



Liberty™ 2.0 Series
Microwave Peptide Synthesizers



9

10

11

45ml

40

35

30

25

45ml

40

35

30

25

45ml

40

35

30

25

45ml

40

35

The Liberty Blue™ 2.0 and Liberty PRIME™ 2.0 are ultra-efficient microwave peptide synthesizers, delivering high-quality peptides with record low waste generation and synthesis times. Through combining CEM's patented and published *No Wash* methodology with flexible and intuitive system controls, the Liberty Blue and PRIME 2.0 systems open up a world of more efficient, high-yielding, and structurally complex syntheses than ever thought possible.



Maximized Sustainability

Through a remarkable combination of methodology optimization, reagent selection, and engineering advancements, Our *No Wash* technology reduces waste production by up to 95%, and all without sacrificing synthesis yield and purity.



Undeniable Efficiency

Liberty Blue and PRIME 2.0 offer up to 95% time-savings, credited to their elegant fluidic delivery design and effective one-pot coupling/deprotection methodology.



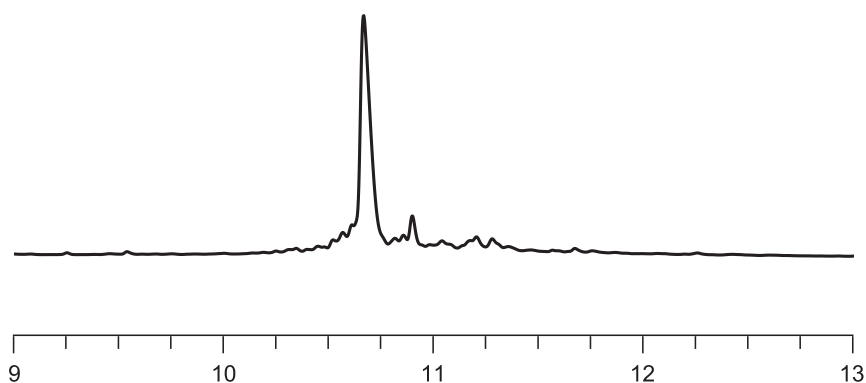
Ultimate Flexibility

Whether your synthesis requirements span a wide scale range, diverse reagent spread, or vast peptide applications, the Liberty 2.0 Series' flexibility for automation is nearly limitless.

Advanced Science — See What's Possible

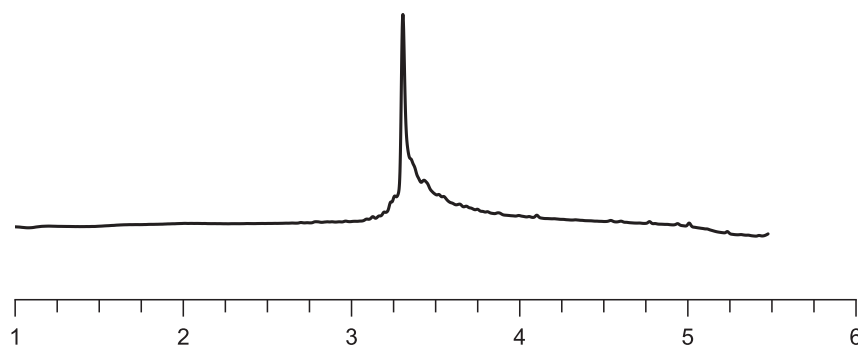
Semaglutide (Crude)

Length: 31 Amino Acids
Scale: 0.1 mmol
Synthesis Time: ~ 1 hour 50 minutes
Waste: 135 mL (Liberty PRIME 2.0)
or 238 mL (Liberty Blue 2.0)



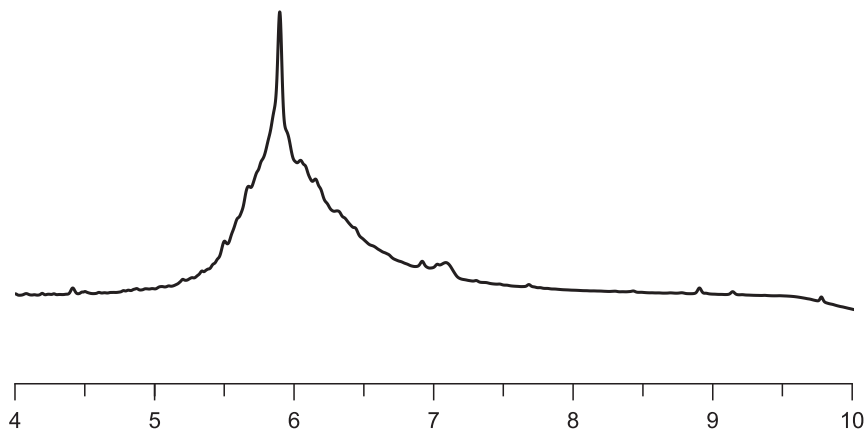
1-42 β -amyloid (Crude)

Length: 42 Amino Acids
Scale: 0.1 mmol
Synthesis Time: ~ 2 hours 30 minutes
Waste: 179 mL (Liberty PRIME 2.0)
or 316 mL (Liberty Blue 2.0)



Proinsulin (Crude)

Length: 86 Amino Acids
Scale: 0.1 mmol
Synthesis Time: ~ 10 hours 40 minutes
Waste: 687 mL (Liberty PRIME 2.0)
or 973 mL (Liberty Blue 2.0)





Waste generated by a 10-mer synthesis at 0.1 mmol scale.



Waste generated by a 50-mer synthesis at 0.1 mmol scale.

Ultra-Efficient Solid Phase Peptide Synthesis (UE-SPPS)

UE-SPPS is a revolutionary approach to peptide production, completely eliminating the resin washing steps required in more traditional approaches to solid phase peptide synthesis. Complete wash elimination is achieved by a combination of in-situ quenching of excess activated amino acid monomers and controlled evaporation of excess deprotection base. All reactions (couplings and deprotections) are enhanced through optimized microwave irradiation, facilitating high quality syntheses of peptides and proteins (even those up to 100 amino acids in length). Through this, UE-SPPS eliminates up to 95% of the total waste produced in typical SPPS methodology. A paper discussing this development was recently published in Nature Communications which you can access below.

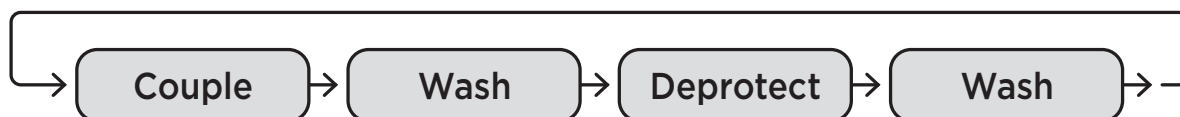
UE-SPPS Cycle

NO WASH METHODOLOGY



Traditional SPPS Cycle

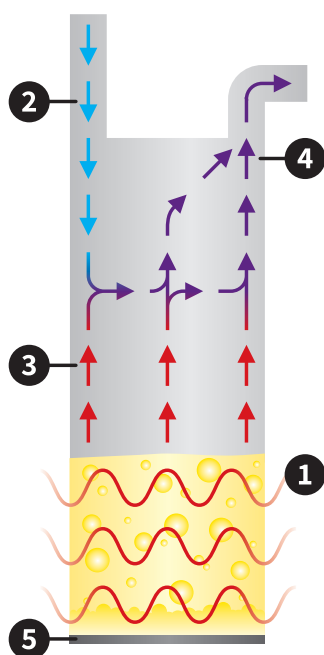
(extensive wash waste)



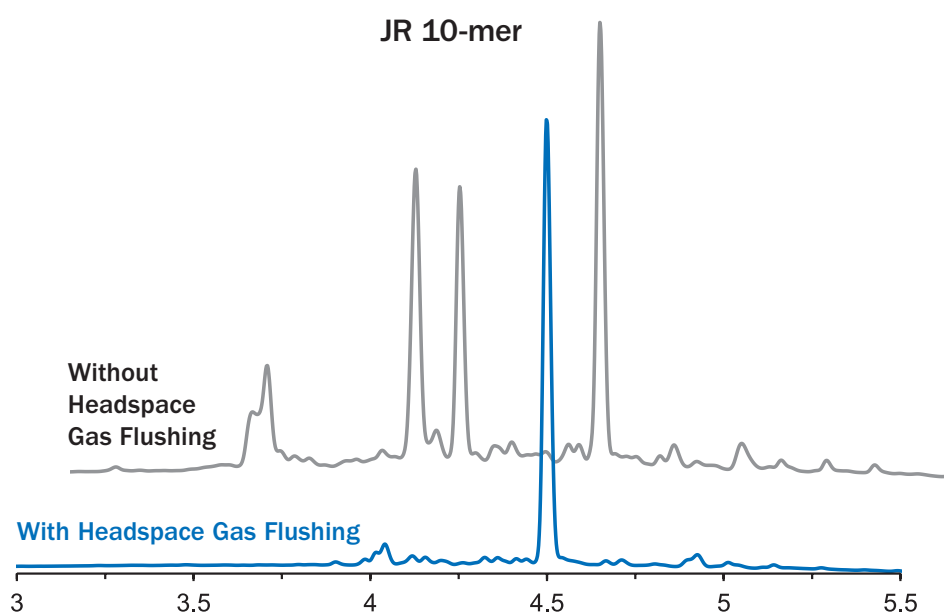
Total wash elimination for solid phase peptide synthesis
– Nature Communications Article

Headspace Gas Flushing

Our patented technology removes volatile deprotection base from the reaction headspace before condensation can occur on upper vessel surfaces. Base condensation and (often inopportune) reaction solution reentry can heavily impact synthesis purity, especially in longer sequences where even small impurity products can quickly accumulate.



1. Microwave heat drives Fmoc-deprotection to completion.
2. Nitrogen (N_2) gas flows into the reaction vessel.
3. Deprotection base evaporates via microwave heating.
4. Nitrogen (N_2) + deprotection base flows out of the reaction vessel to waste.
5. Remaining reagents and side products filter to waste.



Long Sequences, Short Synthesis Times

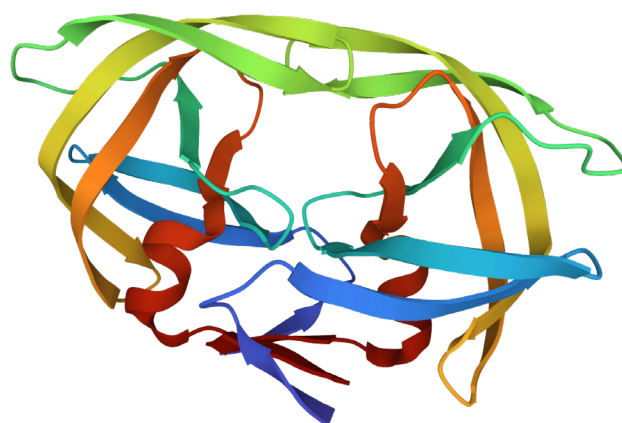
Advanced engineering and improved methodology of the Liberty 2.0 Series allows you to explore lengthier peptide (and small protein) synthesis better than you imagined possible.

Ubiquitin



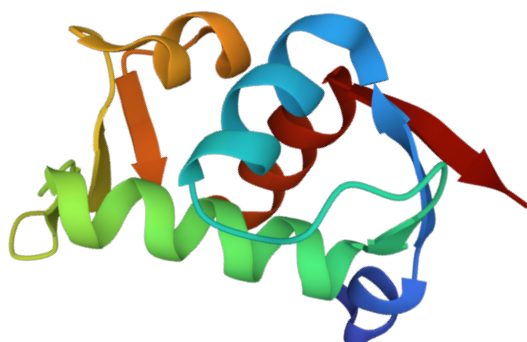
Length: 76 amino acids
Synthesis Time: 9 hrs. 35 min.

HIV Protease



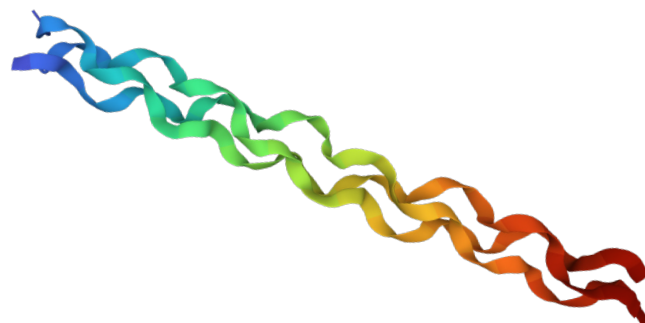
Length: 99 amino acids
Synthesis Time: 12 hrs. 48 min.

MDM2



Length: 118 amino acids
Synthesis Time: 16 hrs. 26 min.

Collagen Like Peptide



Length: 99 amino acids
Synthesis Time: 12 hrs. 30 min.

Non-standard peptides? No problem!

The Liberty 2.0 Series can expand automated synthesis beyond standard peptides. Automate the synthesis of the following and more:

- Branched Peptides
- Disulfide Bonds
- Peptoids
- Phosphopeptides
- Cyclic Peptides
- PNAs
- Glycopeptides
- N-Methyl Peptides
- Stapled Peptides
- Tagged Peptides



Application Notes

Explore our scientist developed and tested applications library.
(cem.com/peptide-synthesis-applications)



Application Note
Automated Microwave-Enhanced Total Synthesis of Proteins

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Automated Microwave-Enhanced Total Synthesis of Proteins



Summary

Proteins and long peptides can be synthesized rapidly and efficiently by microwave-enhanced SPPS on the Liberty Blue 2.0 and Liberty PRIME™ 2.0. The use of optimized micro SPPS incorporating a new headspace flushing technology allows for higher purity synthesis of protein sequences. This technology was demonstrated on a series of biologically relevant proteins (ubiquitin, barstar, proinsulin, collagen, I protease, and MDM2) from 76-127 amino acids which were obtained in good purity through stepwise assembly without ligation steps. High purity samples were isolated from the material by elevated temperature chromatography at 60 °C using the Prodigy™ Preparative HPLC Peptide Purification system.

Introduction

Proteins and long peptides are critical components of biological systems and comprise many important therapeutics, but research is slowed by time-intensive expression or native chemical ligation production methods. Total synthesis by SPPS provides a direct synthetic route to target specific sequences and allows for rapid generation of analogs. However, long peptides and proteins can be challenging targets for SPPS due to the iterative accumulation of impurities and tendency for aggregation to occur. Historically, SPPS was limited to small fragments for native chemical ligation and longer sequences have been of limited accessibility.¹ Recently, rapid flow-based methodology has shown the significant ability to assemble long sequences with extremely quick cycle times.² Herein, we describe the synthesis of a series of biologically relevant



Application Note
Ultrafast Peptide Synthesis at Elevated Temperature

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Ultrafast Peptide Synthesis at Elevated Temperature



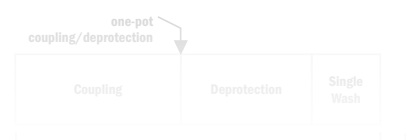
Summary

The Liberty PRIME™ 2.0 microwave peptide synthesizer is the most advanced system available for peptide synthesis. It is based on the use of a new one-pot coupling and deprotection methodology for solid phase peptide synthesis that drastically reduces cycle time and waste usage to unprecedented levels. The system provides a complete cycle time of only 2 min 10 sec (for all 20 standard Fmoc amino acids) with only 8 mL of chemical waste produced, half the amount of CEM's highly efficient Liberty Blue 2.0 peptide synthesizer. The Liberty PRIME 2.0 HT24 is an ideal system for high-throughput peptide synthesis of both standard and complex peptides, with the ability to automatically synthesize up to 24 peptides in a day.

Introduction

Traditional solid phase peptide synthesis involves the use of separate and separate deprotection and coupling steps with

side reactions at the resin bound amino functionality. The Fmoc removal then proceeds uninterrupted at elevated temperature. An optimized use of reagents results in an essentially neutral reaction mixture towards the end of deprotection step. This new procedure offers several advantages such as (a) approximately 90% reduction in solvent requirement for the deprotection step, (b) 75% reduction in solvent requirement for post-deprotection washings, (c) faster deprotection step, since the microwave ramp time is not needed, and (d) shorter cycle time due to absence of post-coupling drain step.



Improving Your Research Capabilities

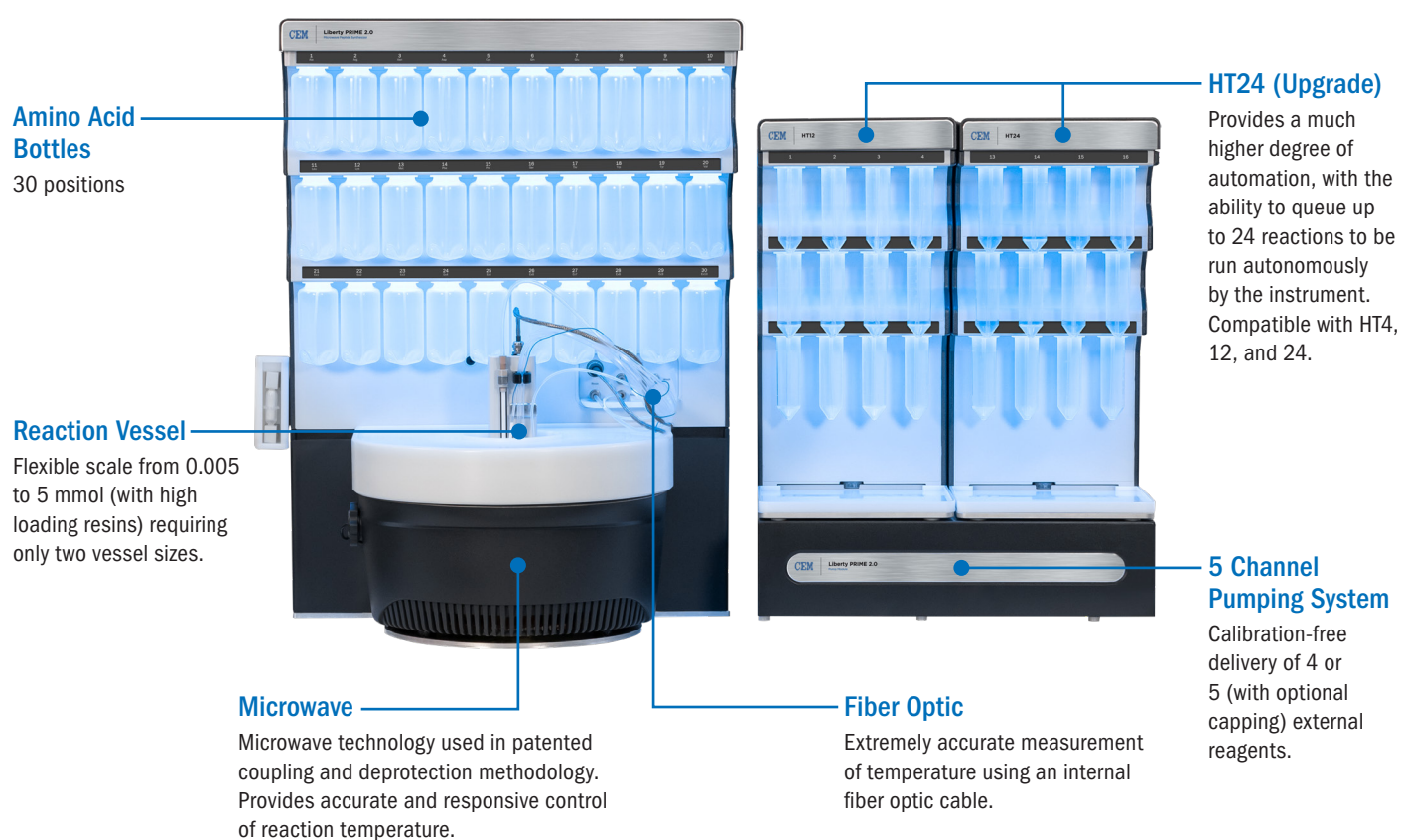
An excellent candidate for research and development-oriented peptide synthesis needs, the Liberty Blue 2.0 boasts less than 4 minutes of time required and 6 mL of waste generated for each amino acid addition cycle (deprotection through coupling).



Learn more about **Liberty Blue 2.0**

Meeting Your High Production Demands

An excellent candidate for production-oriented peptide synthesis needs, the Liberty PRIME 2.0 boasts less than 4 minutes of time required and 5 mL of waste generated for each amino acid addition cycle (deprotection through coupling).



Learn more about **Liberty PRIME 2.0**

Find Your Automated Needs

All Liberty synthesizer models give you access to:

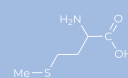
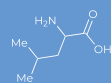
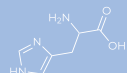
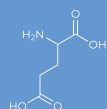
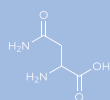
- Fast, Flexible, High-purity Synthesis
- Synthetic Biomolecules
- Alternative Solvents
- Complex Side-chain Functionalization, Cyclization, and Branching
- High-throughput Synthesis
- Less Waste

	Liberty Blue 2.0	Liberty PRIME 2.0
		
Cycle Time (at 0.1mmol)	< 4 minutes per Amino Acid Addition	< 4 minutes per Amino Acid Addition
System Waste (at 0.1mmol)	< 6 mL per Amino Acid Addition	< 5 mL per Amino Acid addition
Scale Range	0.005 - 5 mmol	0.005 - 5 mmol
Headspace Flushing	Yes	Yes
Amino Acid Positions	27	30
External Reagent Positions	4 (2 Activators, Deprotection, Wash)	Up to 5 (2 Activators, Deprotection, Wash, Optional Extra)
RV Camera	Yes	Yes
LED Visual Feedback	Yes	Yes
High-Throughput Options	HT4, HT12	HT4, HT12, HT24
Optional Accessories	N/A	Full cGMP Compliance Package

Liberty PRO

Easily scale up peptides optimized on any Liberty 2.0 Series system. The Liberty PRO™ allows for fully automated, production scale, microwave peptide synthesis under cGMP using a 3, 8, or 15 liter reaction vessels. Batch crude peptides up to 1 kg can be synthesized with a typical cycle time of 15 – 45 min per amino acid.



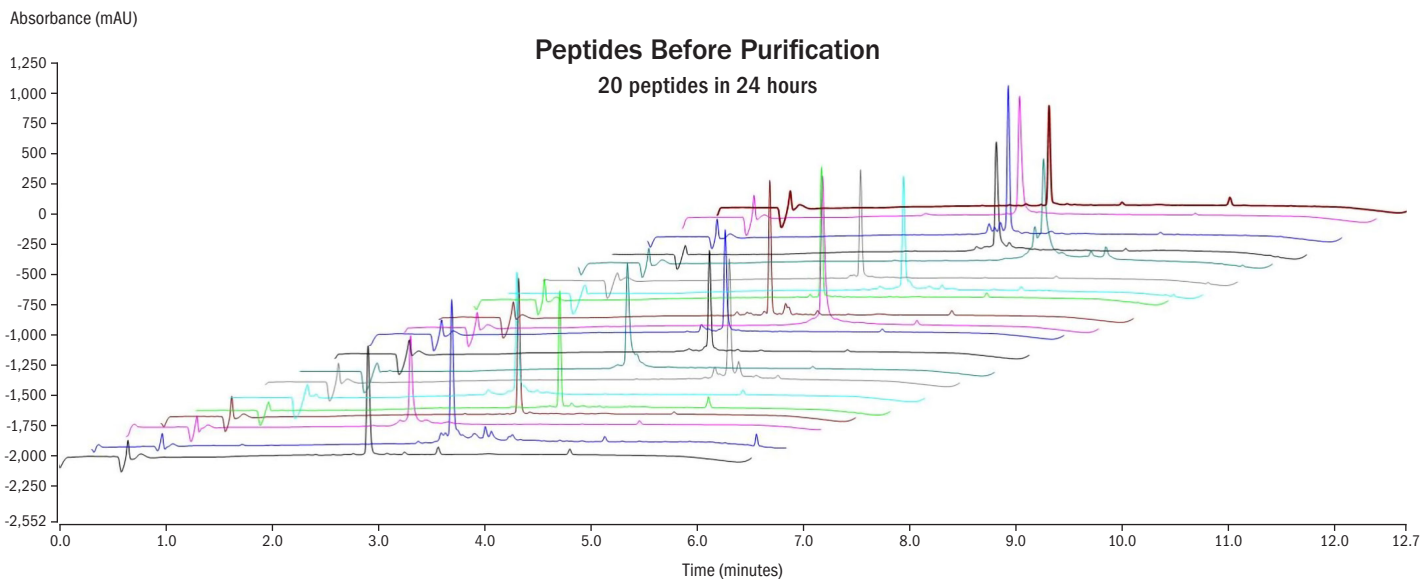


Explore All of Our Unparalleled
Peptide Synthesis Solutions



Automated High Throughput Production

The Liberty 2.0 Series instruments enable high throughput peptide synthesis with high purity. Optional high-throughput modules allow for running automated batch sizes of 4 (HT4), 12 (HT12), or 24 (HT24) peptides on a Liberty 2.0 Series system.



Sequence	Crude Purity	Final Purity*	Recovery (%)	mg
GWVKPIIIGHHAYGDQYRAT	73	99.1	61	103.2
TLYEQEIEV	49	94.5	68	39.7
HGSRKNITDMVEGAKKANG	73	91.7	57	91.1
SLLNQPKAV	79	99.7	46	35.0
EDPYLFELPVLKYLDMGTT	76	98.5	68	38.4
ALAVLSNYDA	84	99.3	13	11.4
TMEDKIYDQQVTKQCLCF	47	97.1	44	47.2
YSYPETPLYMQTASTSYE	47	95.2	26	29.7
KVGYTERQRWDFLSEASIM	61	97.3	44	63.2
RLRMREHMMKNVDTNQD	65	96.3	51	75.2
VYEKNGYIF	90	98.5	47	54.8
ALAVLCNYDA	73	99.3	45	34.7
ALVPPSKRKMVVVSPAeka	78	97.1	66	111.2
ISTPTPTIVHPGSLPLHLG	75	99.2	56	81.7
IVQENNTPGTLLSVSARD	74	96.3	56	89.7
RFHMKVSVYLLAPLREALS	75	96.8	51	88.7
ENLKQNDISAEFTYQTKDA	82	99.3	61	111.5
YMMPVNSEV	70	97.8	44	33.3
TNDVKTLADLNGVIEEEFT	59	97.6	24	29.9
SAWLFRMWYIFDHNYLKPL	48	99.9	66	79

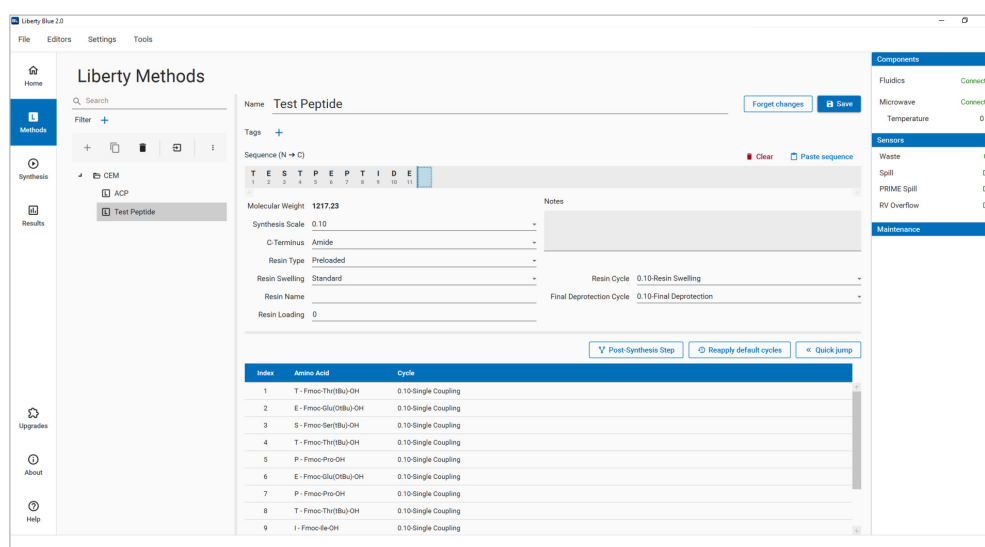
*The peptides were purified on the Prodigy to give >90% final purity on all samples.
 Hilf, N. et al (2019) Nature 565, 240-245.

Flexible and Powerful

The Liberty 2.0 Series of peptide synthesizers feature an updated software system that provides the latest in ease-of-use, flexibility, and conformity with 21 CFR Part 11 compliance. The software allows for simple customization of reagent positions, peptide modifications, and the ability to edit/stop during a method run.

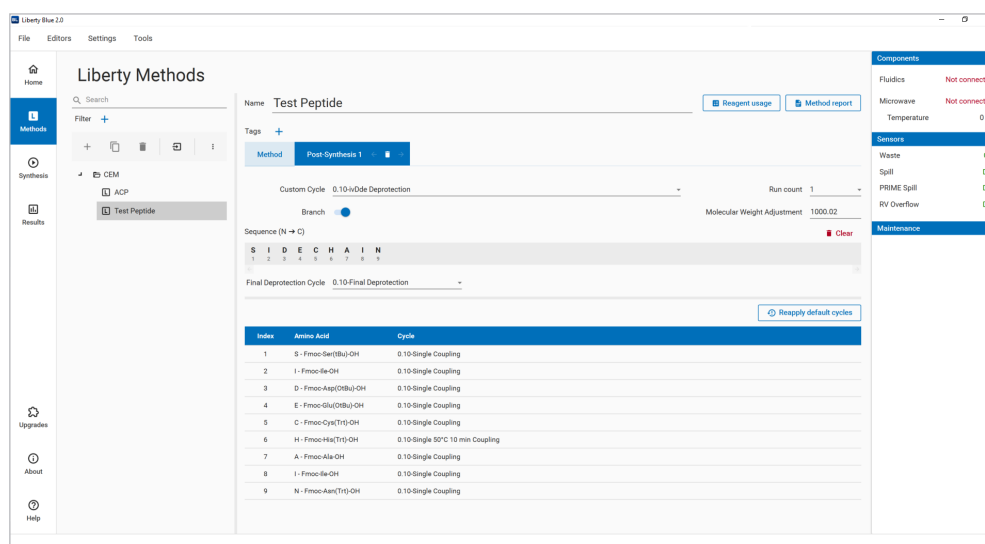
Easy and Flexible Sequence Programming

The method editor allows full customization of reaction parameters. Create, edit and store methods to streamline the run process.



Program Post-Synthesis Modification

Versatile options for post-synthetic steps like branching, cyclization, orthogonal deprotection, labeling, and more. Empower your chemistry with flexible options.



Full Suite of Calculator Tools

Convenient calculators provide the reagents and amounts for a run, streamlining the process of reaction preparation.

Position	Reagent	Volume (mL)	Mass (g)
1	Alanine	6	0.38
3	Aspartic acid	6	0.5
4	Glutamic acid	6	0.52
6	Glycine	0	0
8	Isoleucine	8	0.57
12	Asparagine	3	0.36
13	Proline	6	0.41
14	Glutamine	3	0.37
16	Serine	3	0.24
17	Threonine	8	0.64
18	Valine	3	0.21
20	Tyrosine	3	0.28
ACT 1	Activation (Dgma)	10	
ACT 2	Activation (DIC)	20	
MS	Main Solvent (DMF)	298	
DEP	Deprotection (Piperidine)	63	

Amino acid concentration: 0.2 M Total waste volume: 406 mL

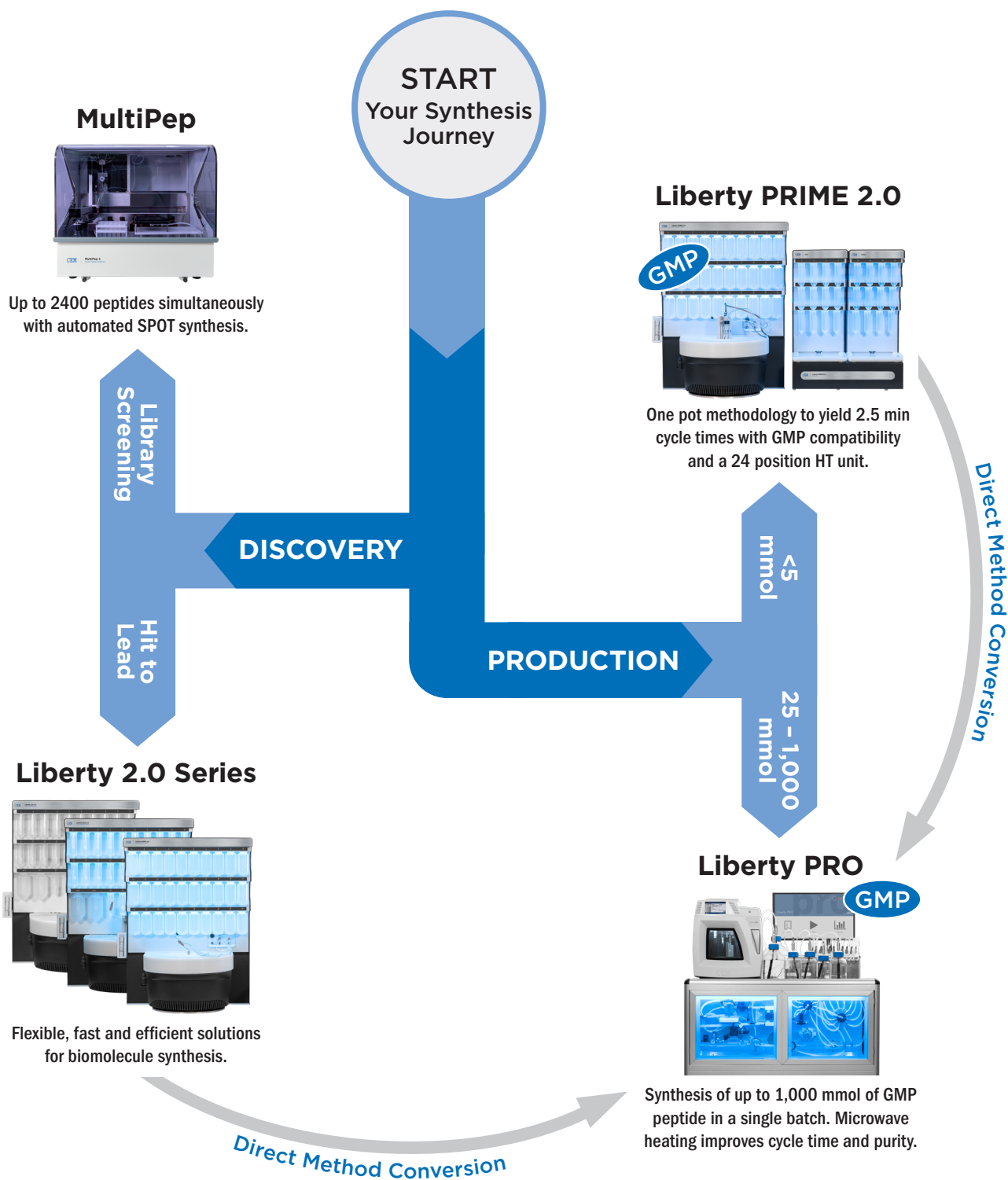
Edit or Monitor at any Step

Easily edit and monitor reactions from the run screen. With an HT module, program a queued run, even while a synthesis is in progress.

Cycle	AA	Operation	Parameters	Pause after
1	E	1 Deprotection	Microwave Method: Standard Deprotection, Deprotection Volume: 3	<input type="checkbox"/>
2	D	2 Wash	Volume: 2, Drain Time: 5	<input checked="" type="checkbox"/>
3	I	3 Wash	Volume: 2, Drain Time: 5	<input type="checkbox"/>
4	T	4 Wash	Volume: 2, Drain Time: 5	<input type="checkbox"/>
5	P	5 Coupling	Microwave Method: Standard Coupling, Amino Acid Volume: 2.5, Reagent #1: DIC, Reagent #1 Vo	<input type="checkbox"/>
6	E			<input type="checkbox"/>
7	P			<input type="checkbox"/>
8	T			<input type="checkbox"/>
9	S			<input type="checkbox"/>
10	E			<input type="checkbox"/>
11	T			<input type="checkbox"/>
12				<input type="checkbox"/>

Estimated time remaining: 00:55:37

We have You Covered from Spot Synthesis to Kilogram Scale Production



Cleavage

Razor

The RAZOR® reduces standard cleavage times from 3 – 4 hours down to only 30 min. The system performs cleavage of up to 12 peptide resins at a time with precise temperature control. The system is compact and easily fits in standard fume hoods.



Purification

Prodigy

The Prodigy™ Peptide Purification System is a Preparatory HPLC that is specially engineered for peptide purification. It features elevated temperature purification, a focused gradient calculator, and is capable of purifying milligrams to grams of crude peptide — all with modern and easy to use software.





We Simplify Science

cem.com



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