Evolutions in Particle, Surface Chemistry, and Hardware Designs: New Liquid Chromatography (LC) Columns and Accessories for 2024

David S. Bell

This article covers liquid chromatography (LC) columns and accessories commercially released after Pittcon 2023 through the 2024 conference. As in the past, *LCGC International* sent out a survey in late 2023 and early 2024 asking vendors to supply information on products launched over the course of the year. Note that new products for gas chromatography (GC), LC instrumentation and software, and sample preparation are covered elsewhere. Information for this article is obtained over the course of many months, and thus, it is possible that some information could have been missed or misinterpreted. The reader is encouraged to check with specific vendor sites for additional product releases, as well as more detailed information on product usage and attributes. Links to vendor sites are provided where applicable.

HE VENDORS THAT responded to the survey and their new liquid chromatography (LC) products are listed in Table I. This year, the new products are classified by the mode of chromatography they are intended for. The largest category can be broadly classified as reversed-phase liquid chromatography (RPLC). Within this category, several subcategories are noted, including unique silica surface modifications, the ongoing trend of utilizing inert hardware, alternative column designs, and columns designed for specific target groups. Following this, and in no particular order, are products intended for other modes of separation, including hydrophilic-interaction liquid chromatography (HILIC), ion-exchange chromatography (IEX), size-exclusion chromatography

(SEC), hydrophobic-interaction chromatography (HIC), chiral chromatography, and columns for preparative purposes. Accessories are a vital component to any LC system, and the last section is devoted to "non-column" new products that also contribute to successful liquid separations. It is noted here that in some cases the new products could have been classified in multiple categories.

Reversed-Phase Chromatography

Products aimed at RPLC continue to be developed and commercialized. Innovations in particle design, surface modifications, column format, and hardware all contribute to improvements in performance. These improvements are often coupled to optimize given products for the specific needs of a class of important target analytes, such as oligonucleotides.

Charged Surface

Advanced Materials Technology introduced both the HALO 160Å PCS C18 column and the HALO 90Å PCS C18 reversed-phase chromatography columns. These columns feature superficially porous particles (SPP), with a particle size of 2.7 µm and a pore size of either 160 Å or 90 Å. The uniqueness of the columns stems from the positively charged surface that is bonded with dimethyloctadecylsilane functional groups. Available in various dimensions, the column offers improved peak shape and loading capacity for basic molecules, the larger pore size intended for peptides and similarly sized analytes. The columns have been shown to be particularly beneficial in low ionic strength conditions with formic acid mobile phases. The

TABLE I: New LC columns and accessories for 2024

COMPANY	PRODUCT	CATEGORY	COMMENTS#
Advanced Materials Technology	HALO 160 Å PCS C18	Reversed-Phase Columns, Charged Surface	SPP, 2.7 µm particles and a pore size of 160 Å. The column offers improved peak shape and loading capacity for basic peptides.
	HALO 90 Å PCS C18	Reversed-Phase Columns, Charged Surface	SPP, 2.7 µm particles and a pore size of 90 Å. The column offers improved peak shape and loading capacity for basic analytes.
Agilent Technologies	AdvanceBio Amide HILIC	HILIC Columns, Glycans	HILIC columns for glycan analysis.
	AdvanceBio Oligonucleotide Columns	Reversed-Phase Columns, Oligonucleotides	SPP with high pH stability and hybrid base material specifically designed for ion-pair reversed-phase analysis of oligonucleotides.
	InfinityLab ZORBAX Eclipse Plus C18	Preparative Columns	Now available in 30 x 150 mm dimension.
	Quick Change HPLC Inline Filters & Filter Discs	Accessories	Inline filters & filter discs suitable for UHPLC Columns up to 1300 bar.
Antec	SweetSep AEX200	Ion-Exchange Columns, Anion	This specialty column enables rapid, high-resolution separations of carbohydrates from mono- to polysaccharides.
ColumnTek LLC	Enantiocel IDC	Chiral Columns	This column can be utilized across normal phase, RP, and SFC, offering unique enantioselectivity.
Fortis	Evosphere BIO	Reversed-Phase Columns, Monodisperse	FPP, monodisperse particles with 300 Å pore size for reversed-phase separation of peptides, proteins and oligos.
	Evosphere BIOMAX	Reversed-Phase Columns, Monodisperse, Inert	FPP, 300 Å pore size monodisperse particles packed in inert hardware.
	Evosphere C12	Reversed-Phase Columns, Monodisperse	FPP, 100 Å pore size modified with C12 ligand for efficient separation of structurally similar compounds.
GL Sciences	ProteoSil 200-C18	Reversed-Phase Columns, Inert	200 Å pore size. Ideal for proteins, peptides, and oligonucleotides separations of intermediate size. Stainless steel and Bio-Inert PEEK hardware.
	ProteoSil 200-C8	Reversed-Phase Columns, Inert	200 Å pore size. Ideal for proteins, peptides, and oligonucleotides separations of intermediate size. Stainless steel and Bio-Inert PEEK hardware.
	ProteoSil 300-C4	Reversed-Phase Columns, Inert	300 Å pore size. Ideal for larger proteins, peptides, and oligonucleotides.
	ProteoSil 300-SEC	Size-Exclusion Chromatography Columns	Dihydroxypropyl modified silica gel for proteins, peptides, monoclonal antibodies, and oligonucleotides. Hardware options include stainless steel and Bio-Inert PEEK.
	ProteoSil HILIC	HILIC Columns	Amide functional group for separating highly hydrophilic compounds, peptides, glycans, and oligonucleotides. Available in stainless steel or Bio-Inert PEEK hardware.
MAC-MOD	MAC-MOD Chiral Columns	Chiral Columns	A series of amylosic and cellulosic chiral phases that provide similar selectivity to industry standard columns as well as provide some unique selectivity.
MilliporeSigma/ Merck	Ascentis Express 90 Å ES-C18	Reversed-Phase Columns	SPP columns recommended for separating cannabinoids, polyphenols, and pesticides, boasting sterically protected ligands that enhance performance under low pH conditions.
Optimize Technologies	OPTI-SOLV Reservoir Filters	Accessories	Provides an economical way to filter particles that may result from buffer salt precipitation, airborne dust, improperly cleaned glassware, or microbial contamination.
Phenomenex	Luna 3 µm Polar Pesticides HPLC Column	HILIC, Multi-Modal Columns	Robust analysis of underivatized polar pesticides in one column with fast column conditioning.

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company claims that this innovation stands out for its ability to improve the separation of basic compounds without compromising the performance of neutral or acidic compounds. For more information, see <u>https://halocolumns.</u> <u>com/halo-pcs/</u>.

Inert Hardware

Restek Corporation submitted information about three new products that utilize inert hardware to reduce or eliminate undesirable nonspecific interactions with metal surfaces: Force Inert Biphenyl, Raptor Inert Biphenyl, and Raptor Inert ARC-18 reversed-phase columns. The Force columns utilize conventional fully porous particle technology modified with a biphenyl functional group. The columns come in a 3.0-µm particle size and a 100 Å pore size, in multiple dimensions. The Force Biphenyl columns are suggested

TABLE I (CONTINUED): New LC columns and accessories for 2024

COMPANY	PRODUCT	CATEGORY	COMMENTS*
Restek Corporation	LC Waste Management Solutions	Accessories	Ensures safe solvent disposal with chemically resistant containers and protective features.
	Force Inert Biphenyl	Reverse-Phase Columns, Inert	Suggested for analyzing mycotoxins, steroid sulfates, and drugs of abuse, offering improved response of metal- sensitive compounds due to inert hardware coating.
	Raptor Inert ARC-18	Reverse-Phase Columns, Inert	SPP boasts a unique feature of low pH (pH 1) stablility, making it particularly suitable for challenging acidic environments.
	Raptor Inert Biphenyl	Reverse-Phase Columns, Inert	Featuring SPP and a unique biphenyl functional group, these columns offer improved responses for metal-sensitive compounds like mycotoxins and phosphorylated steroids.
SIELC Technologies, Inc	BIST A, BIST A+, BIST B, BIST B+	Specialty Charged Columns	Columns developed for Bridge Ion Separation Technique (BIST) for charged molecule separation.
SiliCycle Inc.	C18 Silica Gel Designed for Peptide Purification	Preparative Columns	C18 phase was specifically designed to withstand washing cycles carried out at pH up to 12-13 to help recover full column capacity after repeated injection.
	SiliaSphere PC C18 SMB	Preparative Columns, SMB	Specifically designed for industrial scale simulated moving bed (SMB) and continuous chromatography, providing reproducible purifications for compounds of varying polarity without the backpressure and cost of preparative HPLC.
Thermo Fisher Scientific	µPAC Neo High Throughput	Micro-Pillar Array Columns	Superficially porous pillars for high throughput proteomics: up to 300 samples per day.
	µPAC Neo Low-Load	Micro-Pillar Array Columns	Non-porous pillar base material with a C18 functional group that excels in handling the smallest proteomic sample amounts, enhancing chromatographic performance.
	Hypersil GOLD Peptide Columns	Reversed-Phase Columns	Columns offer superior consistency and are specialized for peptide mapping applications.
	ProPac 3R SCX and SAX HPLC Columns	Ion-Exchange, Anion and Cation	Columns excel in charge variant analysis of therapeutic proteins and fill state analysis of AAV particles, offering unrivaled reproducibility, outstanding resolution, and improved robustness.
Tosoh Bioscience	TSKgel HIC-ADC Butyl	HIC Columns	Hydrophobic interaction chromatography (HIC) columns for analyzing antibody-drug conjugates (ADCs).
Waters Corporation	MaxPeak Premier 3.5 µm HPLC Columns	Reversed-Phase Columns, Hardware	Hardware that reduces unwanted metal adsorption and results in improved peak shapes, increased sensitivity, and faster analysis.
	ACQUITY Premier Glycoprotein BEH Amide Columns	HILIC Columns, Inert	Suitable for released N-glycan analysis and intact glycoprotein or glycopeptide analysis.
	ACQUITY Premier Protein SEC Columns	Size-Exclusion Chromatography Columns, Inert	Designed for size exclusion chromatography (SEC) in protein analysis.
	XBridge Premier GTx BEH SEC 450 Columns	Size-Exclusion Chromatography Columns, Inert	Ideal for aggregate and heterogeneity analysis of viral vectors and small nucleic acids via size-exclusion chromatography.
	Ultra-short ACQUITY Premier Oligonucleotide BEH C18 Columns	Reversed-Phase Columns, Oligonucleotides, Inert	Columns offer ultrafast oligonucleotide separations without sacrificing resolution.
YMC Co.	YMC Accura BioPro IEX QF	Ion-Exchange, Anion, Inert	Anion exchange specialty column designed for applications such as oligonucleotides, antibodies, and LC–MS analyses.
	YMC Accura BioPro IEX SF	Ion-Exchange, Cation, Inert	Designed for cation exchange, the column delivers exceptional benefits including high recoveries without preconditioning, sharp peak shapes, reproducibility, and rapid throughput analyses.

Source: # Comments supplied by vendors

for analyzing mycotoxins, steroid sulfates, and drugs of abuse, offering improved response of metal-sensitive compounds because of the inert hardware coating. The Raptor Inert Biphenyl columns are built on SPP technology with a particle size of 2.7 µm and pore size of 90 Å. The surface is modified with a unique biphenyl functional group. These columns are stated to offer improved responses for metal-sensitive compounds like mycotoxins and phosphorylated steroids. The Raptor Inert ARC-18 columns are constructed on the same SPP technology but carry a sterically protected C18 functional group. The company claims the columns are stable at low pH, making them particularly suitable for challenging acidic environments. The suggested applications include organophosphorus and acidic pesticides. In each case, the inert hardware coating is stated to ensure accurate analysis of metal-sensitive compounds. For more details see <u>https://www.restek.</u> <u>com/enews/view/?id=73967</u>.

Waters Corporation provided information on its MaxPeak Premier 3.5 µm HPLC Columns. These columns, using Waters' MaxPeak HPS Technology for mitigating non-specific adsorption (NSA), feature multiple phases and are available in various dimensions. The company claims the inert hardware technology offers significant benefits, such as improving peak shape and reproducibility, as well as eliminating analyte loss. With suggested applications (including method development and quality assurancequality control), the columns offer scalability and compatibility with any HPLC system. More details can be found on the product webpage (https://www.waters. com/tothemax).

Micro-Pillar Array

Thermo Fisher Scientific continued to expand its product line of micro-pillar array columns by introducing both the µPAC Neo High Throughput and the µPAC Neo Low-Load reversed-phase chromatography columns. The High Throughput columns exhibit a superficially porous layer modified with a C18 functional group on 3 µm x 75 µm pillars and pore sizes ranging from 100-300 Å. The columns offer improved resolution, robustness, and reproducibility and, as the name indicates, particularly beneficial for high-throughput proteomics applications handling up to 300 samples per day. The µPAC Neo Low-Load reversedphase chromatography columns feature a non-porous pillar base material with a C18 functional group and a pillar size of 2.5µm x 16µm. The company notes that these columns offer improved resolution, robustness, and reproducibility, and they are particularly suitable for singlecell proteomics applications. For further product details, see thermofisher.com/ LowFlowHPLCColumns.

Monodisperse, Fully Porous

Fortis Technologies introduced Evosphere BIO and Evosphere BIOMAX reversedphase chromatography columns. These columns feature 300 Å, monodisperse, fully porous silica. The columns are available in 5 µm or 3 µm particle sizes, and with C4, C12, and diphenyl surface chemistries. The monodisperse characteristics combined with the high surface area of the particles offer high efficiency and sensitivity, low backpressure, and high loading capacity. The BIOMAX line offers the same features and characteristics as the BIO line, but with the added feature of inert hardware. The suggested applications include proteins, peptides, and oligonucleotides.

Fortis also introduced the Evosphere C12 reversed-phase chromatography column as an extension of its 100 Å, monodisperse, fully porous particles (FPP) line of columns. The new column features an alkyl chain C12 functional group that offers high pH mobile phase resistance and efficient separation of structurally similar compounds. More details can be found at <u>www.fortis-technologies.com</u>. For further insight into the attributes of monodisperse, fully porous particle technology, see a recent "Column Watch" article entitled "The Effect of Particle Monodispersity in HPLC Column Performance (1)."

Oligonucleotides, Proteins, and Peptides

Agilent Technologies introduced the AdvanceBio Oligonucleotide Columns. The columns feature SPP technology with high pH stability because of a hybrid base material. These columns, with particle sizes of 2.7 µm and 4 µm, boast a pore size of 100 Å and various dimensions ranging from 2.1 mm to 21.2 mm i.d. Specifically designed for ion-pair, reversed-phase analysis of oligonucleotides, the columns provide high resolution separation and are particularly beneficial for distinguishing full-length oligonucleotide products from closely related sequence impurities. Notably, the columns facilitate analytical characterization, semi-preparative, and preparative purification processes relating to oligonucleotides. More information on the product can be found at <u>https://www.</u> agilent.com/en/product/advancebio-oligonucleotide-columns.

GL Sciences provided information on its new ProteoSil 200-C18 and ProteoSil 200-C8 reversed-phase chromatography columns. With particle sizes ranging from 1.9 to 5 µm and internal column dimensions of 2.1 mm and 4.6 mm, these columns are said to be ideal for mid-sized protein, peptide, and oligonucleotide separations. The company notes that the unique 200 Å pore size promotes an "easy-clean" feature ensuring faster analvsis over 100 Å based columns, GL also introduced ProteoSil 300-C4, a reversedphase chromatography column tailored for larger protein and peptide analysis, particularly hydrophobic peptides. The column, with a 5 µm particle size and a 300 Å pore size, offers shorter retention times than many columns, and is suitable for proteins with moderate retention needs. The primary benefits include facilitating analysis and enhancing efficiency compared to existing products. All the columns are available in both stainless steel and Bio-Inert PEEK hardware. For more information, visit https://www. glsciences.com/product/lc_columns/ bio column/02862.html.

Thermo Fisher Scientific submitted information regarding its new Hypersil GOLD Peptide columns. These RPLC columns feature FPP silica with a C18 functional group, 1.9 µm particle size, and 175 Å pore size. Column dimensions range from 2.1 mm x 50 mm to 2.1 mm x 150 mm. The primary benefits include increased retention of hydrophilic peptides and simultaneous separation of deamidated species, ensuring minimal variability and high lot-to-lot consistency crucial for biopharmaceutical development. Notably, these columns offer superior consistency and are specialized for peptide mapping applications. For more information, see https://www.thermofisher.com/order/ catalog/product/26002-152130?SID=srch-srp-26002-152130.

Waters reported on its ultra-short ACQUITY Premier Oligonucleotide BEH C18 columns that are designed for RPLC. The columns offer ultrafast oligonucleotide separations without sacrificing resolution. They utilize BEH hybrid particle technology for maximum pH and temperature stability, along with MaxPeak HPS High Performance Surface Technology to minimize non-specific adsorption. Available in 130 Å and 300 Å pore sizes and dimensions of 2.1 mm x 20 mm, these columns cater to chromatographers seeking efficient oligonucleotide analysis. For further details on specifications and applications, see https://www.waters.com/nextgen/ us/en/shop/columns/186011021-acquitypremier-oligonucleotide-beh-c18-300-a-17-mm-21-x-20-mm-1.html.

Additional RPLC Columns

MilliporeSigma/Merck provided information about the Ascentis Express 90 Å ES-C18 RPLC columns, These columns feature an SPP base material modified with a sterically protected C18 functional group. The columns are offered in various column dimensions and are available with particle sizes of 2.7 μ m and 2 μ m, and a pore size of 90 Å. The company notes that the columns exhibit improved stability at low pH mobile phase conditions, making them suitable for long-term use with acidic hydrolysis protection. They are recommended for separating cannabinoids, polyphenols, and pesticides. For more information, see https://www.sigmaaldrich.com/US/en/ substance/ascentisexpress90esc1827um hplccolumn1234598765.

Hydrophilic Interaction Liquid Chromatography (HILIC)/Multi-Modal

RPLC struggles to retain hydrophilic analytes. For such cases, HILIC and multi-modal modes of chromatography can save the day. Interestingly, this year it is the amide surface chemistry for HILIC that dominates new products in this category.

Agilent Technologies introduced AdvanceBio Amide HILIC columns. These HILIC columns offer increased peak capacity, charge group selectivity, temperature stability, and longevity compared to existing Agilent glycan columns. A notable feature, according to the company, is the unique capability to modulate charge group selectivity by adjusting mobile phase ionic strength. The columns are available in dimensions of 2.1 mm x 100 mm and 2.1 mm x 150 mm, a particle size of 1.8 µm and a pore size of 300 Å. For more details, visit https://www.agilent.com/en/product/ biopharma-hplc-analysis/glycan-analysis/glycan-analysis-columns/advancebio-glycan-mapping.

GL Sciences submitted information on its new ProteoSil HILIC chromatography columns. The columns feature amide functional groups, are available in particle sizes of 1.9, 3, and 5 μ m, and exhibit a pore size of 100 Å. These columns, available in stainless steel or Bio-Inert PEEK hardware, excel in separating highly hydrophilic compounds, peptides, glycans, and oligonucleotides. Find more details at <u>https://www. glsciences.com/product/lc_columns/ bio_column/02862.html.</u>

Waters Corporation provided information about its ACQUITY Premier Glycoprotein BEH Amide columns. The columns are described as a specialty column suitable for released N-glycan analysis and intact glycoprotein or glycopeptide analysis. With a rapid analysis time of under 7 min, the columns offer advantages in large biomolecule analysis, clone identification in bioprocessing, real-time insights in downstream bioprocessing, and drug discovery. These columns are built using inert hardware that minimizes non-specific binding. See https://www.waters.com/ nextgen/us/en/shop/columns/186011017acquity-premier-glycoprotein-beh-amide-300-a-17--m-21-x-20-mm-co.html for additional details.

Multi-Modal Chromatography

Phenomenex submitted information on the Luna 3 µm Polar Pesticides HPLC Column. The column is described as providing robust analysis of underivatized polar pesticides in one column. The product offers fast conditioning, versatile retention for anionic and cationic pesticides, high sample loading, and 100% aqueous and organic stability. The proprietary surface chemistry, built on a 380 m²/g porous silica, provides a multi-modal retention, according to the company. For more information, see <u>www.phenomenex.com/</u> <u>LunaPolarPesticides</u>.

Ion-Exchange Chromatography

Where analytes differ in their charge state or degree of ionization, ion-exchange is a powerful means of separation, and is an indispensable tool for most practicing chromatographers. Based on the number of new products in this category this year, it is apparent end-users are finding growing utility in applying IEX.

Antec Scientific recently launched its SweetSep AEX200 column designed for high-performance anion-exchange chromatography (HPAEC). This specialty column, with a base material of poly(divinylbenzene-co-ethylvinylbenzene), features a unique agglomerated pellicular resin coated with guaternary amine functionalized nanoparticles, enabling rapid, high-resolution separations of carbohydrates from mono- to polysaccharides. According to the company, what sets this column apart is its ability to operate at significantly lower back pressures, making it compatible with a wide range of chromatography instrumentation, including older models. It boasts features like multi-purpose analysis capability and compatibility with electrochemical and mass spectrometry detection. For more information, see https://antecscientific.com/products/ columns/sweetsep/ and a recent article in the Column Watch series about HPAEC (2).

Thermo Fisher Scientific now offers specialty ion-exchange columns known as ProPac 3R SCX and ProPac 3R SAX HPLC columns for strong cation-exchange (SCX) and strong anion-exchange (SAX) modes of operation. These columns, available in various dimensions and featuring sulphonic acid (SCX) and guaternary amine (SAX) functional groups, boast spherical, monodisperse and non-porous particles. The columns excel in charge variant analysis of therapeutic proteins and fill state analysis of AAV particles, offering what the company notes as unrivaled reproducibility, outstanding resolution, and improved robustness. For additional information, visit

https://assets.thermofisher.com/TFS-Assets/CMD/brochures/eb-001998-ccs-ProPac-3R-SCX-SAX-eb001998-na-en.pdf.

YMC introduced two new ion-exchange columns of its own: Accura BioPro IEX OF and Accura BioPro IEX SF. The OF is an anion-exchange specialty column designed for applications such as oligonucleotides, antibodies, and general LC-MS analyses. The SF columns are designed for cation-exchange and are also applicable to antibodies, proteins, and peptides. Both columns boast exceptionally high recoveries without preconditioning, sharp peak shapes, superior reproducibility, and rapid throughput analyses, making them ideal for LC-MS. Both columns also feature inert hardware. For more information, see https:// ymc.eu/d/brDpV or https://ymc.eu/bioinert-columns.html.

Bridge Ion Separation Technique (BIST)

SIELC Technologies introduced the Bridge Ion Separation Technique (BIST) and the columns developed to take advantage of the technique, including BIST A, A+, B, and B+. According to the company, BIST involves the adsorption of doubly charged ions onto a surface of the opposite charge in high organic systems. The result is an excess charge from the doubly charged ions that can then interact with oppositely charged target analytes. Since the excess charge from the double layer requires low water in the system to reduce ion solvation, the potential advantage of the technique lies in the ability to switch polarity solely by changing the water level in the mobile phase. There is thus the potential to retain and separate analytes of opposite charge on a single column. The columns noted above are specifically developed for BIST separation, and may present a unique offering in chromatography. More details about the products and the BIST technique can be found at https://sielc. com/wp-content/uploads/2022/05/BIST-Short-05.12.2022.pdf.

Size-Exclusion Chromatography

Size-exclusion chromatography (SEC) has become a crucial tool for the characterization of large molecule therapeutics and for industrial polymer analysis and design. Improvements in the control of particle pore structure, surface chemistry, and column hardware design have all contributed to new products in this important realm of chromatography.

GL Sciences now offers the ProteoSil 300-SEC column for SEC for large molecule analysis and dialysis. The columns feature dihydroxy propyl ligands bonded to 5µm silica, and are available in both stainless steel and Bio-Inert PEEK hardware with dimensions ranging from 2.1 mm to 7.6 mm IDs. The columns are suitable for protein, peptide, monoclonal antibodies, and oligonucleotide applications. For more information, see <u>https://www. glsciences.com/product/lc_columns/ bio_column/02862.html</u>.

Waters Corporation launched ACQUITY Premier Protein SEC columns. The columns, designed for SEC of proteins, feature a Bridged Ethylene Hybrid (BEH) surface. The columns are available in a pore size of 250 Å and particle size of 1.7 µm. Notably, the columns deliver fast analyses (< 3 min) for large biomolecules such as monoclonal antibodies (mAbs), facilitating rapid identification of clones in bioprocessing and real-time insights into mAb quality attributes. The key advantages include reduced development time, minimized non-specific binding, and suitability for high throughput screening. For additional information, see https://www.waters.com/nextgen/ie/en/ shop/columns/186011018-acquity-premierprotein-sec-column-250-a-17--m-46-x-100mm-1-pk.html.

Waters Corporation also provided information on its XBridge Premier GTx BEH SEC 450 chromatography columns. These columns are specifically designed for SEC, and are ideal for aggregate and heterogeneity analysis of viral vectors and small nucleic acids. The columns feature a diol bonded to ethylene bridged hybrid substrate, providing higher resolution and low multi-angle light scattering (MALS) noise compared to current products. Available in various dimensions, such as 4.6 mm x 150 mm and 7.8 mm x 300 mm, and 2.5 µm particle size, these columns offer unique benefits, including low binding adsorption hardware and

minimal secondary interaction. More information about these columns can be found at <u>https://www.waters.com/nextgen/se/</u> en/products/columns/gtx-columns.

Hydrophobic Interaction Chromatography

Tosoh Bioscience highlighted its new product, TSKgel HIC-ADC Butyl, for hydrophobic-interaction chromatography (HIC) analysis of antibody-drug conjugates (ADCs). The columns feature a 5 µm, non-porous polymeric spherical base material. Noteworthy benefits include superior separation performance, fast analyses (such as the determination of antibody drug ratio in 7 min), and highly reproducible data with long column lifetime. For more information, visit <u>https://www.separations.eu.tosohbioscience.com/products/</u> <u>hplc-columns-uhplc-columns/hydrophobic-interaction/tskgel-hic-adc-butyl</u>.

Chiral Chromatography

ColumnTek continues to add to its line of chiral columns with the new Enantiocel IDC. The new columns boast an immobilized cellulose tris(3,5-dichlorophenyl carbamate) as its functional group, enabling high column efficiency and expanding solvent compatibility over its coated predecessor. According to the company, the columns can be utilized across normal phase, reversedphase, and supercritical fluid chromatography. For more information, see www.columntek.com.

MAC-MOD Analytical now offers its own line of chiral columns under the brand MAC-MOD Chiral Columns. The new line contains a variety of amylose and cellulose materials, providing diverse selectivity. In some cases, these columns offer similar selectivity to industry standard columns and in other cases provide unique selectivity. For further details, visit <u>https://www. mac-mod.com/brands/mac-mod-chromatography-solutions/mac-mod-chiral/</u>.

Preparative Chromatography

Agilent Technologies added a new dimension of 30 mm x 150 mm to its InfinityLab ZORBAX Eclipse Plus C18 chromatography column line. The preparative columns, with a base material of 5 µm silica, are noted for their high pH resistance (from 2.0 to 9.0), making them suitable for moderately high pH applications. The columns offer a unique endcapped phase ensuring superior peak shape for basic compounds alongside a scalability feature from sub-2 µm column dimensions to prep HPLC column dimensions. Further details on the product can be found at https:// www.agilent.com/store/productDetail. jsp?catalogId=575150-902&catId=Sub-Cat1ECS 1642312. For an interesting article comparing the use of SPP and FPP particles for preparative efforts, the reader is referred to "Developing a Fast Purification Method for a Natural Product with a Preparative LC Column Packed with Superficially Porous Particles" from a recent LCGC supplement (3).

SiliCycle introduced C18 Silica Gel Designed for Peptide Purification that the company notes is ideal for chromatographers aiming for high-quality peptide purification. This RPLC column boasts high pH tolerance and coverage, making it suitable for a range of applications, including the purification of GLP-1 receptor agonists, such as liraglutide and semaglutide. Notably, its proprietary grafting and endcapped stationary phase characteristics ensure longevity and efficiency, even after repeated injections and rigorous washing cycles up to pH 12-13. More details can be found at https:// www.silicycle.com/products/c18-silica-gel-designed-for-peptide-purification.

SiliaSphere PC C18 SMB, a RPLC column with high coverage of C18 monomeric functional groups, was also introduced by SiliCycle. This silica-based column, with particle sizes ranging from 200 to 500 µm and a pore size of 100 Å, is specifically designed for industrial scale simulated moving bed (SMB) and continuous chromatography, providing reproducible purifications for compounds of varying polarity without the backpressure and cost of preparative HPLC. For further information, see https://www.silicycle. com/products/siliasphere-pc-c18-smb.

Accessories

Agilent Technologies offers Quick Change HPLC Inline Filters & Filter Discs, suitable for UHPLC columns up to 1300 bar. As particles can enter the system from a variety of sources, inline filters can be used to protect valuable columns by capturing the particles before they cause irreparable damage. The new inline filter design features finger-tight and tool free replacement of filter discs. Multiple dimensions are available. For more information, see https://www.agilent. com/en/product/liquid-chromatography/hplc-supplies-accessories/pumpdegasser-supplies-for-hplc/infinitylab-quick-change-inline-filter.

Optimize Technologies recently introduced the OPTI-SOLV Reservoir Filters. The product uses a conical flow path design to prevent air bubbles from being trapped and interfering with analyses. Utilizing reservoir filters is an essential means of filtering particles that may come from buffer salt precipitation, airborne dust, improperly cleaned glassware, or microbial contamination. More information can be found at <u>https://</u> www.optimizetech.com.

Restek Corporation reported on the launch of LC Waste Management Solutions, a series of products for ensuring safe solvent disposal with chemically resistant containers and protective features. The newly released products include safety spouts for decanting or emptying of waste, chemically resistant carboy waste collection containers, and waste funnels with a protective lid and sieve for catching stir bars. Each product prioritizes safety and convenience in laboratory solvent management. For additional information, see https://www. restek.com/search/solvent-waste-management/_/N-236285123?Ns=restek-Product.x_productBadge%7C0.

Conclusions

Developments in particle design, improvements in surface chemistry modification, column hardware advances, and the combination of these tech-

nologies continues to produce new products in the realm of liquid chromatography. The largest number of new products can be classified broadly as intended for RPLC. New surface modifications, alternate particle architecture, and further products centered around micro-pillar array formats are highlighted. It is also clear from the abundance of new products launched aiming at HILIC, IEX, SEC, HIC, and chiral chromatography that alternative modes of retention are being demanded and utilized by practicing chromatographers. In addition, columns for preparative purposes and the need for quality accessories continue to be developed and introduced.

There continue to be evolutionary improvements made in all aspects of the column design, from particle to hardware to format. Several of the new products are new combinations of existing technologies, often targeted for a particular area of focus. In many cases this year, new products have been developed that utilize advances in inert hardware, a trend observed consistently over the past several years.

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BOUT COLUMN EDITOR

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Lead Consultant and Owner at ASKkPrime, LLC, specializes in separation science consultancy, is Editor of the Column Watch series of articles and serves on the Editorial Advisory Board

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