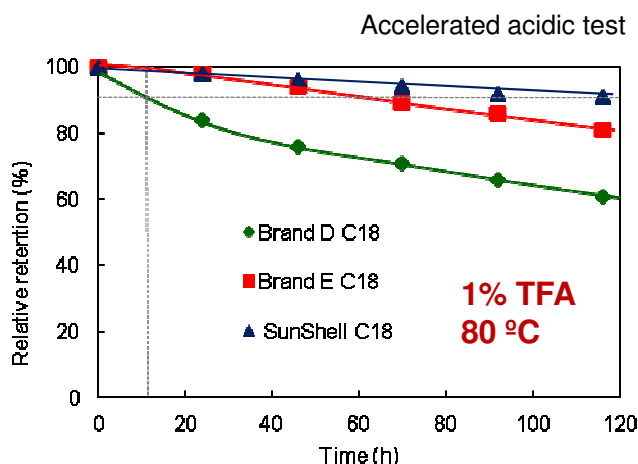
Amitriptyline overloads at low weight when acetonitrile/0.1% formic acid mobile phase. A peak is shifted forward under overloading.



Brand D 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 Brand D C18 was only one hundredth to compare with SunShell C18 under acetonitrile/20mM phosphate buffer pH7.0=(60:40) mobile phase. Brand E C18 always showed poor peak of amitriptyline.



◆ Evaluation of Stability

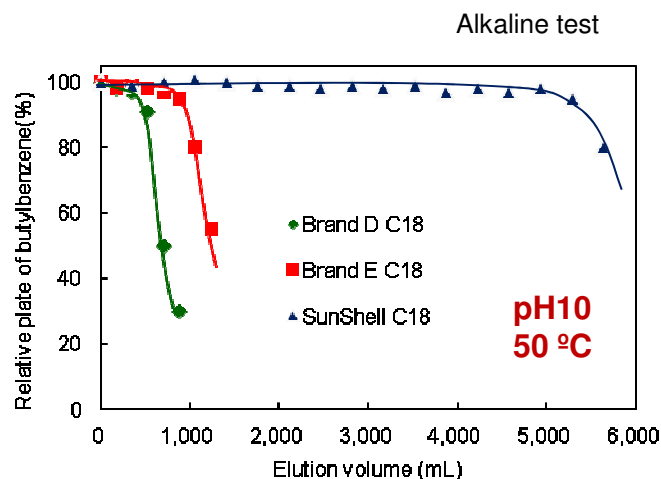


Durable test condition

Column size: 50 x 2.1 mm
Mobile phase: CH₃CN/1.0% TFA, pH1=10/90
Flow rate: 0.4 mL/min
Temperature: 80 °C

Measurement condition

Column size: 50 x 2.1 mm
Mobile phase: CH₃CN/H₂O=60/40
Flow rate: 0.4 mL/min
Temperature: 40 °C
Sample: 1 = Uracil (*t₀*)
2 = Butylbenzene



Durable test condition

Column Size: 50 x 2.1 mm
Mobile phase:
CH₃OH/20mM Sodium borate/10mM NaOH=30/21/49 (pH10)
Flow rate: 0.4 mL/min
Temperature: 50 °C

Measurement condition

Column Size: 50 x 2.1 mm
Mobile phase: CH₃CN/H₂O=60/40
Flow rate: 0.4 mL/min
Temperature: 40 °C
Sample: 1 = Butylbenzene

Stability under acidic pH condition was evaluated at 80 °C using acetonitrile/1% trifluoroacetic acid solution (10:90) as mobile phase. 100% aqueous mobile phase expels from the pore of packing materials by capillarity and packing materials doesn't deteriorate. 10% acetonitrile in a mobile phase allows an accurate evaluation.¹⁻³⁾

★ 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.

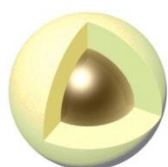
- 1) N. Nagae, T. Enami and S. Doshi, LC/GC North America October 2002.
- 2) T. Enami and N. Nagae, American Laboratory October 2004.
- 3) T. Enami and N. Nagae, BUNSEKI KAGAKU, 53 (2004) 1309.

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

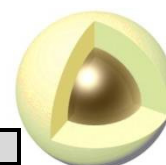
Elevated temperature of 10 °C makes column life be one third. The other company shows stability test at ambient (room temperature). If room temperature is 25 °C, column life at room temperature (25 °C) is sixteen times longer than that at 50 °C.

★ 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.

★ SunShell C18 can be used at the pH range from 1.5 to 10.



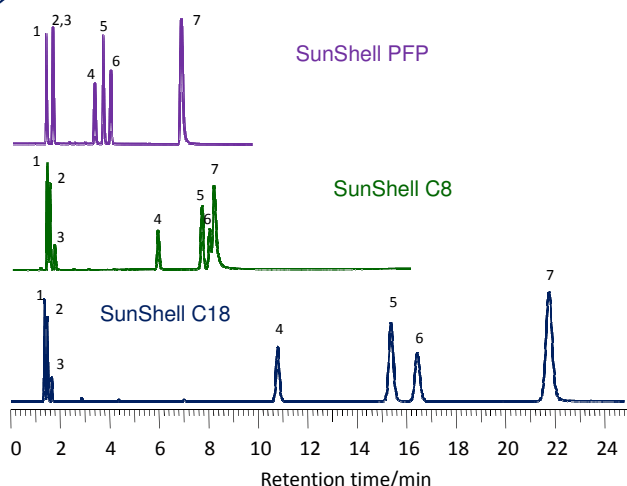
SunShell C8, PFP (Pentafluorophenyl)



◆ Characteristics of SunShell

	Core shell silica			Bonded phase			
	Particle size (μm)	Pore diameter (nm)	Specific surface area (m ² /g)	Carbon content (%)	Bonded phase	Maximum operating pressure	Available pH range
SunShell C18	2.6	9	150	7	C18	60 MPa or 8,570 psi	1.5 - 10
SunShell C8	2.6	9	150	4.5	C8	60 MPa or 8,570 psi	1.5 - 9
SunShell PFP	2.6	9	150	4.5	Pentafluorophenyl	60 MPa or 8,570 psi	2 - 8

◆ Comparison of standard samples



Column:

SunShell PFP, 2.6 μm 150 x 4.6 mm

SunShell C8, 2.6 μm 150 x 4.6 mm

SunShell C18, 2.6 μm 150 x 4.6 mm

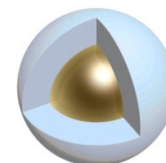
Mobile phase: CH₃OH/H₂O=75/25

Flow rate: 1.0 mL/min

Temperature: 40 °C

Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene

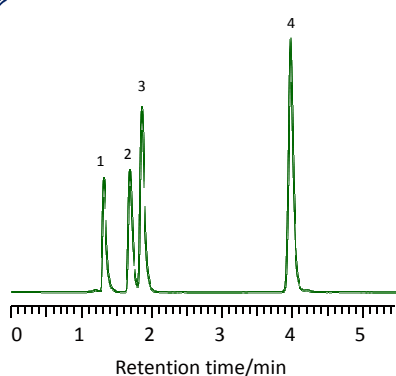
5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene



	Hydrogen bonding (Caffeine/Phenol)	Hydrophobicity (Amylbenzene/Butylbenzene)	Steric selectivity (Triphenylene/o-Terphenyl)
SunShell PFP	1.00	1.31	2.38
SunShell C8	0.32	1.46	1.08
SunShell C18	0.39	1.60	1.46

Retention of standard samples was compared for three kinds of phases such as C18, C8 and PFP. C18 showed the highest hydrophobicity and PFP showed both the highest steric selectivity and the highest hydrogen bonding. The feature of PFP phase is to have hydrogen bonding, dipole-dipole interaction, aromatic and pi-pi interactions and hydrophobicity, which causes a different selectivity from a C18 phase.

Separation of amitriptyline using C8



SunShell C8, 2.6 μm 150 x 4.6 mm

Mobile phase:

CH₃CN/20mM phosphate buffer pH7.0=60/40

Flow rate: 1.0 mL/min

Temperature: 40 °C

Detection: UV@250nm

Sample: 1 = Uracil

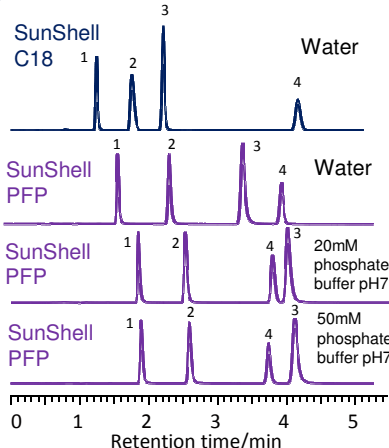
2 = Propranolol

3 = Nortriptyline

4 = Amitriptyline

SunShell C8 showed a sharp peak for amitriptyline as well as SunShell C18.

Separation of xanthines



SunShell C18, PFP 2.6 μm 150 x 2.1 mm

Mobile phase: CH₃OH/water or buffer=30/70

Flow rate: 0.3 mL/min

Temperature: 25 °C

Detection: UV@250nm

Sample: 1 = Theobromine

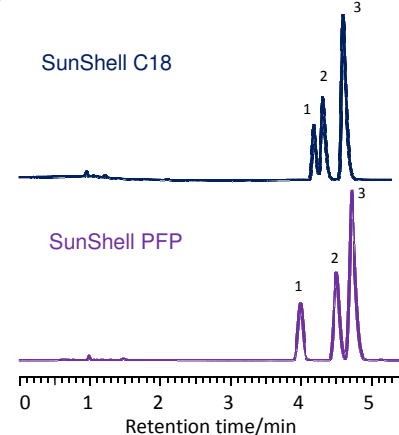
2 = Theophylline

3 = Caffeine

4 = Phenol

SunShell PFP can retain xanthines more than SunShell C18. The higher the concentration of

Separation of isomers of xylene



SunShell C18, PFP 2.6 μm 150 x 2.1 mm

Mobile phase:

CH₃OH/water=75:25 for SunShell C18

CH₃OH/water=60:40 for SunShell PFP

Flow rate: 0.3 mL/min

Temperature: 25 °C

Detection: UV@250nm

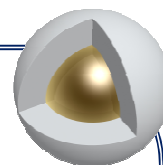
Sample: 1 = o-Xylene

2 = m-Xylene

3 = p-Xylene

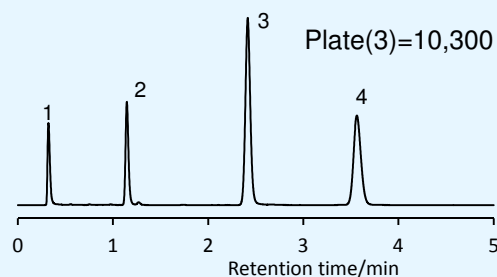
SunShell PFP showed the different selectivity from SunShell C18.

Efficiency of SunShell C18

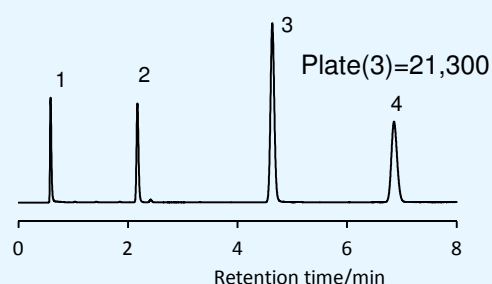


UHPLC

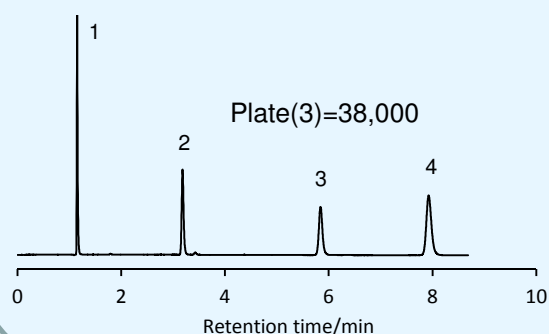
Column: SunShell C18, 50 x 2.1 mm



Column: SunShell C18, 100 x 2.1 mm



Column: SunShell C18, 150 x 4.6 mm



Column: SunShell C18, 2.6 μ m 50 x 2.1 mm

Mobile phase: CH₃CN/H₂O=60/40

Flow rate: 0.3 mL/min

Pressure: 7 MPa

Temperature: 23 °C

Sample: 1 = Uracil

2 = Toluene

3 = Acenaphthene

4 = Butylbenzene

Column: SunShell C18, 2.6 μ m 100 x 2.1 mm

Mobile phase: CH₃CN/H₂O=60/40

Flow rate: 0.3 mL/min

Pressure: 12.5 MPa

Temperature: 25 °C

Efficiency=253,000 plate/m

Column: SunShell C18, 2.6 μ m 150 x 4.6 mm

SunShell C18, 2.6 μ m 100 x 4.6 mm

Mobile phase: CH₃CN/H₂O=70/30

Flow rate: 1.0 mL/min

Pressure: 14.5MPa(UHPLC), 13.5 MPa(HPLC) for 150 mm
9.5MPa(HPLC) for 100 mm

Temperature: 25 °C

Sample: 1 = Uracil

2 = Toluene

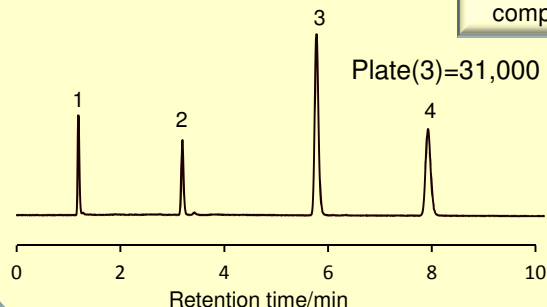
3 = Acenaphthene

4 = Butylbenzene

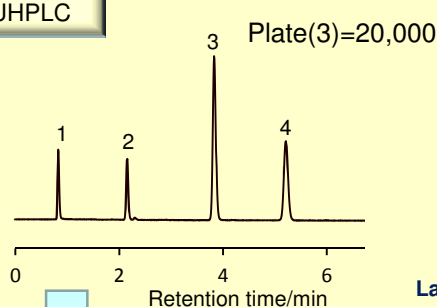
HPLC

Column: SunShell C18, 150 x 4.6 mm

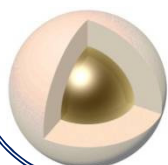
80% efficiency to
compare with UHPLC



Column: SunShell C18, 100 x 4.6 mm



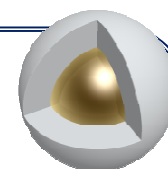
LaChrom ELITE



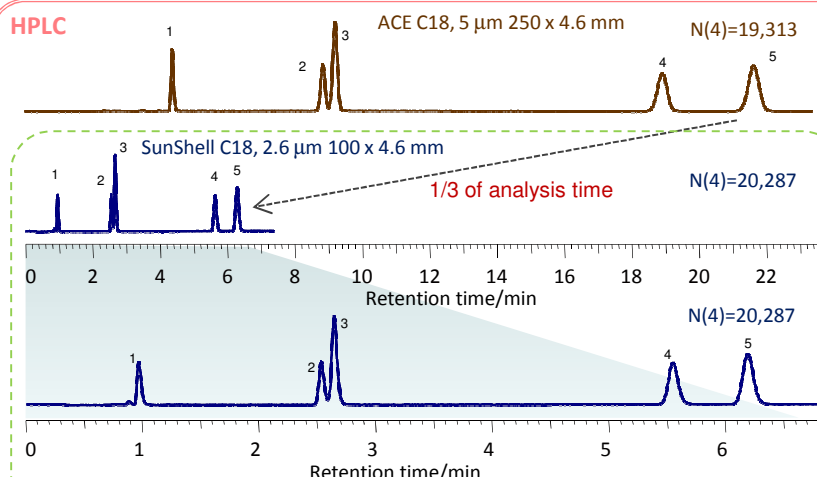
The same efficiency as
5 μ m, 250 x 4.6 mm

Saving 60% for
analytical time and
consumption of solvent

Examples of transfer from a conventional 5 µm column to SunShell column



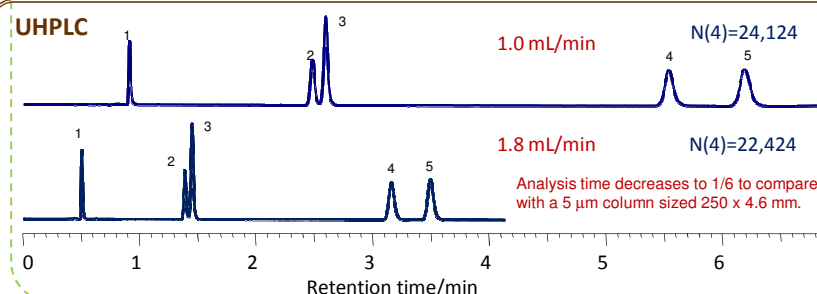
Isocratic separation



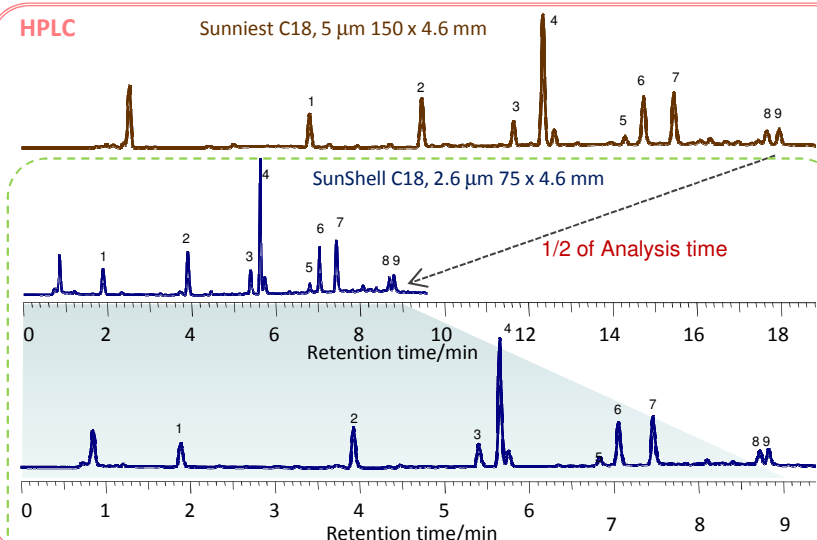
Column:
ACE C18, 5 µm 250 x 4.6 mm
SunShell C18, 2.6 µm 100 x 4.6 mm
Mobile phase:
CH₃CN/20mM Phosphoric acid = 45/55
Flow rate: 1.0 mL/min,
1.8 mL/min at the lowest chromatogram
Temperature: 25 °C
Pressure: 9.5 MPa for ACE C18 5 µm
13.4 MPa for SunShell C18 2.6 µm
Detection: UV@230 nm

Sample: 1 = Benzydamine
2 = Ketoprofen
3 = Naproxen
4 = Indomethacin
5 = Ibuprofen

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)
UHPLC: Jasco X-LC



Gradient separation



Column:
Sunniest C18, 5 µm 150 x 4.6 mm
SunShell C18, 2.6 µm 75 x 4.6 mm
Mobile phase:
A) 0.1% Phosphoric acid
B) CH₃CN
Gradient program for Sunniest C18

0 min	15 min	20 min
2%	25%	25%

for SunShell C18

0 min	7.5 min	10 min
2%	25%	25%

Flow rate: 1.0 mL/min,
Temperature: 25 °C
Detection: UV@250 nm
Sample: Oolong tea
1 = Galliccatechin, 2 = Epigallocatechin,
3 = Catechin, 4 = Caffeine, 5 = Epicatechin,
6 = Epigallocatechin gallate, 7 = Galliccatechin gallate, 8 = Epicatechin gallate, 9 = Catechin gallate

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)
UHPLC: Jasco X-LC

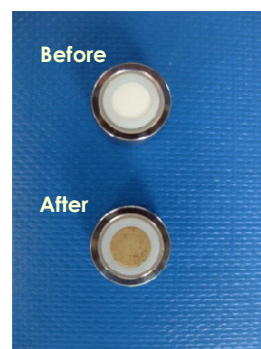
<<Caution>>

There are difference of system time lag between HPLC and UHPLC. UHPLC has much less system time lag than HPLC because of high pressure gradient system for UHPLC and low pressure gradient system for HPLC.

SunShell RP Guard Filter

<Cartridge Type, Bonded with C18 and End-Capped with TMS>

Available as a guard column for reversed phase



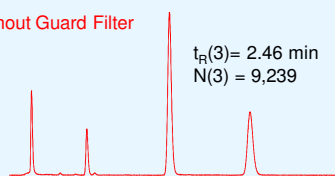
- ✓ The filter is made of porous glass sized 4 mm i.d. and 4 mm thickness.
- ✓ Pore diameter is 2 μ m.
- ✓ Low dead volume structure
- ✓ Back pressure on glass filter is ca. 0.1 MPa at 1.0 mL/min of flow rate.
- ✓ Upper pressure limit is more than 60 MPa
- ✓ Available for 2.1 mm i.d to 4.6 mm i.d. column



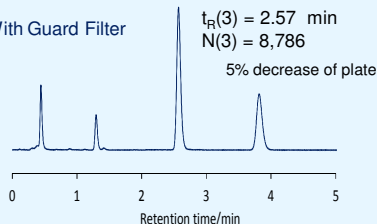
Evaluation of SunShell RP Guard Filter

SunShell C18, 2.6 μ m 50 x 2.1 mm

Without Guard Filter



With Guard Filter

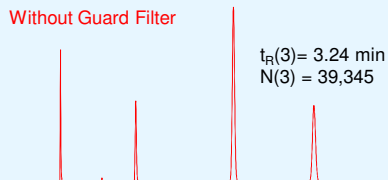


Mobile phase:
CH₃CN/H₂O=60/40 for 2.1 mm i.d.
CH₃CN/H₂O=70/30 for 4.6 mm i.d.
Flow rate:
0.3 mL/min for 2.1 mm i.d.
1.8 mL/min for 4.6 mm i.d.

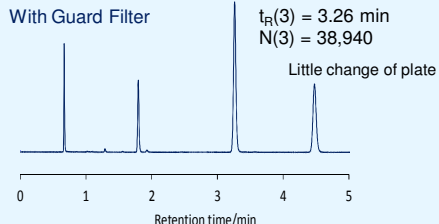
Temperature: 25 °C
Detection: UV@250nm
Sample: 1 = Uracil
2 = Toluene
3 = Acenaphthene
4 = Butylbenzene

SunShell C18, 2.6 μ m 150 x 4.6 mm

Without Guard Filter



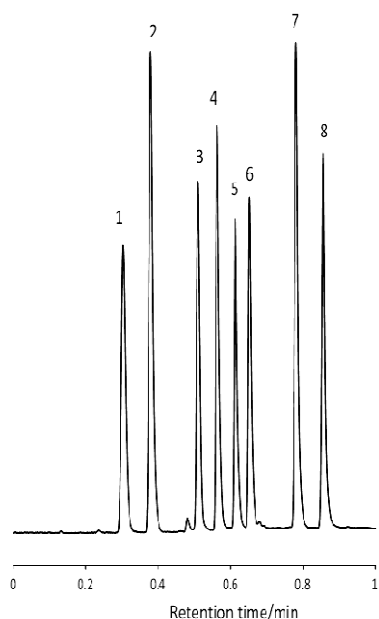
With Guard Filter



Price of SunShell RP Guard Filter

Name	quantity	Part number	Photo
SunShell RP Guard Filter For exchange	5 pieces	CBGAAC	
SunShell RP Guard Filter Holder	1 piece	CBGAAH	

High-throughput separation



Column: SunShell C18 30 x 3.0 mm. Mobile phase: A) Water, B) Acetonitrile; Gradient (Acetonitrile %), 0.00 min - 35%, 0.40 min - 100%, 0.80 min - 100%, 0.85 min - 35%, 1 cycle; 1.8 min, (High-pressure gradient). Flow rate: 1.0 mL/min. Temperature: 40 °C. Injection Volume: 1 µL. Wavelength: 200 - 500nm, CH-9, 215 - 500nm (Max Abs.). Sample: Mixture of ultraviolet absorbers,
 1 = 2,2',4,4'-Tetrahydroxybenzophenone,
 2 = Ethyl *p*-aminobenzoate, 3 = 2, 4-Dihydroxybenzophenone,
 4 = 2,2'-Dihydroxy-4-methoxybenzophenone,
 5 = 2,2'-Dihydroxy-4,4'-dimethoxybenzophenone,
 6 = 2-Hydroxy-4-methoxybenzophenone,
 7 = 2-(2'-Hydroxy-5'-methylphenyl) benzotriazole,
 8 = 4-*tert*-Butylphenyl salicylate.
 Courtesy of Jasco.

8 kinds of compounds were separated using SunShell C18 30 x 3.0 mm column in one minute.

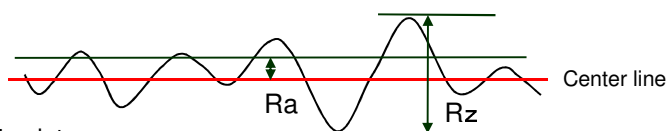
A peak width of just one second!!

Surface Roughness on Inner Surface of Column

Parameter of surface roughness

Ra: Average roughness from center line

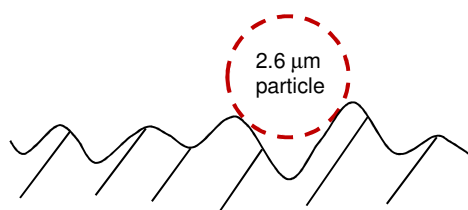
Rz: Roughness calculated from 10 points average (5 points of maximum and 5 points of minimum)



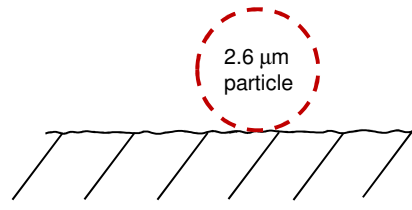
Schematic diagram of surface roughness

	G company	Y company	S1 company	S2 company	W company	ChromaNik Technologies
Ra	0.34 µm	0.32 µm	0.37 µm	0.03 µm	0.20 µm	0.01 µm
Rz	1.88 µm	1.62 µm	1.91 µm	0.19 µm	0.90 µm	0.10 µm

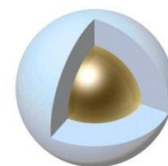
It is considered that surface roughness affects column performance. Surface asperity of ChromaNik Technologies column with 2.1 mm i.d. and 3.0 mm i.d. is 1/30 to 1/20 to compare with that of GL Sciences, YMC, Shimadzu and Waters columns. ChromaNik Technologies provides a column with a very smooth surface which is the most suitable for 2.6 µm core shell particle packings.



Inner surface of column of A, B, C companies



Inner surface of column of ChromaNik Technologies



Ordering information

SunShell C18	Inner diameter(mm)	2.1	3.0	4.6
	Length (mm)	Catalog number	Catalog number	Catalog number
	20	CB6921	CB6321	CB6421
	30	CB6931	CB6331	CB6431
	50	CB6941	CB6341	CB6441
	75	CB6951	CB6351	CB6451
	100	CB6961	CB6361	CB6461
	150	CB6971	CB6371	CB6471

SunShell C8	Inner diameter(mm)	2.1	3.0	4.6
	Length (mm)	Catalog number	Catalog number	Catalog number
	20	CC6921	CC6321	CC6421
	30	CC6931	CC6331	CC6431
	50	CC6941	CC6341	CC6441
	75	CC6951	CC6351	CC6451
	100	CC6961	CC6361	CC6461
	150	CC6971	CC6371	CC6471

SunShell PFP	Inner diameter(mm)	2.1	3.0	4.6
	Length (mm)	Catalog number	Catalog number	Catalog number
	20	CF6921	CF6321	CF6421
	30	CF6931	CF6331	CF6431
	50	CF6941	CF6341	CF6441
	75	CF6951	CF6351	CF6451
	100	CF6961	CF6361	CF6461
	150	CF6971	CF6371	CF6471



**Next phases, C18-WP (16 nm), RP-AQUA, Phenyl and HILIC-Amide
Coming soon**

**Global Sales
Biotech AB**

**Manufacturer
ChromaNik Technologies Inc.**



Transfer Guide

from conventional column to SunShell (core-shell) column

1) Choice of column dimension. Terms: same efficiency, same theoretical plate (TP)

In case of using HPLC

C18 5 μ m 250 x 4.6 mm, 20,000 plate	SunShell C18 2.6 μ m 100 x 4.6 mm, 25,000 plate (UHPC) 20,000 plate (HPLC)
C18 5 μ m 150 x 4.6 mm, 12,000 plate	SunShell C18 2.6 μ m 75 x 4.6 mm, 15,000 plate (UHPC) 12,000 plate (HPLC) SunShell C18 2.6 μ m 50 x 4.6 mm, 12,500 plate (UHPC) 10,000 plate (HPLC)
C18 3 μ m 150 x 4.6 mm, 20,000 plate	SunShell C18 2.6 μ m 100 x 4.6 mm, 25,000 plate (UHPC) 20,000 plate (HPLC)
C18 3 μ m 100 x 4.6 mm, 13,000 plate	SunShell C18 2.6 μ m 75 x 4.6 mm, 15,000 plate (UHPC) 12,000 plate (HPLC) SunShell C18 2.6 μ m 50 x 4.6 mm, 12,500 plate (UHPC) 10,000 plate (HPLC)

In case of using UHPLC

C18 5 μ m 250 x 4.6 mm, 20,000 plate	SunShell C18 2.6 μ m 100 x 3.0 mm, 20,000 plate SunShell C18 2.6 μ m 100 x 2.1 mm, 20,000 plate
C18 5 μ m 150 x 4.6 mm, 12,000 plate	SunShell C18 2.6 μ m 75 x 3.0 mm, 12,000 plate SunShell C18 2.6 μ m 75 x 2.1 mm, 12,000 plate SunShell C18 2.6 μ m 50 x 3.0 mm, 10,000 plate SunShell C18 2.6 μ m 50 x 3.0 mm, 10,000 plate
C18 3 μ m 150 x 4.6 mm, 20,000 plate	SunShell C18 2.6 μ m 100 x 3.0 mm, 20,000 plate SunShell C18 2.6 μ m 100 x 2.1 mm, 20,000 plate
C18 3 μ m 100 x 4.6 mm, 13,000 plate	SunShell C18 2.6 μ m 75 x 3.0 mm, 12,000 plate SunShell C18 2.6 μ m 75 x 2.1 mm, 12,000 plate SunShell C18 2.6 μ m 50 x 3.0 mm, 10,000 plate SunShell C18 2.6 μ m 50 x 3.0 mm, 10,000 plate

2) Decision of flow rate, injection volume and gradient time program.

$$\text{Flow rate}_{\text{SunShell}} = \text{Flow rate}_{3 \text{ or } 5 \mu\text{m}} \times \left[\frac{\text{Diameter}_{\text{SunShell}}}{\text{Diameter}_{3 \text{ or } 5 \mu\text{m}}} \right]^2 \times \text{Coefficient (1.0 – 2.5)}$$

Terms in case of 1.0 of coefficient. (More than 1.5 of coefficient is available for all conditions.)

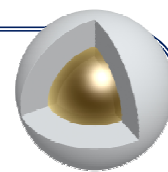
Molecular weight of sample		Less than 400		More than 400	
Mobile phase		Methanol/water	Acetonitrile/water	Methanol/water	Acetonitrile/water
Temperature	25°C	OK	OK	OK	OK
	40°C	OK	Avoidance	OK	OK

$$\text{Injection volume}_{\text{SunShell}} = \text{Injection volume}_{3 \text{ or } 5 \mu\text{m}} \times \left[\frac{\text{Diameter}_{\text{SunShell}}}{\text{Diameter}_{3 \text{ or } 5 \mu\text{m}}} \right]^2 \times \frac{\text{Length}_{\text{SunShell}}}{\text{Length}_{3 \text{ or } 5 \mu\text{m}}}$$

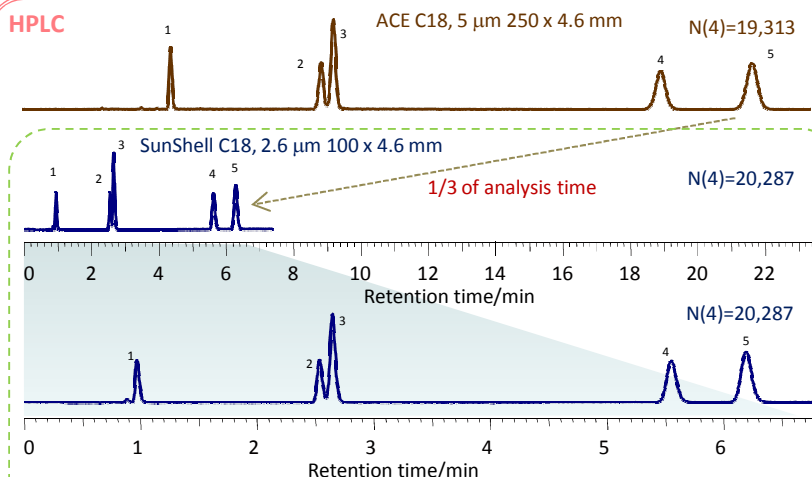
$$\text{Gradient time}_{\text{SunShell}} = \text{Gradient time}_{3 \text{ or } 5 \mu\text{m}} \times \frac{\text{Flow rate}_{3 \text{ or } 5 \mu\text{m}}}{\text{Flow rate}_{\text{SunShell}}} \times \left[\frac{\text{Diameter}_{\text{SunShell}}}{\text{Diameter}_{3 \text{ or } 5 \mu\text{m}}} \right]^2 \times \frac{\text{Length}_{\text{SunShell}}}{\text{Length}_{3 \text{ or } 5 \mu\text{m}}}$$

* HPLC system time lag of beginning gradient elution should be considered.

Examples of transfer



Isocratic separation



Column:

ACE C18, 5 μ m 250 x 4.6 mm
SunShell C18, 2.6 μ m 100 x 4.6 mm

Mobile phase:

CH₃CN/20mM Phosphoric acid = 45/55

Flow rate: 1.0 mL/min,

1.8 mL/min at the lowest chromatogram

Temperature: 25 °C

Pressure: 9.5 MPa for Brand F C18 5 μ m

13.4 MPa for SunShell C18 2.6 μ m

Detection: UV@230 nm

Sample: 1 = Benzydamine

2 = Ketoprofen

3 = Naproxen

4 = Indomethacin

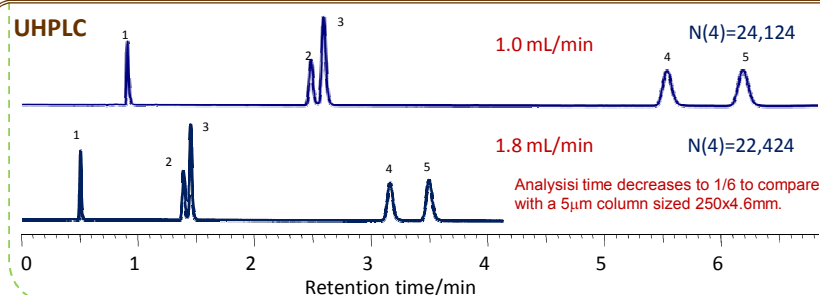
5 = Ibuprofen

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)

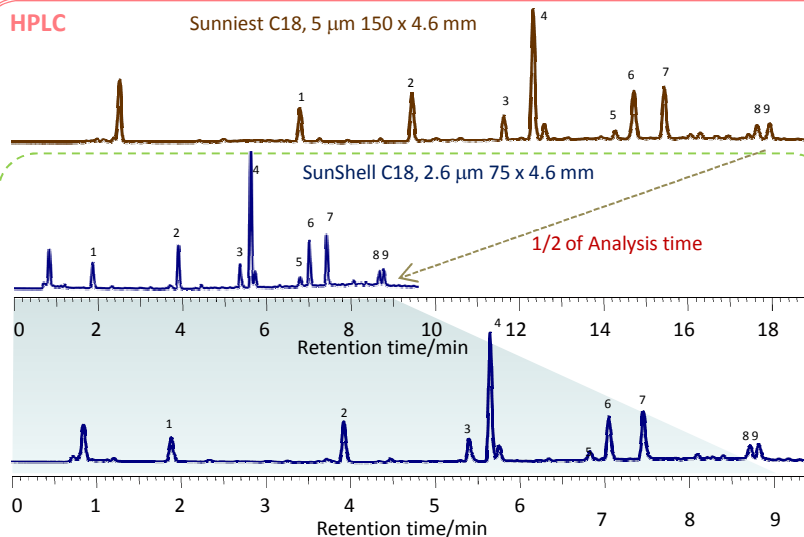
UHPLC: Jasco X-LC



UHPLC



Gradient separation



Column:

Sunniest C18, 5 μ m 150 x 4.6 mm
SunShell C18, 2.6 μ m 75 x 4.6 mm

Mobile phase:

A) 0.1% Phosphoric acid

B) CH₃CN

Gradient program for Sunniest C18

0 min	15 min	20 min
2%	25%	25%

for SunShell C18

0 min	7.5 min	10 min
2%	25%	25%

Flow rate: 1.0 mL/min,

Temperature: 25 °C

Detection: UV@250 nm

Sample: Oolong tea

1 = Gallic acid, 2 = Epigallocatechin,

3 = Catechin, 4 = Caffeine, 5 = Epicatechin,

6 = Epigallocatechin gallate, 7 = Gallic acid

gallate, 8 = Epicatechin gallate, 9 = Catechin gallate

HPLC: Hitachi LaChrom ELITE (using 0.25 mm i.d. tubing)

UHPLC: Jasco X-LC

<<Caution>>

There are difference of system time lag between HPLC and UHPLC. UHPLC has much less than system time lag than HPLC because of high pressure gradient system for UHPLC and low pressure gradient system for HPLC.



Biotech AB

E-mail: info@biotech.se

URL: www.biotech.se

Are Silanol Groups Bad or Good for Basic Compounds?

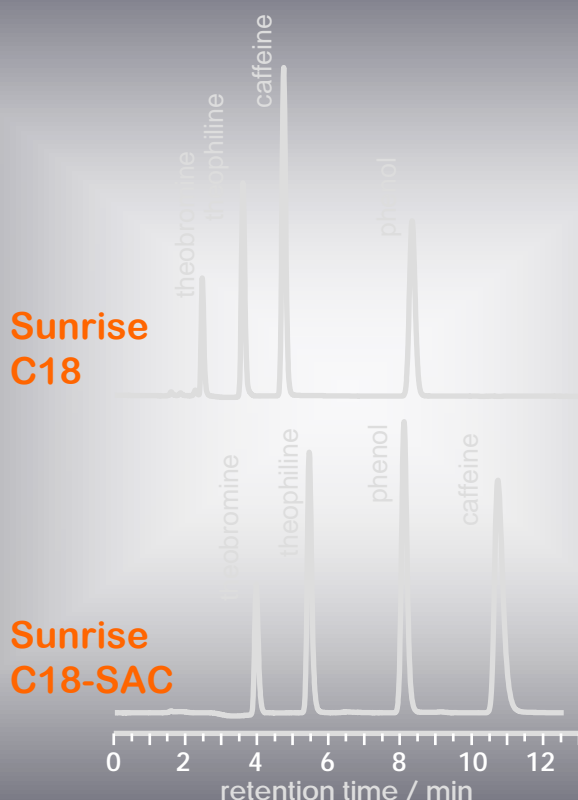
Sunrise C18

Sunrise C18-SAC

Silanol Activity Controlled C18 Column



New-Type RP Column



Sunrise C18 and C18-SAC

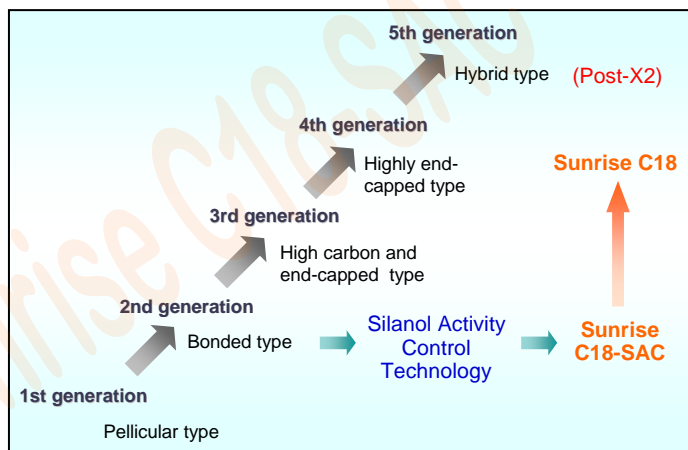
Silanol Activity Controlled C18 HPLC Column



◆ New generation reversed-phase utilized silanol groups

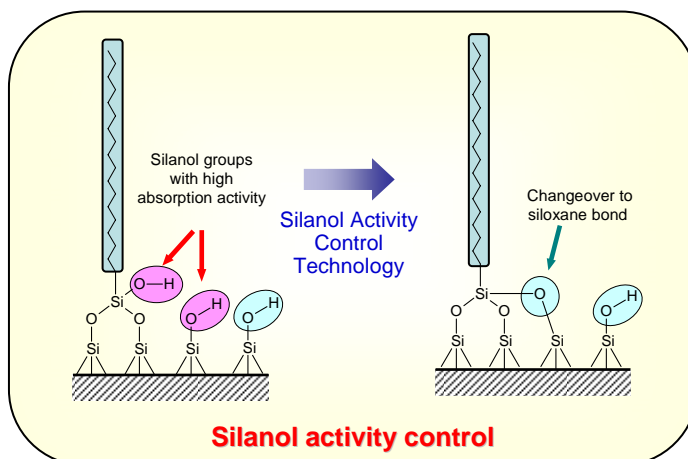
■ Silanol group and peak tailing

It is generally said that residual silanol groups on a stationary phase such as C18 (ODS) causes absorption or peak tailing for a sample. Especially silanol groups near a hydrophobic site don't solvate with water completely, so that they show high absorption for basic compounds. Its peak shows terribly tailing. Several end-capping techniques have been developed to solve these problems for many years.



■ Silanol activity control technology

ChromaNik developed the technique that decreased only silanol groups with high absorption activity to a basic compound and remained effective silanol groups on the stationary phase. Silanol activity control and no end-capping led the existence of silanol groups with high hydration which created a new and unique reversed-phase separation mode including hydrogen bond and ion-exchange interaction. Furthermore, silanol activity controlling, then end-capping technique improved a peak shape of a basic compound exceedingly.



◆ Feature of Sunrise series

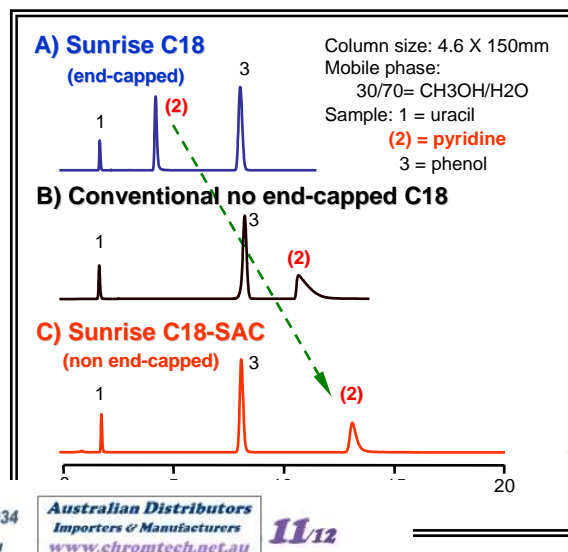
Sunrise C18

- The "1st Choice" column as a fully end-capped C18 column
- Full end-capping after silanol activity control
- Reducing adsorption of a basic compound extremely
- A good peak shape for a metal chelating compound
- Widely available for general reversed-phase separation

Sunrise C18-SAC

- The "2nd Choice" column which takes advantage of effective silanol groups interaction
- Reducing silanol groups with high adsorption activity
- The new separation mechanism including hydrogen bond and ion-exchange interaction
- Effective for separation of a basic compound and a polar compound
- Different selectivity
- Changing a

■ The elution order of pyridine



Sunrise C18 and C18-SAC

Silanol Activity Controlled C18 HPLC Column



◆ Sunrise series create an unique separation

* Effectiveness of silanol activity control: Comparison between Sunrise C18 and C18-SAC

Sunrise C18 is the so-called fully end-capped C18 column. It shows the same separation behavior as a conventional C18 column.

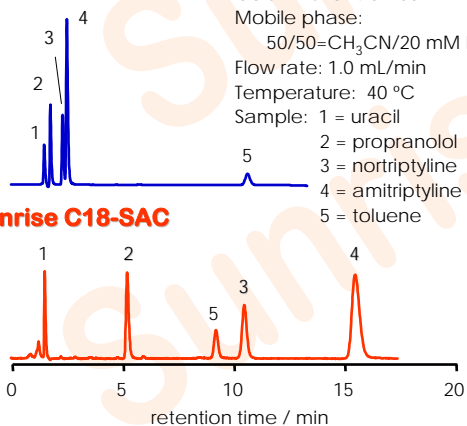
On the other hand, Sunrise C18-SAC shows hydrogen bond and ion-exchange interactions based on a residual silanol on the silica support in addition to reversed-phase separation. For example Sunrise C18 column separates a basic compound

similarly as a conventional C18, while Sunrise C18-SAC makes retention of a basic compound be large because an ion-exchange interaction works although a non-ionic compound shows the almost same retention on both Sunrise C18 and C18-SAC. Furthermore, Sunrise C18-SAC shows large retention for a polar compound such as caffeine.

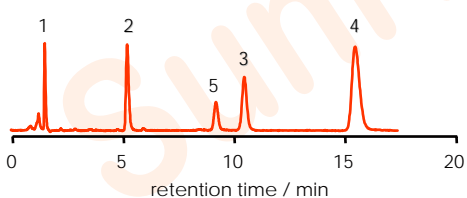
■ comparison of selectivity for basic compounds

A) Sunrise C18

Column size: 4.6x150 mm
Mobile phase: 50/50=CH₃CN/20 mM PBS pH4.5
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = uracil
2 = propranolol
3 = nortriptyline
4 = amitriptyline
5 = toluene



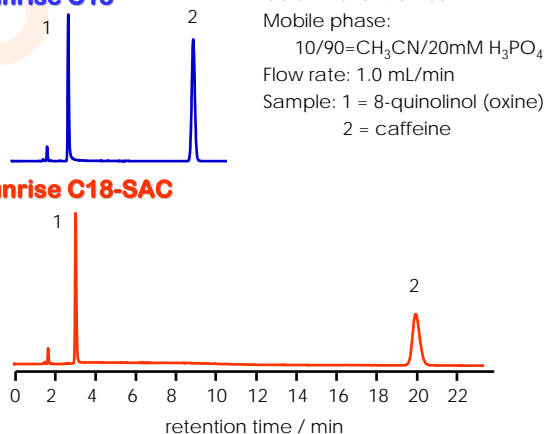
B) Sunrise C18-SAC



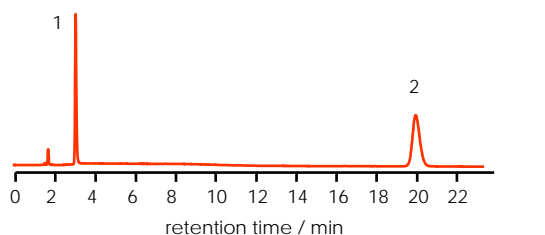
■ comparison of peak shape and retention

A) Sunrise C18

Column size: 4.6x150 mm
Mobile phase: 10/90=CH₃CN/20mM H₃PO₄
Flow rate: 1.0 mL/min
Sample: 1 = 8-quinolinol (oxine)
2 = caffeine



B) Sunrise C18-SAC



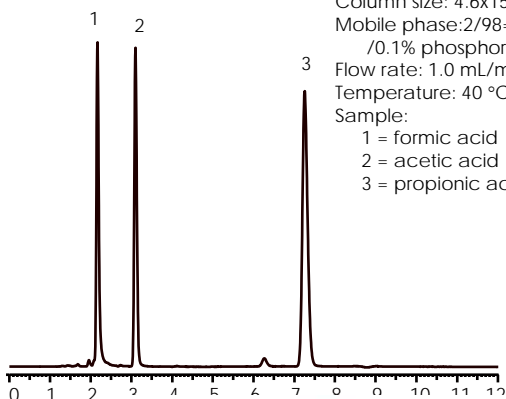
* C18 with both silanol activity control and full end-capping is effective in separation of polar compounds.

Sunrise C18 is bonded with octadecylsilane on pure silica gel (average pore size: 12nm, specific surface area: 340m²/g), and end-capped after silanol activity control. Final carbon content of Sunrise C18 is 15%.

Ligand density of Sunrise C18 is intentionally rather low and uniformity of ligands is high, so that it shows enough retention, even if a mobile phase with a low organic solvent content is used, and good peak shape for a polar compound.

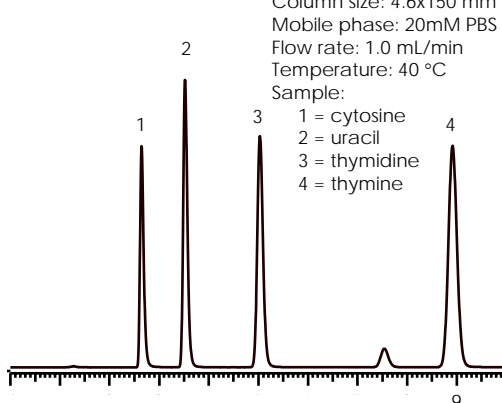
■ Separation of organic acid (Sunrise C18)

Column size: 4.6x150 mm
Mobile phase: 2/98=CH₃CN /0.1% phosphoric acid
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = formic acid
2 = acetic acid
3 = propionic acid



■ Separation of nucleic acid bases (Sunrise C18)

Column size: 4.6x150 mm
Mobile phase: 20mM PBS (pH4.5)
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = cytosine
2 = uracil
3 = thymidine
4 = thymine



Sunrise C18 and C18-SAC

Silanol Activity Controlled C18 HPLC Column



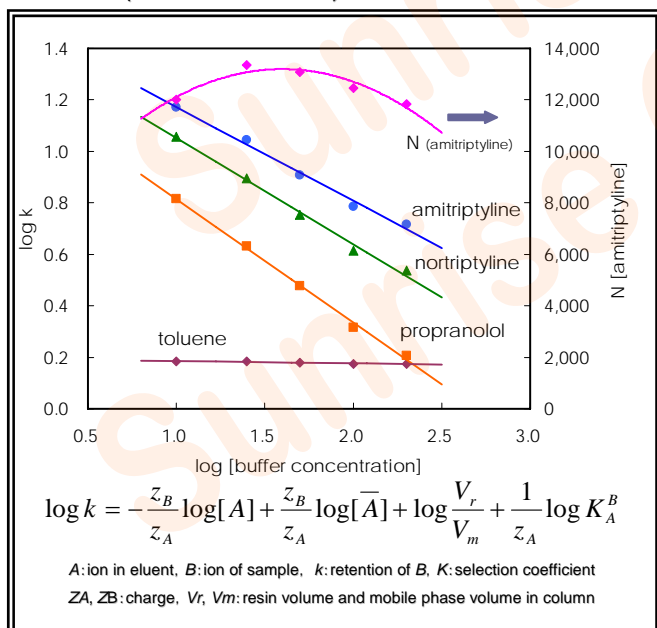
◆ Multiple mode separation is achieved on Sunrise series

* Silanol groups controlled its activity functions as ion-exchange groups

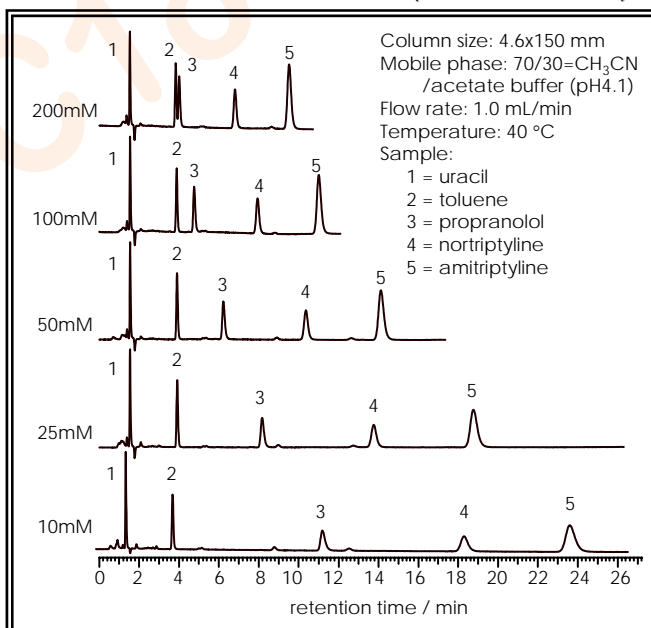
Sunrise C18-SAC is bonded with octadecylsilane on a pure silica gel and controlled its silanol activity without end-capping. Its carbon content is 14%.

Separation on Sunrise C18-SAC is done including hydrogen bond and ion-exchange interaction based on silanol groups except for hydrophobic interaction. Control of pH and salt concentration of a mobile phase can regulate retention.

■ Relationship between buffer concentration and retention(Sunrise C18-SAC)



■ Separation of basic compounds with ammonium acetate: Effect of salt concentration(Sunrise C18-SAC)



Ordering infomation

Inner diameter [mm]	length [mm]	Sunrise C18, 5µm	Sunrise C18, 3µm	Sunrise C18-SAC, 5µm	Sunrise C18-SAC, 3µm
		Cat. No.	Cat. No.	Cat. No.	Cat. No.
2.0	50	SB3241	SB2241	SA3241	SA2241
	75	—	SB2251	—	SA2251
	100	SB3261	SB2261	SA3261	SA2261
	150	SB3271	SB2271	SA3271	SA2271
4.6	10	SB3411	SB2411	SA3411	SA2411
	50	SB3441	SB2441	SA3441	SA2441
	75	—	SB2451	—	SA2451
	100	SB3461	SB2461	SA3461	SA2461
	150	SB3471	SB2471	SA3471	SA2471
	250	SB3481	—	SA3481	—
10.0	250	SB3781	—	SA3781	—
20.0	250	SB3881	—	SA3881	—