Waters
THE SCIENCE OF WHAT'S POSSIBLE.™

ACQUITY UPLC® Technology

Transforming Lives and Laboratories for 15 Years

Charlotte Yu

Waters UPLC® Technology

Waters
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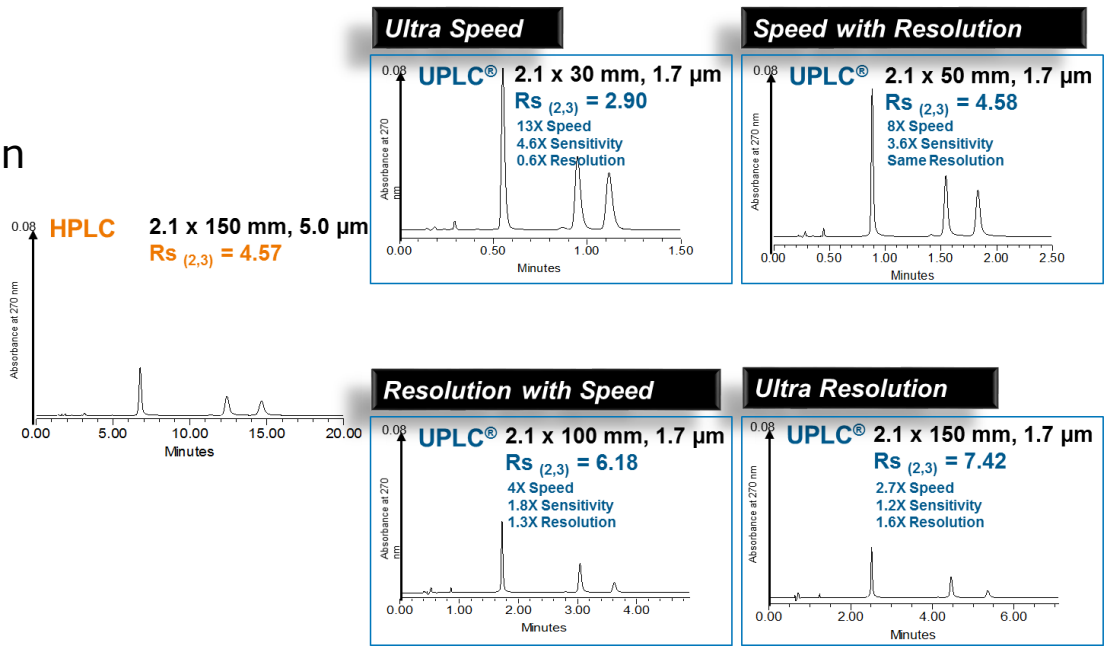
- In 2004, Waters revolutionized separation science with the introduction of Ultra-Performance Liquid Chromatography
- Waters made significant advances in instrumentation and column technology to achieve dramatic increases in resolution, speed and sensitivity
- For the first time, a holistic approach involving simultaneous innovations in particle technology and instrument design was endeavored to meet and overcome challenges of the analytical laboratory



ACQUITY® Product Family

Driving scientific achievements and breakthrough discoveries

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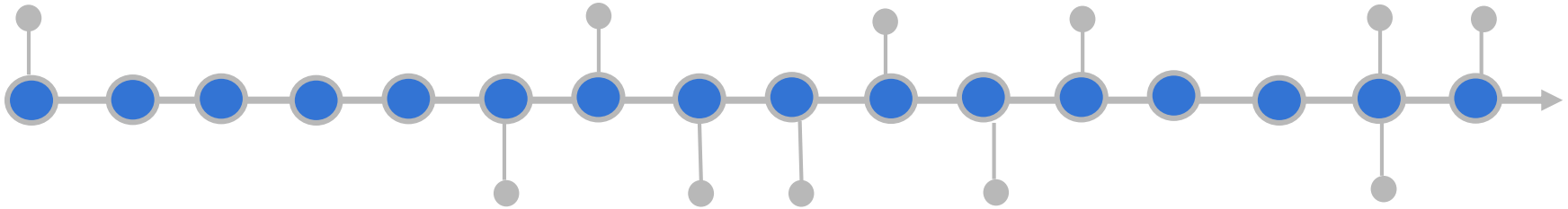

2004
ACQUITY UPLC System
Transforms expectations of labs worldwide

2009
ACQUITY System
10,000+ installations worldwide

2010
ACQUITY UPLC H-Class System
Performance that advances your lab

2011
ACQUITY UPLC I-Class System
Complex challenges, solved

2012
ACQUITY UPC2® System
First convergence chromatography system

2013
ACQUITY APC System
Next era in polymer separation

2014
ACQUITY UPLC M-Class System
Nano to microscale separations

2015
ACQUITY® Arc™ System
HPLC/UHPLC method compatibility at flip of a switch

2018
ACQUITY UPLC H-Class PLUS System
Performance that advances your lab

2018
ACQUITY UPLC I-Class PLUS System
Complex challenges, solved

2019
ACQUITY Systems
40,000+ installations worldwide

ACQUITY Product Family

General Purpose, UPLC MS, Specialized LC Systems

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General Purpose UHPLC/UPLC	UPLC MS	Specialized LC Systems
• 1.7 to 5 µm column particles • 9,500 to 15,000 psi • LC and MS detectors • Quaternary, Binary pumps • Automatic injectors	• Sub-2 µm column particles • Up to 18,000 psi • LC and MS detectors • Binary pumps • Automatic injectors	• Various column particle sizes • Wide pressure range • Range of detectors • Range of pumps • Range of injectors
ACQUITY Arc ACQUITY Arc Bio ACQUITY UPLC H-Class PLUS ACQUITY UPLC H-Class PLUS Bio	ACQUITY UPLC H-Class PLUS Binary ACQUITY UPLC H-Class PLUS Bio Binary ACQUITY UPLC I-Class PLUS ACQUITY UPLC M-Class	ACQUITY UPLC with 2D Technology ACQUITY APC ACQUITY UPC2 ACQUITY UPLC IVD

ACQUITY General Purpose UHPLC/UPLC Systems

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Versatility without compromise

ACQUITY Arc System

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- True plug-and-play method compatibility with Arc Multi-flow path technology
- Replicate your established methods
  - Accept and replicate methods from any HPLC platform
  - Auto•Blend Plus Technology for on-line blending of buffers
  - Optical and Mass Detection options designed to maximize HPLC and UHPLC performance
- Adapt methods to maximize asset utilization
  - Flexibility to maximize productivity through efficient and rapid 2.5 µm – 2.7 µm UHPLC separations
  - Accommodate larger 3.0 µm – 5 µm HPLC particles

Transform standard procedures into ultimate performance

ACQUITY UPLC H-Class PLUS Quaternary System

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- Leverage industry-leading resolution capability to improve characterization of your complex samples
- Take advantage of advanced tools that simplify and streamline your method development workflow
  - Automated column selection with up to 6, independently controlled column temperature zones
  - Optional embedded solvent select valve to access 6 additional mobile phase lines
  - Auto•Blend Plus Technology for on-line blending of buffers
  - Optical and Mass Detection flexibility for efficient peak tracking and purity assessments
- Match the need of your laboratory through support of your existing HPLC, UHPLC, and UPLC methods

Ensuring Food Ingredient Quality and Consistency

Kalsec® Business Solution

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Background	•Kalsec is the leading producer of natural spice and herb flavor extracts •Labs continually faced a very high volume of samples, ran three shifts/day •Labs tasked with both in-process and final product quality assessments •Labs utilize several techniques such as HPLC-UV, GC, titrations and wet chemistry
Challenge	•15-minute HPLC-UV/FLR assay for quantification of low-level capsaicinoids •Assay challenged with co-eluting analytes •Significant matrix interference
Solution	•ACQUITY UPLC H-Class System •ACQUITY QDa Mass Detector •Empower® 3 Chromatography Software
Business Benefits	•Improved sample throughput and productivity, with a 73% reduction in run-time to 4 minutes •Lower operating costs, with a 88% reduction in solvent consumption •Improved data quality, with the inclusion of mass detection in the new method •Accelerated pace of decision making for lot releases

Business Solution – Ensuring Food Ingredient Quality and Consistency with Novel Mass Detection Technology (720005996)

ACQUITY UPLC MS Systems

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Deliver greater precision, speed and robustness

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ACQUITY UPLC H-Class PLUS Binary System *NEW*

- Insulin assay.
- Not enough reproducibility on H-Class while plugging on I-Class.
- 4-system evaluation including Hybrid, H-Class, 1290 and Vanquish.

novo nordisk

- Open access system in Med Chem group.
- Prefer BSM for throughput and need a workhorse for large volume of samples and strong solvents.
- Hybrid system installed in May and evaluation to be finished in October.

Lilly

- Standardized on H-Class Bio Systems in 2011 with 50+ units in place including QC.
- Increasing number of peptide mapping applications since 2016 and found QSM not well suited.
- Started evaluating Hybrid Bio system in late 2017.

Genentech
IN BUSINESS FOR LIFE

- Other potentials
  - HTP analysis but of none optimal samples.
  - Quoted for Q4 order, Q1 2019 shipment.
  - Low organic shallow gradient, small molecule applications.
  - 300+ H-Class systems in house.

gsk

GILEAD

Deliver greater precision, speed and robustness

ACQUITY UPLC H-Class PLUS Binary System *NEW*

Waters
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- Combines the lowest system volume ACQUITY UPLC PLUS solvent manager (BSM) with the most robust sample manager (FTN-H) for:
  - Greater precision for long shallow gradients
  - Increased speed for high-throughput analyses
  - Improved tolerance for challenging sample matrices and harsh solvents
- Provides greater system configuration flexibility to better address the needs of select customers and applications
- Match the need of your laboratory through support of your existing HPLC, UHPLC, and UPLC methods
- Ideal binary inlet to mass spectrometry for routine LC/MS applications

What separates you from everyone else

ACQUITY UPLC I-Class PLUS System

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- Ultra efficient, narrow peaks improve the sensitivity of any mass spectrometer to enhance characterization of your complex samples
- Industry-leading ultra low dispersion and delay volumes enable ultra-efficient, rapid separations to maximize productivity
- Multidimensional UPLC configurations lead to enhanced sample characterization through selective isolation
- Heightened sensitivity through industry-leading carryover performance
- Ideal binary inlet to mass spectrometry for research LC/MS applications

Low Dispersion Detection

As low as 4 µL total system dispersion
UPLC optimized optical detection
PDA, UV/Vis, FLR, RI, ELS
ACQUITY QDa

Column Management

eCord intelligent column tracking
Active solvent preheating up to 90 °C
Up to two independent thermal zones
Support up to 150 mm lengths

Sample Manager – FTN-I / FL-I

Inject from 0.1 to 1000 µL (FTN-I)
Inject from 0.1 to 250 µL (FL-I)
≤ 0.001% Carryover
Auto-addition and Auto-dilution
Optional 7,296 capacity with Sample Organizer
Optional thermally controlled fraction collection

Binary Solvent Manager

18,000 PSI
0.001 to 2.0 mL/min
High pressure, binary mixing
Active check valves
Gradient SmartStart
Integrated solvent select valve (+2 solvents/line)
Extend selectivity with multidimensional LC

Flexible nano-scale to micro-scale UPLC

ACQUITY UPLC M-Class System

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- Delivers the most robust, reliable, and highest quality nano- to microscale UPLC separations to every laboratory performing LC/MS analyses
- Quantifies small changes in protein conformation by extending its pressure range to enable a higher efficiency separation
- Streamlines 2D-LC separations with a highly intuitive menu-driven method setup, standardized separation chemistries, and intelligent valve operation
- Provides excellent performance over a range of column sizes (75 µm to 1.0 mm) delivering outstanding results over a 170-fold range of column dimensions
- Ideal binary inlet to mass spectrometry for research LC/MS applications

Detection
UPLC optimized optical detection - PDA, UV/Vis

HDX Technology
Hydrogen Deuterium Exchange for monitoring protein conformation

IonKey/MS®
Microflow LC/MS with the turn of a key

Trap Valve Manager
Nanoscale (75µm to 150µm ID) separations
Capillary scale (300µm ID) separations
Microscale scale (500µm to 1mm ID) separations

Sample Manager – µSM-FL
Inject from 0.1 to 100 µL
Optional 7,296 capacity with Sample Organizer

Micro Binary Solvent Manager
15,000 PSI
200nL/min to 100µL/min
High pressure, binary mixing
Active check valves

A Center of Excellence for Precision Medicine

National University Hospital (NUH) Business Solution

Waters
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Background	•NUH is a Singapore-based tertiary hospital and major referral center for medical specialties •NUH participates in national research as part of an interdisciplinary network of clinical, basic science and public health companies
Challenge	•NUH was at the edge of their capabilities for work with oxidative stress, which was hindering their progress with biomarker method development •NUH's mass spectrometers didn't possess the level of sensitivity required for their assays •NUH needed to develop and validate a new sample preparation method with high recovery and with no evaporation and reconstitution steps
Solution	•ACQUITY UPLC I-Class System •Xevo® TQ-XS Mass Spectrometer •Oasis® MAX Solid Phase Extraction (SPE) Sorbents •Partnership between NUH and Waters
Business Benefits	•LC-MS/MS solution provided NUH with the ability to use reduced sample volumes •LC-MS/MS solution provided the high level of sensitivity required for biomarker discovery

Business Solution – Waters Xevo TQ-XS provides the ultimate analytical sensitivity for biomarker development (720006176)

ACQUITY Specialized LC Systems

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ACQUITY Specialized LC Systems

Waters
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ACQUITY UPLC with 2D Technology

- Offers the lowest dispersion system for maximum peak capacity with the most reliable, highest performing solvent managers and valve compartments to ensure accuracy and precision of the entire assay
- Ready-to-use configurations to get you to successful 2D UPLC experiments faster, with less troubleshooting and more confidence

ACQUITY APC

- Low-dispersion chromatographic system with fluid paths, fully optimized for solvents typically used in the aqueous and organic analysis of polymers
- Innovative RI Detector designed to specifically operate with low dispersion systems
- Innovative sub-3-µm hybrid-polymer column chemistries optimized for the analysis of aqueous and organic polymer separations

ACQUITY UPC2

- Chiral and achiral separations in one system, with unequaled speed and confidence
- The chromatographic principles and selectivity of normal-phase LC
- The ease-of-use and method development simplicity of reversed-phase LC
- Enables the use of gradients across the widest polarity range

ACQUITY UPLC IVD

- Clinical laboratories now have access to the selectivity, sensitivity, and versatility of LC-MS/MS analysis not seen using traditional techniques
- Eliminates significant time and cost per sample
- Benefit from Waters' patented sub-2-µm hybrid particle chemistry
- Waters follows internationally recognized standards with respect to its medical devices

A CRO Advances Polymer Characterization with UHPLC SEC

Intertek Business Solution

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Background

- Intertek is a global provider of quality and safety services
- Intertek's Allentown, PA facility is an ISO 17025 laboratory that provides advanced analytical expertise and capabilities for chemical and materials analysis and R&D
- Laboratory employs diverse techniques including chromatography, mass spectrometry, failure analysis, rheology and spectroscopy to analyze many sample types

Challenge

- Increased demand for polymer analysis services and increased sample diversity
- Faced some inherent limitations with gel permeation chromatography techniques including:
  - Particles greater than 5µm which compromise resolution
  - Large system volumes of conventional GPC which require large diameter columns to mitigate band spreading, which can lead to resolution deterioration

Solution

- ACQUITY Advanced Polymer Chromatography System
- ACQUITY APC Columns
- Empower 3 Chromatography Data Software

Business Benefits

- Solvent equilibration times reduced to 4 hours from 24 to 48 hours (with conventional GPC)
- Revenue increased from ability to pursue more exploratory analyses
- Better characterizations for the presence of low molecular weight oligomers
- Greater productivity (ease of use); lower operating costs from reduced solvent consumption

Business Solution – A CRO Advances Polymer Characterization with Ultra High Performance SEC (720005566)


ACQUITY UPLC
H-Class Plus System
ACQUITY ARC
BIO System
ACQUITY UPLC
H-Class PLUS
BIO System
ACQUITY UPLC
M-Class System
ACQUITY UPLC
I-Class Plus System
ACQUITY ARC
System
ACQUITY APC
System
ACQUITY UPLC
Systems with
2D Technology
ACQUITY UPLC
System
ACQUITY QDa
Mass Detector
ACQUITY PATROL
UPLC Process
Analysis System
ACQUITY UPC²
System
Maximized Uptime
MORE CONFIDENCE
Acquity
UPLC™
Enhanced precision and sensitivity
GET MORE DONE, FASTER

Waters

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ERA