ASYMCHEM



PEPTIDE SERVICES



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Capability & Capacity

- **1** Commercial & **7** PPQ & **70+** IND
- **500+** Experienced Process and Analytical Chemists
- **DAC-150** to **DAC-1200** Prep-HPLC
- **~250 m²** Total Lyophilization Capacity
- **69,000 L** SPPS Capacity (2026 Q4)
- **324,000 L** LPPS Capacity (2026 Q4)
- **MCSGP** TWIN-1000, DAC-300 to DAC-600
- Spray dryer: PSD-1 / PSD-2 / PSD-3* / PSD-4*

* in 2027



50L, 100L, 200L, 500L, 1000L, 2000L, 3000L SPPS Reactors



2000L - 12500L Reactors (Cleavage, LPPS)



DAC150, 200, 300, 600, 800, 1000, 1200 & MCSGP (TWIN1000) for Purification



Concentration (0.5m² - 60m²) (TFF)



Lyophilization (~250m²)



Spray Drying (PSD-1, PSD-2, PSD-3, PSD-4)

Peptide Development and Manufacturing

- Lead time of 4-6 months for IND filing
- Empowering NDA filing with tailored solutions



*MT capacity data is calculated based on reactor volume & proven historical average yield. Actual varies by molecule/process.

Peptide Technology Platform



Solid Phase Peptide Synthesis (SPPS)

Hybrid Strategy

Liquid Phase Peptide Synthesis (LPPS)

★Tag-assisted peptide synthesis

Bio-Synthesis

Chemo-Enzymatic Peptide Synthesis (CEPS)

Purification

- Normal / Reverse prep-HPLC
- MCSGP technology
- Prediction Modelling

Concentration

- TFF concentration
- Reactor & Film concentration

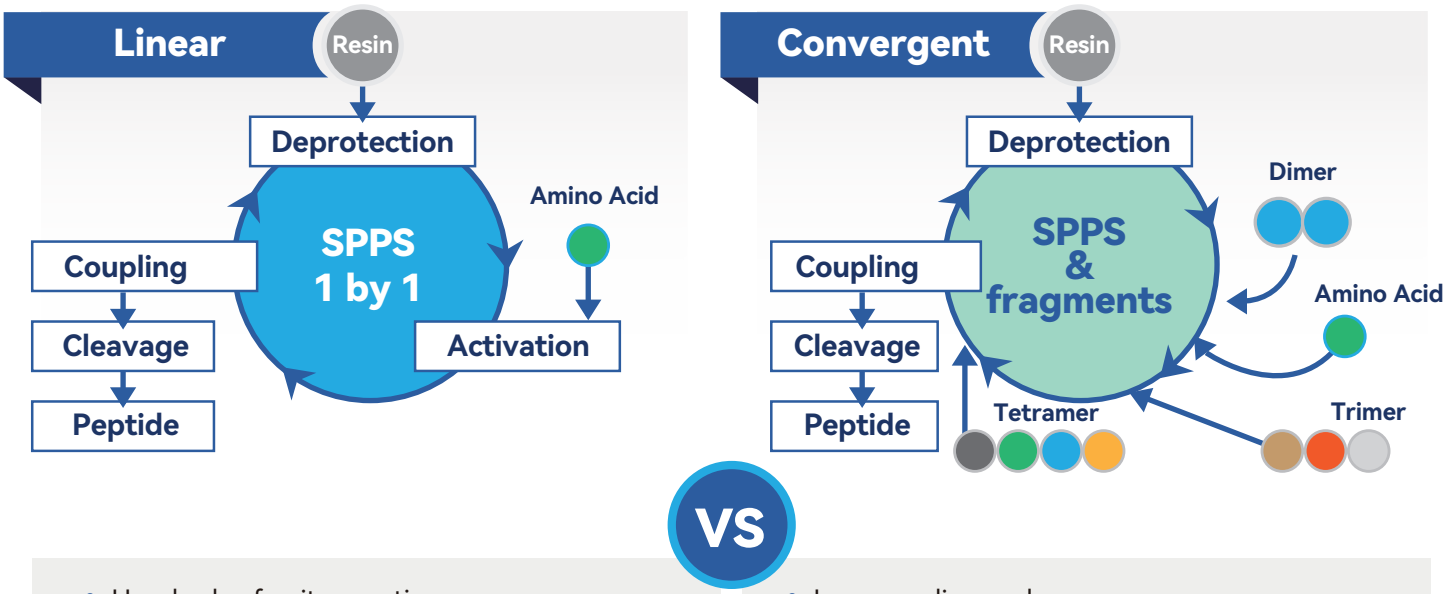
Isolation

- Precipitation / Crystallization
- Spray Drying
- Lyophilization

Coupling / de-Fmoc Post Wash / TFF

- NIR / MIR ▸ Raman ▸ UV

SPPS Cost Saving

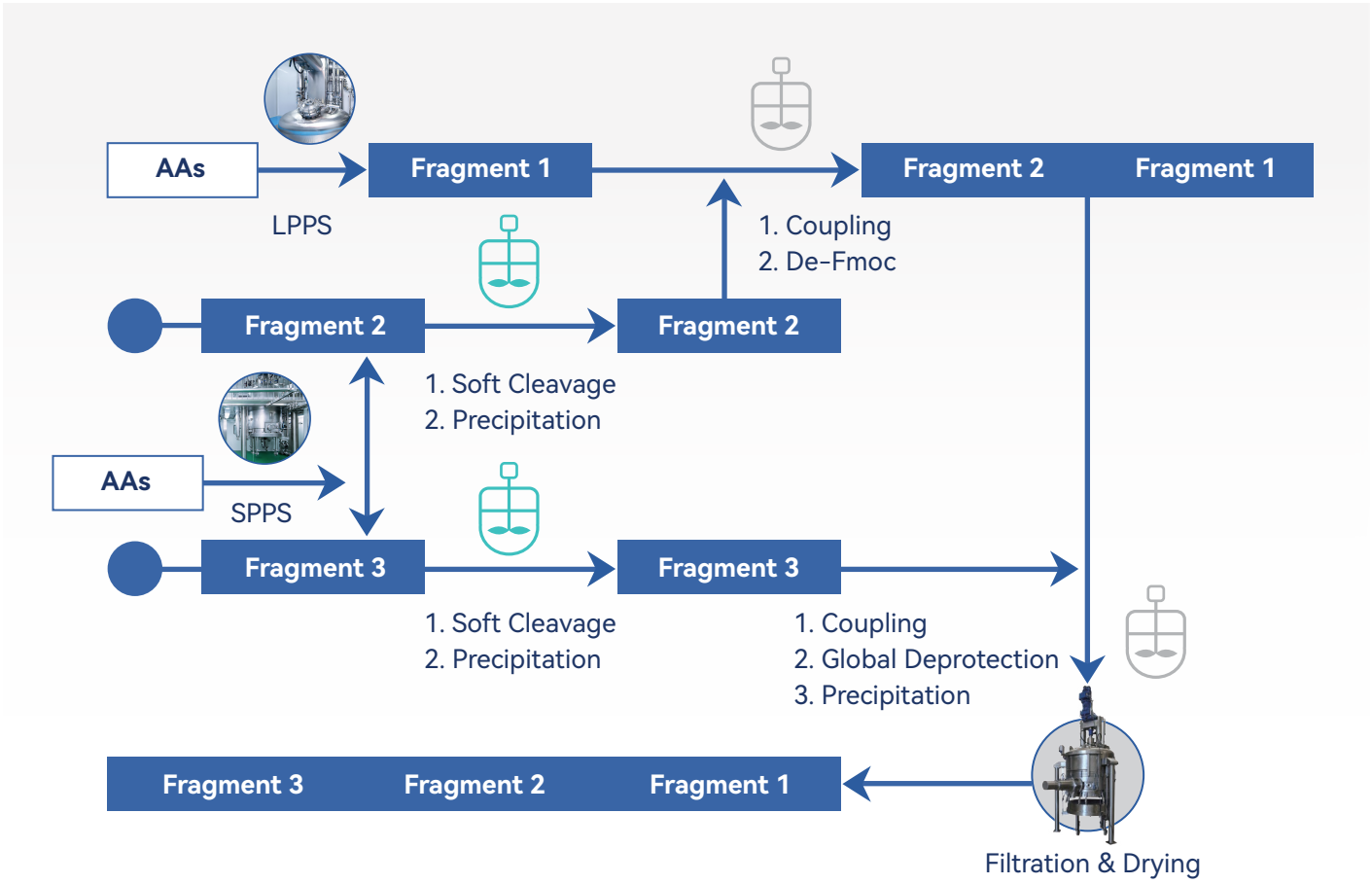


- Hundreds of unit operations
- Weeks of synthesis
- High solvent consumption

- Less coupling cycle
- Better quality control
- Reducing ~30% operation time
- Saving 50~70% solvents
- Introducing **Green** Solvent

Fragments as RSM	Coupling & Ligation		API
LPPS (up to 5mers)	SPPS	Gen 1.0	MCSGP
TAPS	LPPS	Gen 2.0 Gen 2.1: Continuous process	Precipitation
Biosynthesis	CEPS (Enzyme)	Gen 3.0 Gen 3.1: Emobilized Enzyme	Spray drying

Hybrid Peptide Synthesis



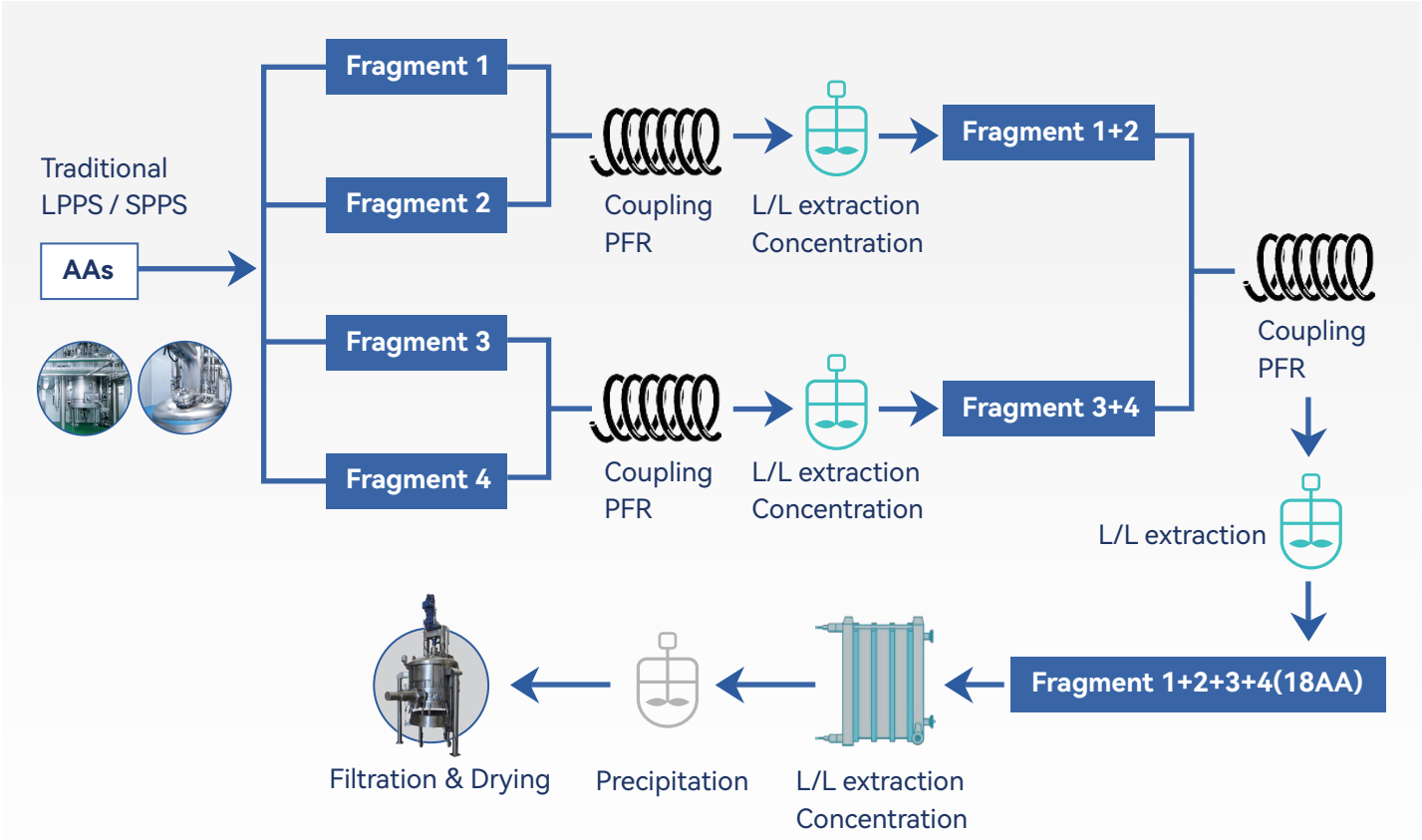
Project Experience

- 6+ IND & Later phase
- 20~40 AAs, batch size
- ≥ 96% purity
- Unknown individual impurity ≤ 0.5%

To Overcome Epimerization

- Starting material control
- Coupling agents and additives selection
- Side chain protection group
- Connection point of peptide
- Native chemical ligation/Enzymatic peptide synthesis
- Flow reaction application
- Fragment application

LPPS Flow Process



- Condensation reaction plug flow reactor (PFR)
- Continuous hydrogenation reaction
- Continuous de-protection
- Continuous nano-filtration

Advantage

- Condensation reaction time can be controlled within minutes or second
- Without intermediate purification and crystallization
- Improve manufacturing efficiency by ~15%; Reduce material cost by 35%~50%

TAG-Assisted Peptide Synthesis (TAPS)

A sustainable liquid-phase peptide synthesis platform designed for scalability, safety, and commercial readiness.

The Challenge

Solid-phase peptide synthesis hits real walls at commercial scale—poor mass transfer, excessive DMF waste, and non-linear scale-up.

The Breakthrough

Asymchem TIDES innovation team built a different way forward: a proprietary Tag-Assisted Liquid-Phase Peptide Synthesis (Tag-LPPS) platform.

Key Innovations

- Green solvent system replacing DMF with 2-MeTHF and liquid-liquid extraction
- Iterative Tag design for enhanced stability and solubility
- Scalable process innovations for De-Fmoc removal and DBF capture
- Design and characterization of proprietary coupling reagents

Impact

The platform has already been validated across multiple peptide fragments-from generic APIs to cosmetic peptides-demonstrating its readiness for commercial delivery.

From Toxic to Sustainable Solvents

Traditional solvents face increasing REACH restrictions. Modern green alternatives offer comparable reactivity with significantly reduced environmental and safety risks.

Solvent System	Greenness Profile	Reactivity / Performance	Regulatory Status
2-MeTHF/DMSO (Toluene, ACN)	Medium-High	Good solubility; TAPS and Fragment condensation	REACH Compliant
DMSO / EtOAc	Medium	Good reactivity; SPPS and TAPS	Safe / Unrestricted
CPME	High	Excellent for specific couplings	Green Alternative
DMF / NMP	Low (Toxic)	High (Industry Standard)	Restricted / Phasing Out

60 – 80%
Waste Reduction

30 – 50%
Cost Savings

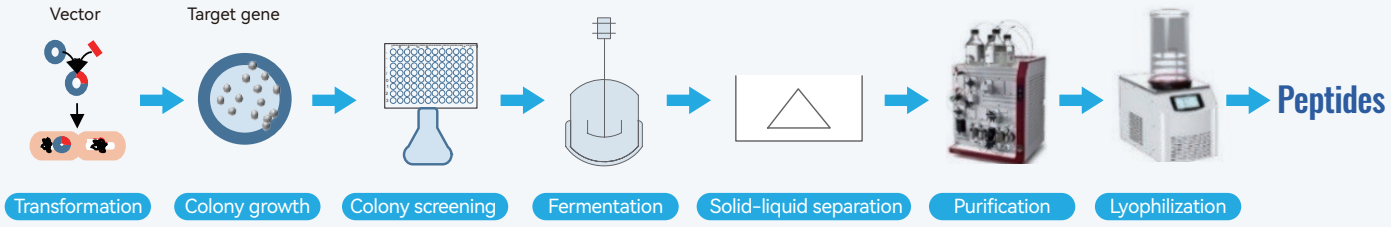
High
Supply Security

Improved
Health & Safety

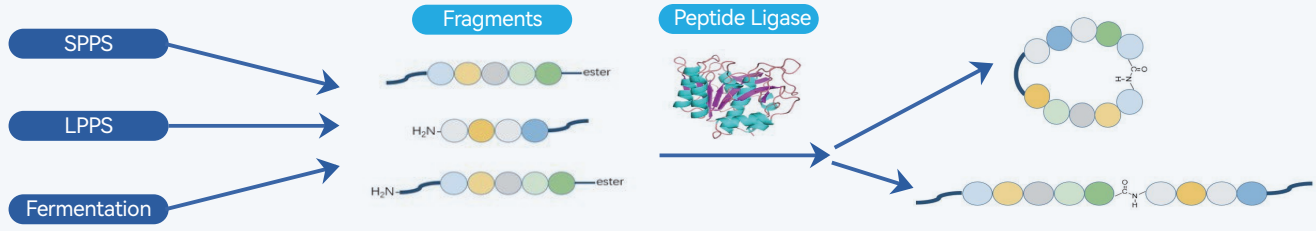
Peptide Biosynthesis

E. coli	B. subtilis	Yeast
		

Biosynthesis Workflow



Chemo-Enzymatic Peptide Synthesis (CEPS)



Key CEPS Performance Highlights

Full consumption of acyl donor with minor hydrolysis

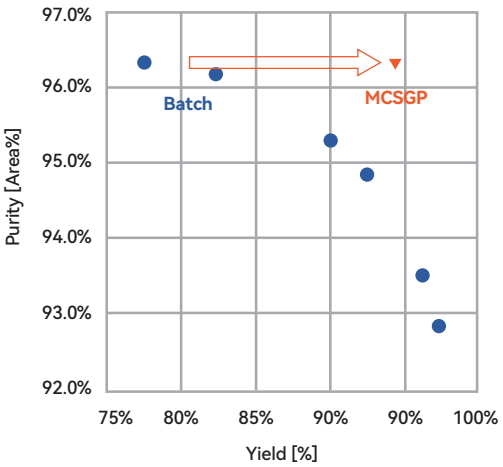
>90%
conversion

>99%
purity of API

>40%
overall yield

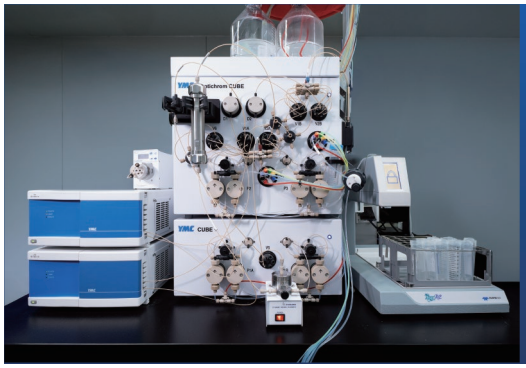
Continuous Chromatography Purification

Single Column Batch Mode	VS	MCSGP
Relies on expertise & trial-and-error	Process Robustness	Process transfer & development with predictive modeling
Yield-purity trade-off	Quality & Cost	Increase yield while keep high quality
2D-batch mode and side-cut recovery	Manufacturing Efficiency	Dramatically decrease purification time
fractionation and mock pool analysis	QC Burden	Greatly reduce the analytical burden by generating far fewer samples
Tons of solvent per kilo API	PMI	Due to increased purification yield, fewer input and less waste



MCSGP vs Batch mode (GLP-1RA)

	2D Batch mode	MCSGP	
Yield	78%	~90%	10%~15%
Productivity	0.27 Kg/h	1.62Kg/h (2D→1D purification)	X 6 Folds
	6+14 d / batch (Purification + IPC)	1+3 d / batch (Purification + IPC)	80%
IPC burden	~100 / batch	~20 / batch	80%
Overall Solvent Consumption	~2030 L/Kg	~1000 L/Kg	50%



YMC CUBE 100w

- Column ID: 10-50 mm



YMC Twin 1000

- DAC 300-600 mm

- Increasing yield while keeping high quality
- Decreasing purification time and buffer consumption
- Downsizing skid by using small column
- Saving cost and cutting PMI

Advanced Process Development

Spray Drying Process Development

Thermal Stability	Inlet Temperature	Outlet Temperature	Heat Balance Modeling	PSD Study	Scale-up
Upper Limit for Inlet Temperature	Highest Temperature in Spray Drying	A Comprehensive Consideration	For Gas Flow & Feed Rate	To Determine Atomization Conditions	Drying across Scales



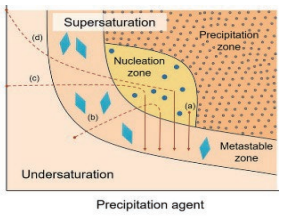
PSD-2

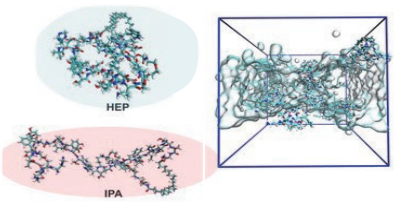


SHANGHAI OHKAWARA SCOC-25 (T)

Precipitation Process Development

Thermodynamic Research & Molecular Simulation	Precipitation Screening	Initial Condition Optimization	Dynamic Process Control	Process Validation & Scale-up

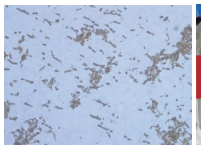




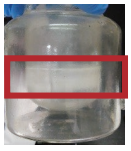
Thermodynamic studies combined with molecular dynamics

Case Outcome: Optimized Precipitation Process

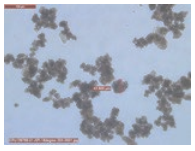
Original Process	Optimized Process
Small particle size, wall sticking and material leakage in filtration	Large aggregated particles, less wall sticking and no leakage



Microscopic image



Wall Sticking



Microscopic image



Clean Wall

Amino Acids(AA) and Unnatural Amino Acid(UAA) Supply Chain Security

100+	10+	20+	300+	100+
Dedicated Chemists	Ph.D	Dedicated Analysts	Projects experience	UAA production experience

Leveraging our green technologies, we drive cost-effective and highly secured supply chain solutions for AA & UAAs

Gen 1: Chemical Synthesis

- Broad substrate scope
- Racemization issues
- Harsh conditions
- Multi-step processes

Gen 2: Enzyme Catalysis

- Excellent stereoselectivity
- Mild & green
- High atom economy
- Enzyme Cost & Stability
- Substrate limitations
- Scale-Up Challenges

Gen 2.1: Immobilized Enzyme

- Continuous processing
- Enhanced stability
- Simplified purification
- Mass transfer limitations
- Mechanical fragility

State-of-the-Art Biotransformation Technology

8 major enzyme types with **500+** self developed variants

35+ applied in **100kg** manufacture campaigns

10 mature flow immobilized enzyme processes, scaling up for manufacturing

200+ applicable substrates

2~5MT/Month capacity for each AA/UAA

ASYMCHEM

CHINA

Asymchem Laboratories (Tianjin) Co., Ltd Headquarters

USA

ASYMCHEM INC.

UK

ASYMCHEM LIMITED

JAPAN

Asymchem Japan K.K.

Questions or inquiries please contact:

inquiry@asymchem.com

202606EN