

Sepax CNT SEC Phases

Pioneering in the Separation of Nanotubes

The Best Quality Products

General Description

Utilizing proprietary surface technologies, the Sepax *CNT* SEC phases are made of specially coated porous silica materials. The silica support has high purity and enhanced mechanical stability. The Sepax *CNT* SEC phases have been innovatively and specially designed to ensure highest resolution and maximum recovery for the separation of nanotubes, such as carbon nanotubes, and nanorods. The Sepax proprietary surface technology allows extremely high column-to-column reproducibility and provides exceptional phase stability. The uniform, spherical particles of the Sepax *CNT* SEC phases have a nominal pore size at 300 Å, 500 Å, 1,000 Å, and 2,000 Å with the pore volume at *ca.* 1.0 mL/g. The Sepax *CNT* SEC phases are packed with a proprietary slurry technique to achieve uniform and stable packing bed density for maximum column efficiency. Typical applications for the Sepax *CNT* SEC columns are the separations of nanotubes in aqueous buffer solutions as well as normal organic solvents, such as acetonitrile, methanol and THF.

Characteristics

- High efficiency and resolution
- Extremely stable in high salt solution
- Great batch-to-batch reproducibility
- High temperature resistance (up to 100 °C)
- High recovery and easy for scale-up
- Wide pH application range 2 – 8.5

Applications

- Separation of carbon nanotubes by length
- Separation of nanorods by length
- Separation of nanoparticles by diameter
- Analytical, semi-preparative, and preparative separation

Carbon nanotubes are manufactured with random diameter from a few of nanometers to *ca.* 1,000 nm and variable diameters. An uniform length of carbon nanotubes is crucial for their applications in electronics. Figure 1 shows an AFM image of a single-walled carbon nanotube wrapped with DNA molecules. The DNA wrapped CNT is

soluble in water so that the separation can be effectively achieved.

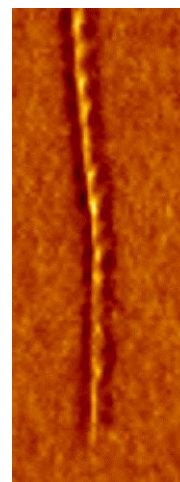


Figure 1. An AFM image of a DNA wrapped single-walled carbon nanotubes. (Courtesy of Dr. Ming Zheng, Du Pont)

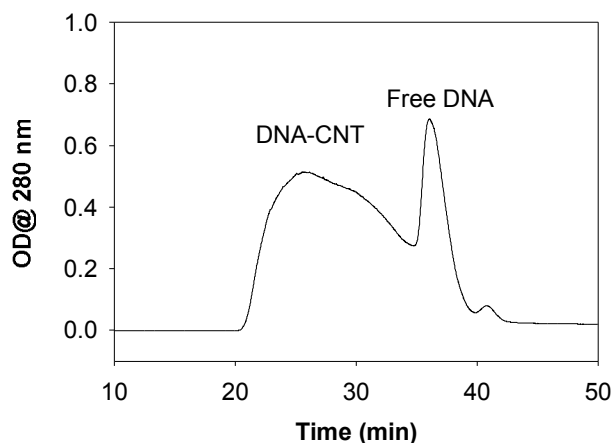


Figure 2. Separation of DNA wrapped carbon nanotubes by a combination of Sepax *CNT* SEC-300, *CNT* SEC-1000, and *CNT* SEC-2000 columns (4.6x250 mm, 5µm). Mobile phase: 0.1 M Tris + 0.2 M NaCl, pH 7.0. Flow rate: 0.25 mL/min. (Courtesy of Huang et al, *Anal. Chem.* **2005**, 77, 6225)

Figure 2 shows the elution profile of DNA wrapped carbon nanotubes by running three consecutive Sepax *CNT* SEC-300, *CNT* SEC-1000, and *CNT* SEC-2000 columns. Each of the fractions was collected for analyzing the length profile. Figure 3 shows AFM images of three fractions: f21, f25 and f30 carbon nanotubes. The average length for f21, f25, and f30 is 600, 200, and 100 nm, separately. The AFM images indicated fairly uniform length for each of the fractions.

F21: L = 527±32 nm

F25: L = 192±19 nm

F30: L = 75±8 nm

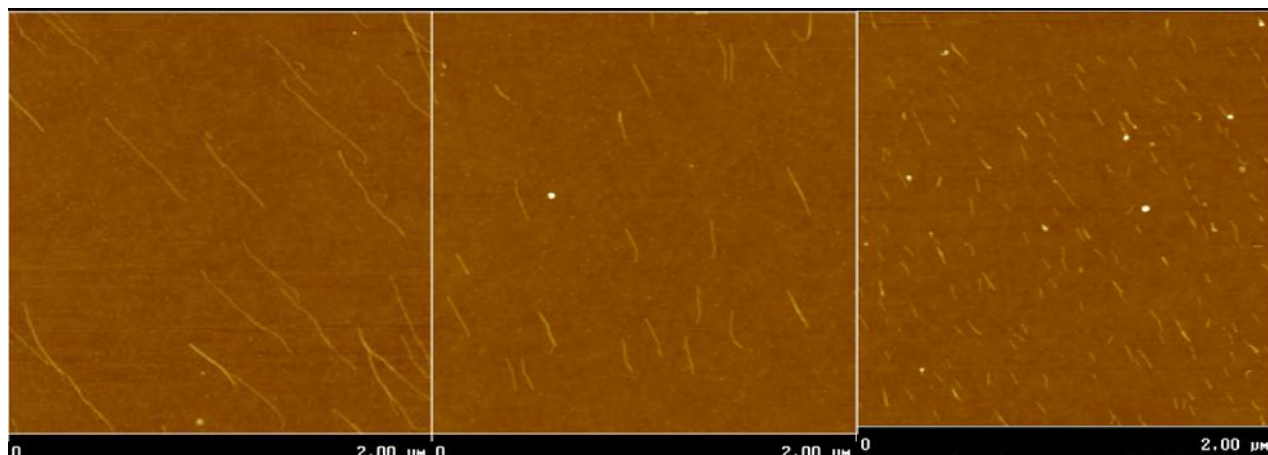


Figure 3. Uniform length separation of DNA wrapped carbon nanotubes by a running consecutive Sepax CNT SEC-300, CNT SEC-1000, and CNT SEC-2000 columns (4.6x250 mm, 5μm). (Courtesy of Dr. Ming Zheng, Du Pont)

CNT SEC Technical Specifications

Product	Pore Size	Particle Size	MW Range (Dalton)	pH	Temperature limitation	Applications
CNT SEC-300	300 Å	5, 10 μm	Length 1-100 nm Diameter 1-5 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles
CNT SEC-500	500 Å	5, 10 μm	Length 25-250 nm Diameter 1-10 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles
CNT SEC-1000	1,000 Å	5, 10 μm	Length 100-500 nm Diameter 1-25 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles
CNT SEC-2000	2,000 Å	5, 10 μm	Length 300-1000 nm Diameter 1-50 nm	2-8.5	100 °C	Carbon nanotubes, nanorods, and nanoparticles

Samples and Mobile Phases

To avoid clogging the column, all samples and solvents including buffers should be filtered through 0.45 μm or 0.2 μm filters before use. The CNT SEC columns are compatible with aqueous mobile phase, organic solvent, or a mixture of organic and water, such as methanol or acetonitrile and water. **The CNT SEC columns are incompatible with cationic species, such as cationic detergents, polymers and proteins.** Always degas the mobile phase. A simple way for degassing is to sonicate it for 5 minutes under water pumped vacuum.

Sepax CNT SEC Products

CNT SEC	ID x Length (mm x mm)	Particle size	Pore size	P/N
300	4.6x250	5 μm	300Å	205300-4625
	7.8x300	5 μm	300 Å	205300-7830
	21.2x250	5 μm	300Å	205300-21225
500	4.6x250	5 μm	500Å	205500-4625
	7.8x300	5 μm	500 Å	205500-7830
	21.2x250	5 μm	500Å	205500-21225
1000	4.6x250	5 μm	1000Å	211000-4625
	7.8x300	5 μm	1000 Å	211000-7830
	21.2x250	5 μm	1000Å	211000-21225
2000	4.6x250	5 μm	2000Å	212000-4625
	7.8x300	5 μm	2000 Å	212000-7830
	21.2x250	5 μm	2000Å	212000-21225

Ordering Information

Sepax CNT SEC-300 phases

P/N	Particle Size	Pore Size	ID x Length (mm x mm)
205300-4603	5 μm	300 Å	4.6 x 30
205300-4605	5 μm	300 Å	4.6 x 50
205300-4625	5 μm	300 Å	4.6 x 250
205300-4630	5 μm	300 Å	4.6 x 300
205300-7805	5 μm	300 Å	7.8 x 50
205300-7815	5 μm	300 Å	7.8 x 150
205300-7825	5 μm	300 Å	7.8 x 250
205300-7830	5 μm	300 Å	7.8 x 300
205300-10005	5 μm	300 Å	10 x 50
205300-10010	5 μm	300 Å	10 x 100
205300-10015	5 μm	300 Å	10 x 150
205300-10025	5 μm	300 Å	10 x 250
205300-10030	5 μm	300 Å	10 x 300
205300-21205	5 μm	300 Å	21.2 x 50
205300-21210	5 μm	300 Å	21.2 x 100
205300-21215	5 μm	300 Å	21.2 x 150
205300-21225	5 μm	300 Å	21.2 x 250

Sepax CNT SEC-500 phases

P/N	Particle	Pore	ID x Length (mm x mm)
205500-4603	5 μm	500 Å	4.6 x 30
205500-4605	5 μm	500 Å	4.6 x 50
205500-4625	5 μm	500 Å	4.6 x 250
205500-4630	5 μm	500 Å	4.6 x 300
205500-7805	5 μm	500 Å	7.8 x 50
205500-7815	5 μm	500 Å	7.8 x 150
205500-7825	5 μm	500 Å	7.8 x 250
205500-7830	5 μm	500 Å	7.8 x 300
205500-10005	5 μm	500 Å	10 x 50
205500-10010	5 μm	500 Å	10 x 100
205500-10015	5 μm	500 Å	10 x 150
205500-10025	5 μm	500 Å	10 x 250
205500-10030	5 μm	500 Å	10 x 300
205500-21205	5 μm	500 Å	21.2 x 50
205500-21210	5 μm	500 Å	21.2 x 100
205500-21215	5 μm	500 Å	21.2 x 150
205500-21225	5 μm	500 Å	21.2 x 250

Sepax CNT SEC-1000 phases

P/N	Particle	Pore	ID x Length (mm x mm)
211000-4603	5 μm	1000 Å	4.6 x 30
211000-4605	5 μm	1000 Å	4.6 x 50
211000-4625	5 μm	1000 Å	4.6 x 250
211000-4630	5 μm	1000 Å	4.6 x 300
211000-7805	5 μm	1000 Å	7.8 x 50
211000-7815	5 μm	1000 Å	7.8 x 150
211000-7825	5 μm	1000 Å	7.8 x 250
211000-7830	5 μm	1000 Å	7.8 x 300
211000-10005	5 μm	1000 Å	10 x 50
211000-10010	5 μm	1000 Å	10 x 100
211000-10015	5 μm	1000 Å	10 x 150
211000-10025	5 μm	1000 Å	10 x 250
211000-10030	5 μm	1000 Å	10 x 300
211000-21205	5 μm	1000 Å	21.2 x 50
211000-21210	5 μm	1000 Å	21.2 x 100
211000-21215	5 μm	1000 Å	21.2 x 150
211000-21225	5 μm	1000 Å	21.2 x 250

Sepax CNT SEC-2000 phases

P/N	Particle	Pore	ID x Length (mm x mm)
212000-4603	5 μm	2000 Å	4.6 x 30
212000-4605	5 μm	2000 Å	4.6 x 50
212000-4625	5 μm	2000 Å	4.6 x 250
212000-4630	5 μm	2000 Å	4.6 x 300
212000-7805	5 μm	2000 Å	7.8 x 50
212000-7815	5 μm	2000 Å	7.8 x 150
212000-7825	5 μm	2000 Å	7.8 x 250
212000-7830	5 μm	2000 Å	7.8 x 300
212000-10005	5 μm	2000 Å	10 x 50
212000-10010	5 μm	2000 Å	10 x 100
212000-10015	5 μm	2000 Å	10 x 150
212000-10025	5 μm	2000 Å	10 x 250
212000-10030	5 μm	2000 Å	10 x 300
212000-21205	5 μm	2000 Å	21.2 x 50
212000-21210	5 μm	2000 Å	21.2 x 100
212000-21215	5 μm	2000 Å	21.2 x 150
212000-21225	5 μm	2000 Å	21.2 x 250