

microFAST SingleCell

Complete Solution for Single Particle and Single Cell ICPMS Applications

Automated sample introduction system for Agilent ICPMS

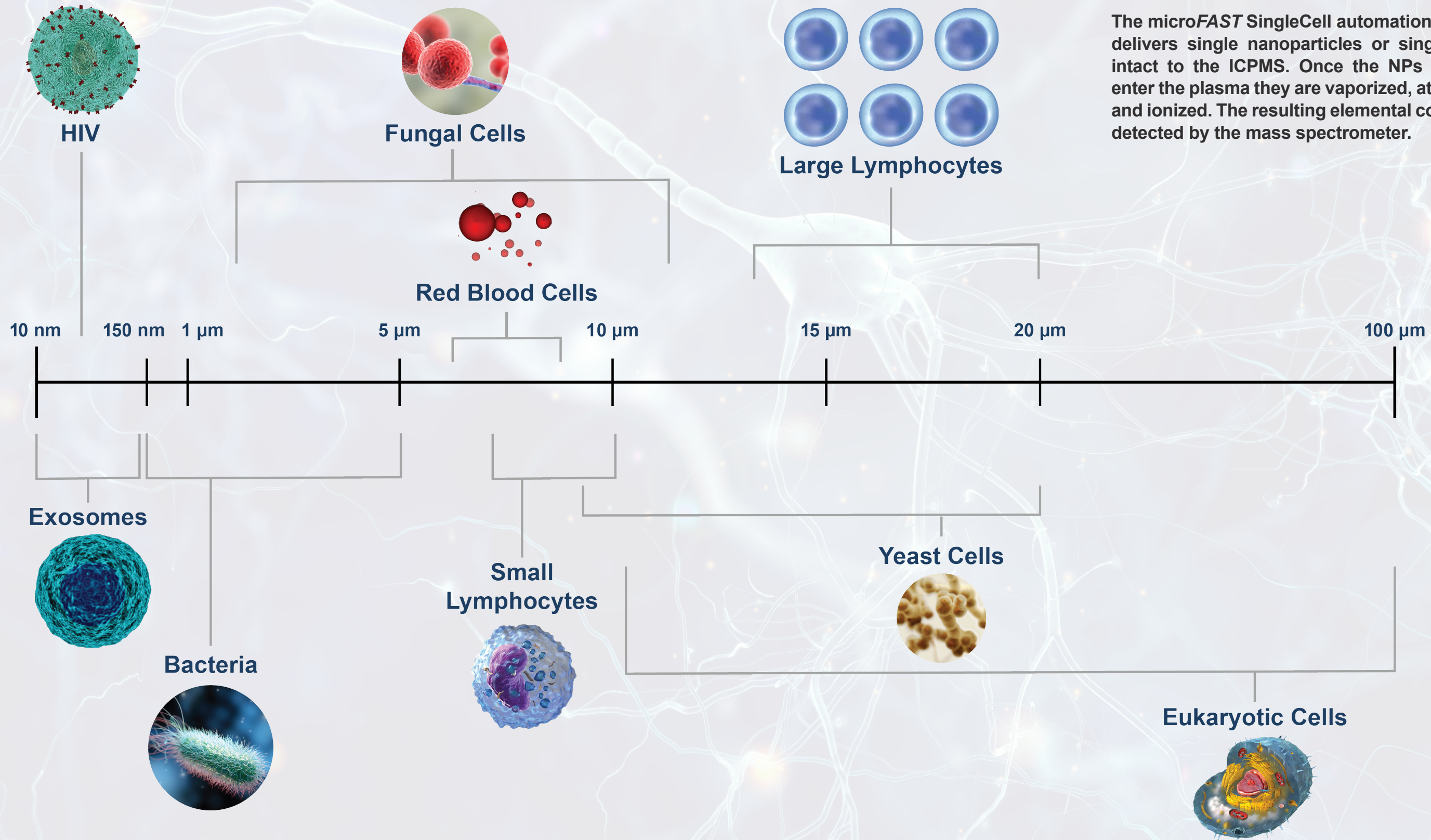


Learn More

Biological Size Scale

Biological Size Scale

The microFAST SingleCell automation system delivers single nanoparticles or single cells intact to the ICPMS. Once the NPs or cells enter the plasma they are vaporized, atomized, and ionized. The resulting elemental content is detected by the mass spectrometer.



Single Cell ICPMS

The ability to introduce single cells into an ICPMS and measure the elemental content in each cell, or tagged to each cell, accurately takes a dedicated, well-designed sample introduction system. Having this ability allows for investigators to better understand how much of a specific nanoparticle, metallodrug, or metal-based compound enters the cell. These cells or nanoparticles will vary in size from a few nm's up to a few 100 μ m's. The typical cell types of interest will vary and with that the stability of the cell-line also varies, such that a gentle, controlled nebulization must be employed in order to not disrupt or lyse the cell.

Single Cell ICPMS Requirements

- Flexible sample volumes – μ L to mL of sample
- Ensure cells stay intact, no cell lysing
- Low pressure sample introduction
- High transport efficiency

Elemental Scientific has developed a complete sample introduction system designed specifically for single cell and nanoparticle applications. This system consists of:

- **microFAST SingleCell Autosampler**
- **CytoNeb** – single cell nebulizer
- **CytoSpray** – single cell spray chamber
- **One-piece Torch** – ICPMS torch for simple, direct connection



microFAST SingleCell

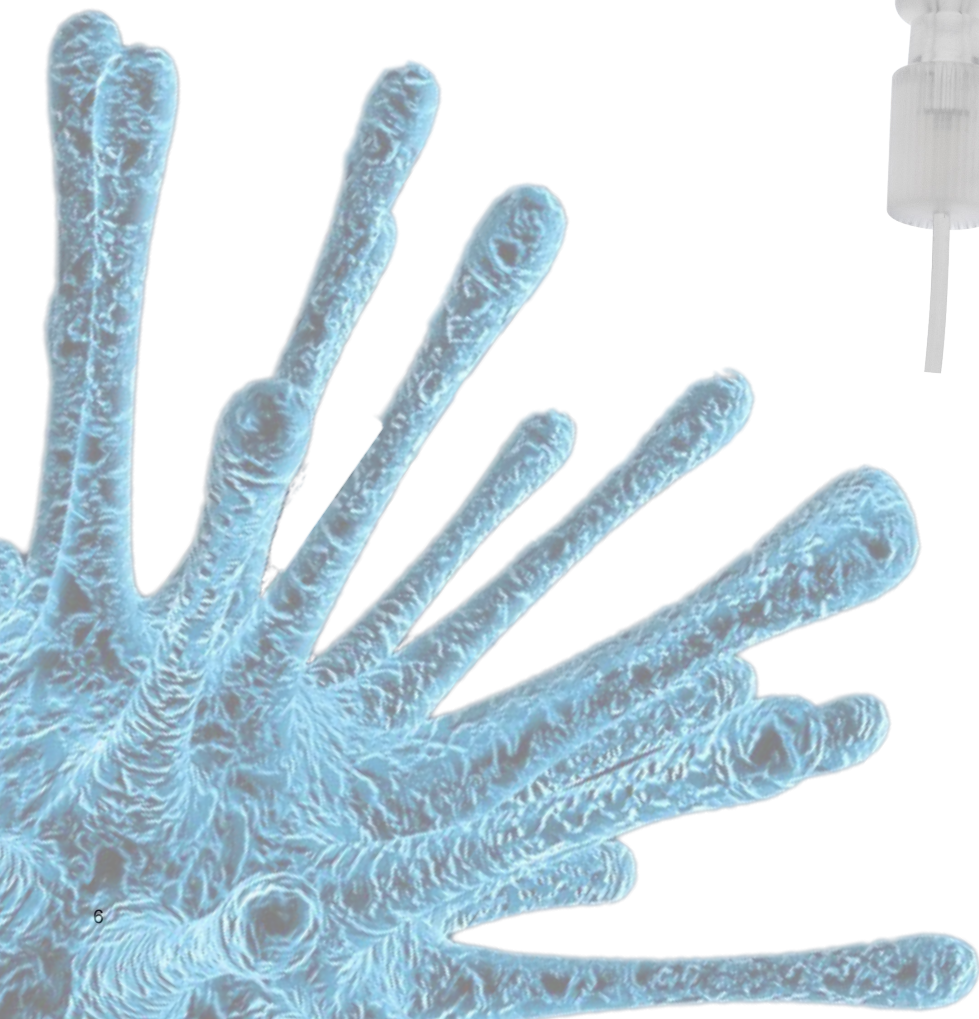
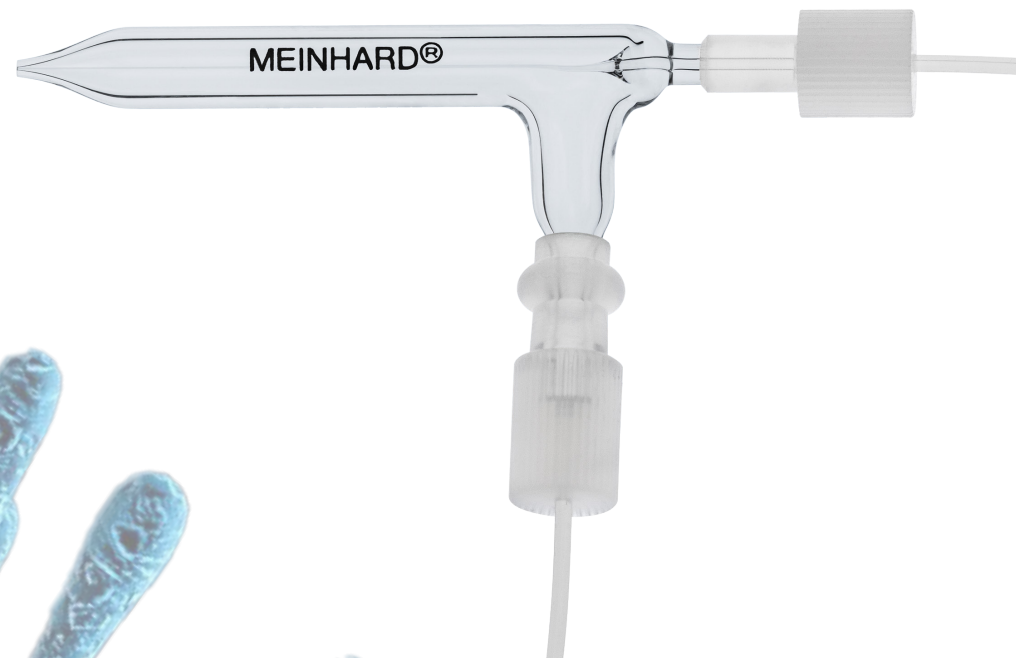


microFAST SingleCell Automated
Sample Introduction System for Agilent ICPMS
Part Number: MF-SC2-79

CytoNeb and CytoSpray

CytoNeb

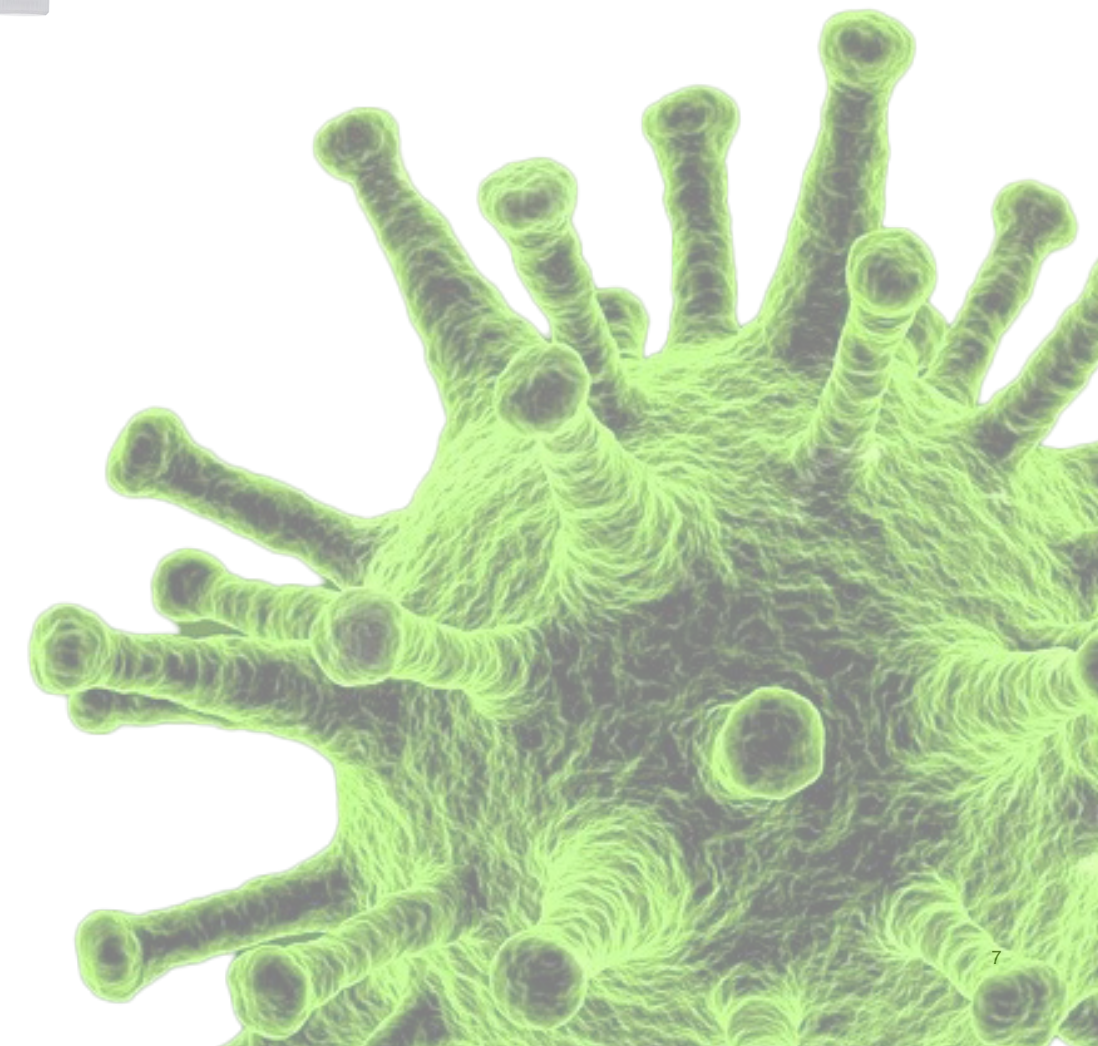
- Meinhard high efficiency nebulizer
- Designed to efficiently nebulize single cells without cell rupturing
- Low internal volume
- Low backpressure (1-50 $\mu\text{L}/\text{min}$ = <50 psi)
- Low dead volume
- Patented inert PFA quick connects for nebulizer gas and samples lines



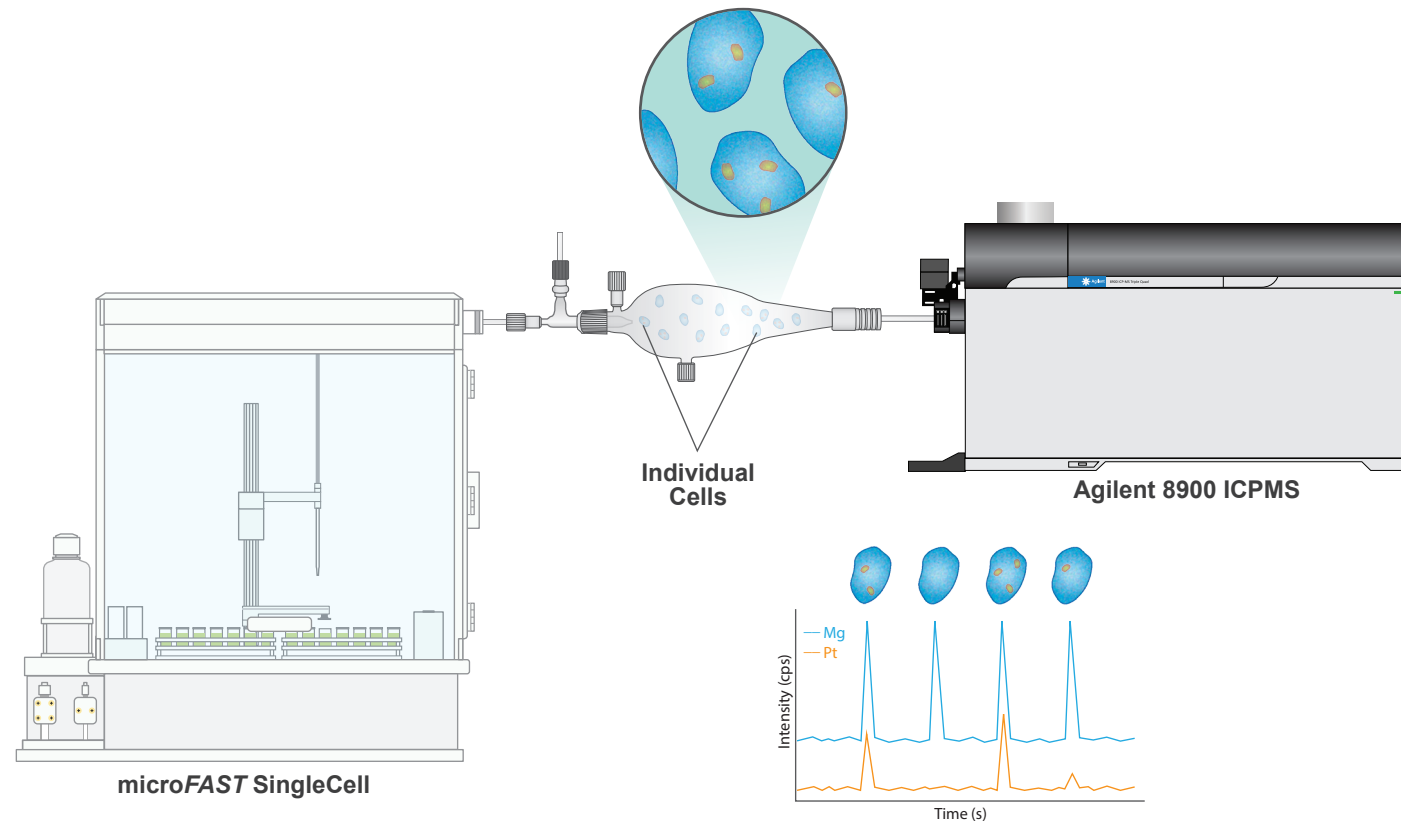
CytoNeb and CytoSpray

CytoSpray

- Spray chamber designed specifically for single cell and nanoparticle applications
- High-transport efficiency
- Separate make-up gas for better transport efficiency
- Includes one-piece ICPMS torch for simple and direct connection to the CytoSpray

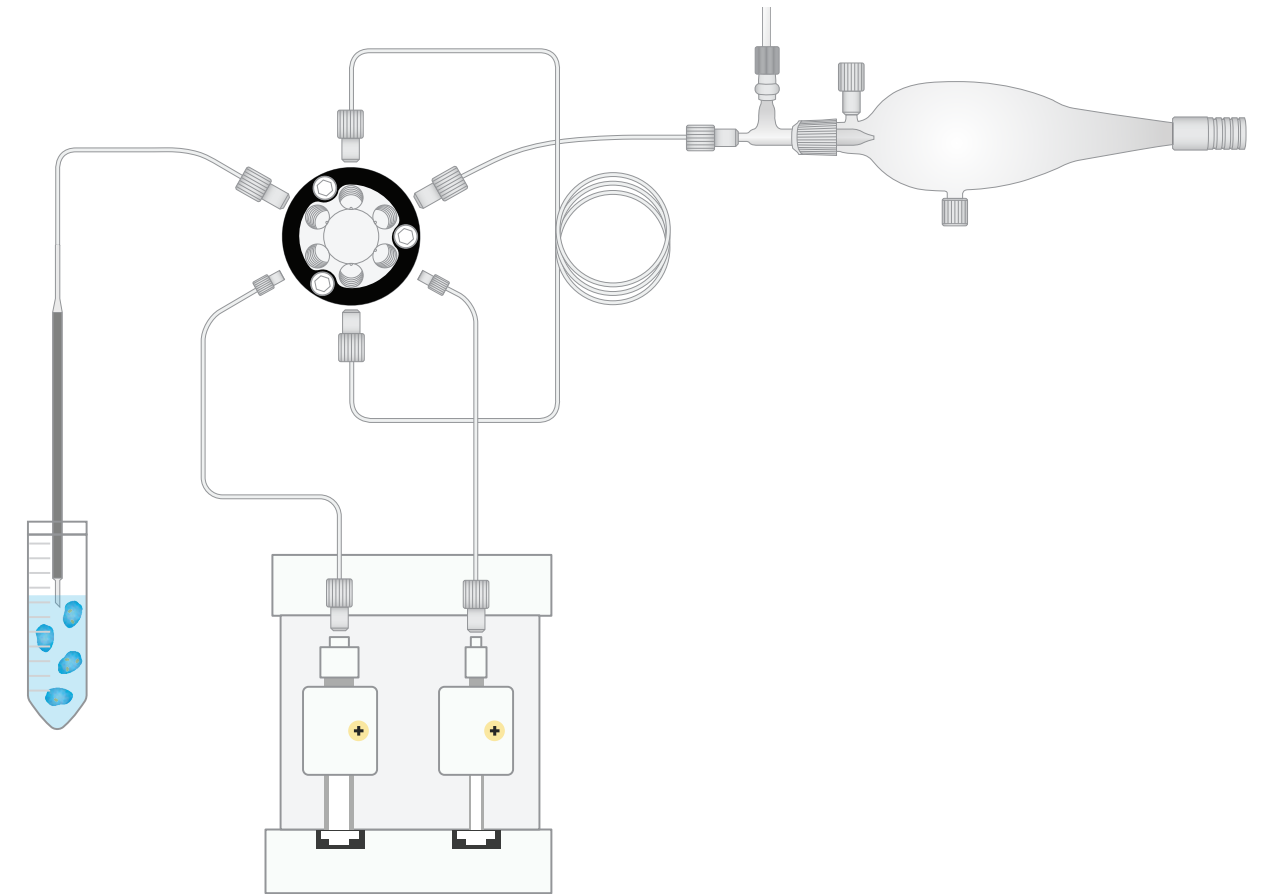


microFAST SingleCell System



Simple Schematic of the setup for measuring Pt in cells

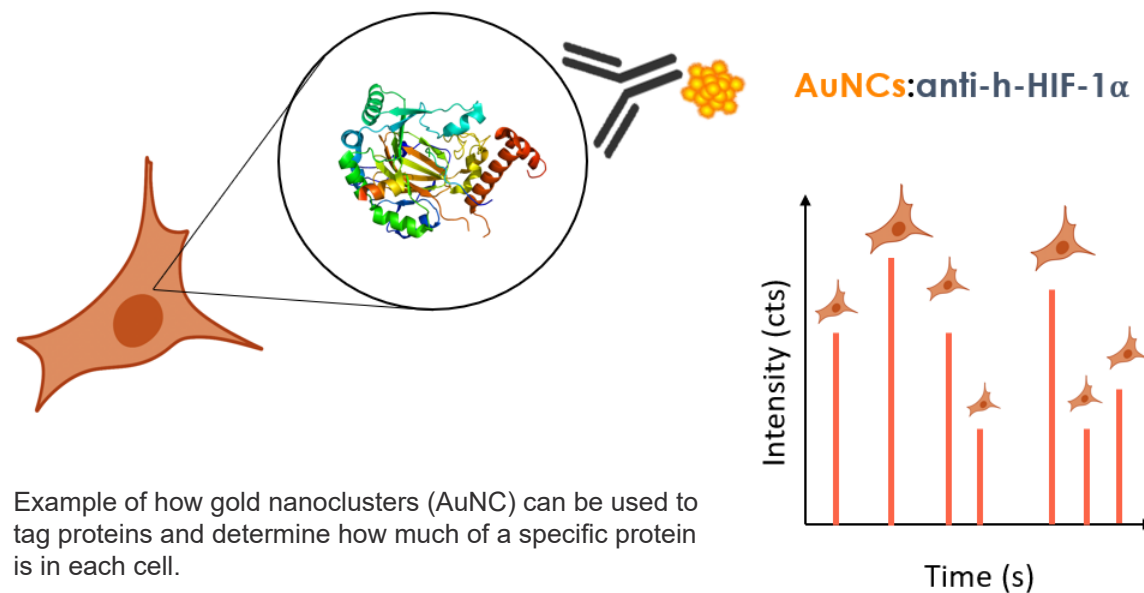
microFAST SingleCell System



microFAST SingleCell flow path with syringe carrier and sample loading

The microFAST SingleCell system has been built for performance by optimizing the inner diameter (ID) and line lengths to ensure a quick sample transfer from vial to ICP torch.

- Fast sample-to-sample times. For example, at 20 $\mu\text{L}/\text{min}$ flow rate:
 - <3 min, when utilizing a 30 s ICPMS measurement time
 - <4 min, when utilizing a 100 s ICPMS measurement time
- High-flow sample loop washout
- Simple conversion for total metal analysis using FAST system
 - Vacuum or syringe sample loading
 - Micro or large sample volume capabilities



Agilent Method Setup

Nanoparticle Mode Options

MassHunter Method Wizard

Single Particle Analysis Configuration
Set parameters for Single Particle Analysis.

Sample Pump Tube ID: 1.02 mm

Sample Inlet Flow: 0.010 ml/min

Response Factor Calibration Solution:

Ionic Standard Concentration at 197 u: 1.000 ppb

Reference Material: Custom

Reference Element Mass: 197 u

Mean Reference Particle Diameter: 27 nm

Reference Material Density: 19.32 g/cm³

Concentration of Reference Material: 50.0 ng/l

Unknown Sample:

Target Element Mass: 197 u

Analyte Mass Fraction: 1.000

Particle Density: 19.32 g/cm³

Buttons: < Back, Next >, Done, Cancel

Analysis Setup

MassHunter Method Wizard

Analysis Mode
Select appropriate Analysis Mode. Also make the following changes to radio button selections.

Conventional Analysis

Spectrum/TRA
Spectrum: Conventional Mass Spectra are acquired.
TRA: Conventional Time Resolved Data are acquired.

Nanoparticle

Single Element / Isotope
Single Particle Analysis using fast TRA mode.

Rapid Multi-Element Nanoparticle Analysis
Fast Time Program Analysis for multi-element nanoparticle.

2 Elements / Isotopes
Average element/isotope ratios of multiple particles.

FFF ICP-MS
Particles acquired using conventional TRA mode after separation by FFF.

To continue, click Next.

Buttons: < Back, Next >, Done, Cancel

Agilent Method Setup

Sample List

File Edit View Instrument Hardware Startup Batch Queue User Tune Tools Help

Hardware Plasma Tune Batch Queue Data Analysis Report

Instrument Status

Error: 6/11/2021 11:08:22 AM 1222. Error: Large or small top Cover opened.

IF/BK Press 1.49E+0 Pa Water RF/WC/IF 0.00 L/min MU./Dil. Gas 0.00 L/min Reflected Power 0 W

Batch - NP TestLb

Save Batch Add to Queue Validate Method Import Sample List Autosampler Nebulizer Pump Speed

Acq Method Data Analysis Method Sample List

Estimated Time for Batch Acquisition: 3670.000 sec

	Skip	Sample Type	Sample Name	Comment	Vial#	File Name	Replicates
1	<input type="checkbox"/>	IonicBlk	Blank		1		
2	<input type="checkbox"/>	IonicStd (AN)	1ppb Au in 2%HNO3		2		
3	<input type="checkbox"/>	IonicStd (RM)	1ppb Au in 2%HNO3		2		
4	<input type="checkbox"/>	RM	50nm Au nano part		3		
5	<input type="checkbox"/>	Sample	Sample 1		1101		
6	<input type="checkbox"/>	Sample	Sample 2		1102		
7	<input type="checkbox"/>	Sample	Sample 3		1103		
8	<input type="checkbox"/>	Sample	Sample 4		1104		
9	<input type="checkbox"/>	Sample	Sample 5		1105		
10	<input type="checkbox"/>	Sample	Sample 6		1106		
11	<input type="checkbox"/>						
12	<input type="checkbox"/>						

Example Histogram

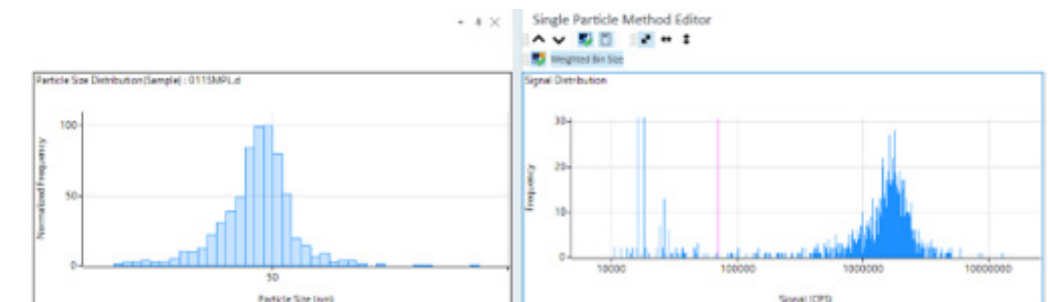
50nm Pt

Average 1329

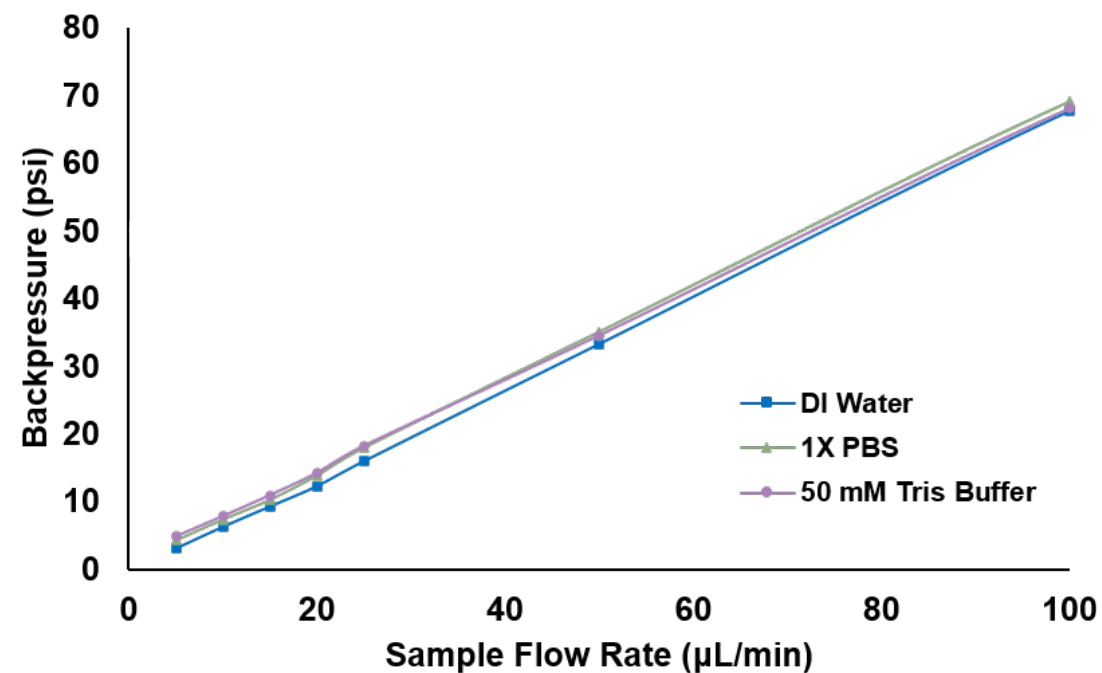
STD. Dev. 31

%RSD 2.3

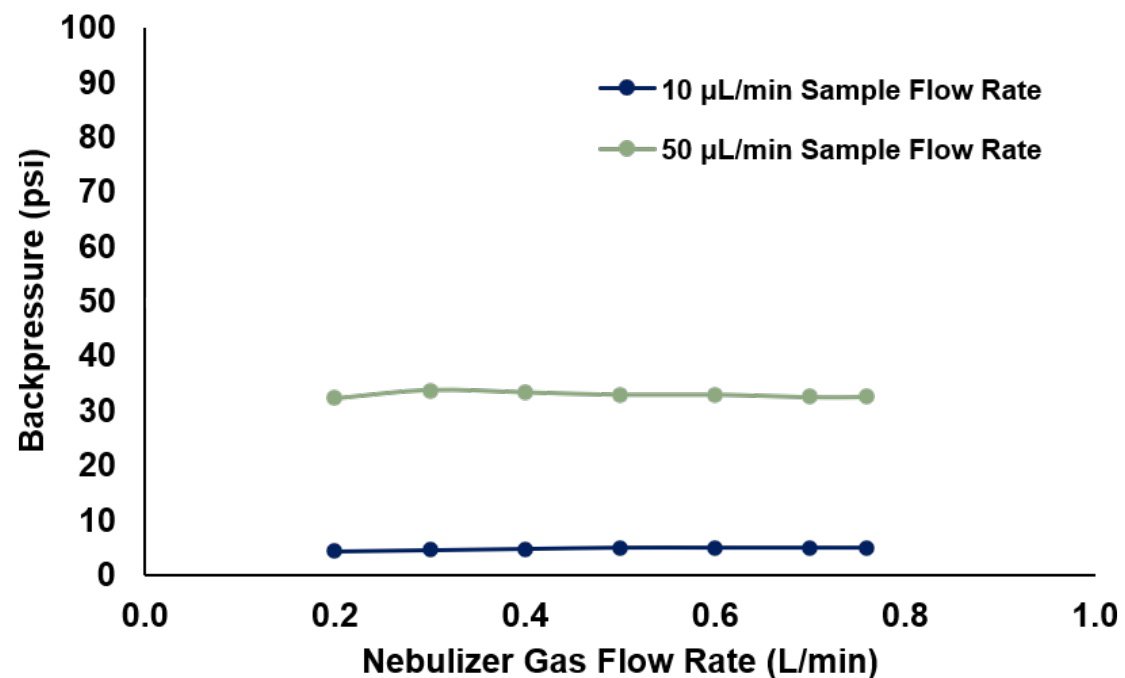
Size 47



Single Cell Introduction Kit Performance



Backpressure was recorded for each sample flow rate using DI water, 1X PBS, or 50 mM Tris buffer as the carrier solution. Larger ID tubing can be substituted to achieve lower backpressures.

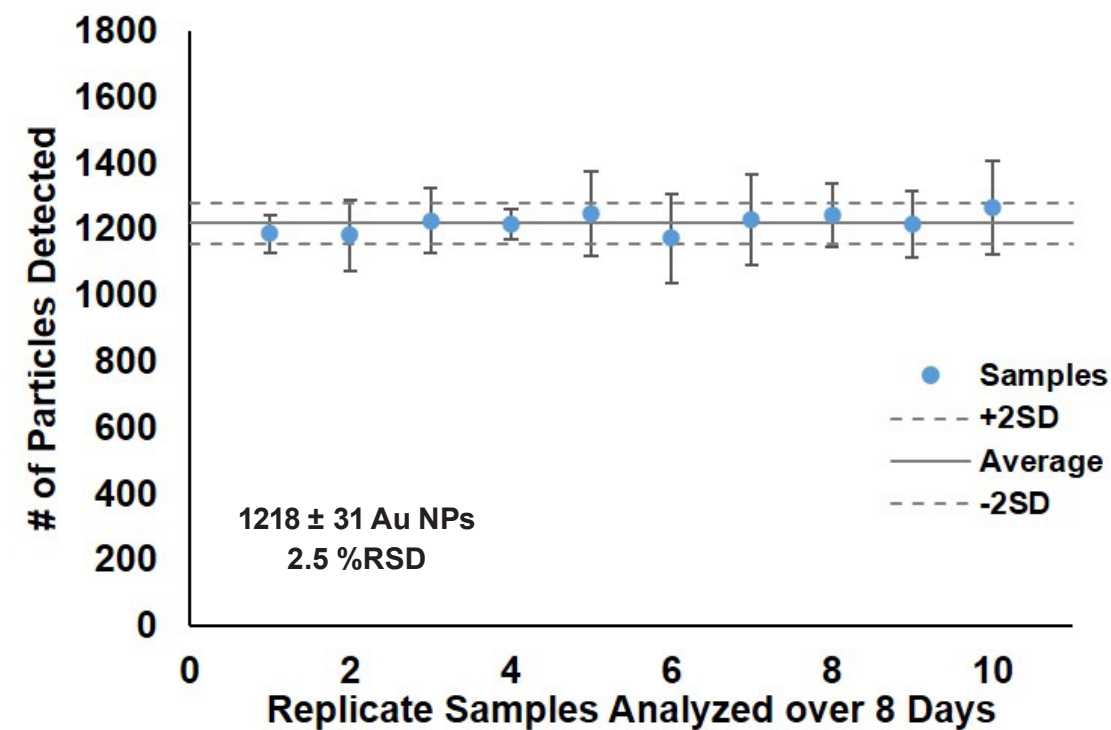


Backpressure was recorded for varying nebulizer gas flow rates using 10 and 50 µL/min sample flow (DI water as the carrier solution).

Nanoparticle Performance

50 nm Au NPs

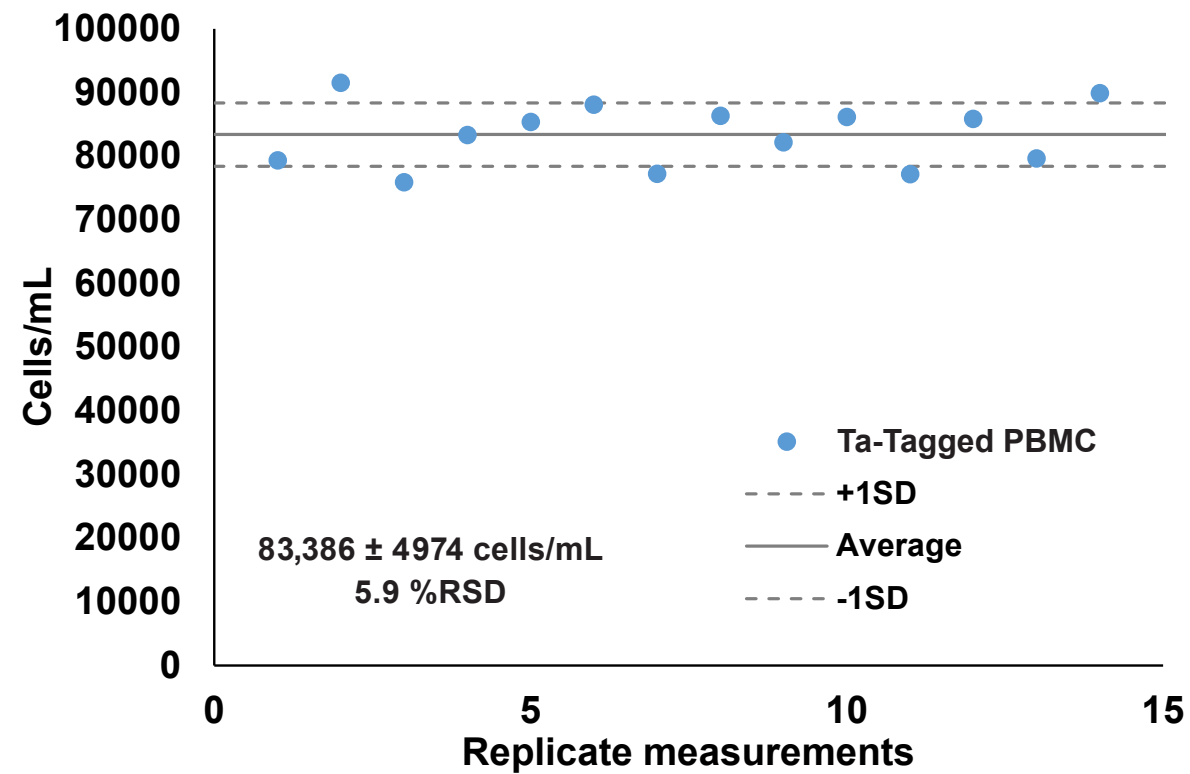
Typical Transport Efficiency for 50 nm Au NPs = ~80% or greater



Ten 50 nm Au NPs were prepared under the same conditions and analyzed over an 8-day period. Samples were sonicated before each day's analysis. Data points represent the average response for each sample over the 8 days. Error bars represent ± 1 standard deviation (SD) over the 8 days. The plot above shows the average response for all data points and the ± 2 SD.

Single Cell Performance

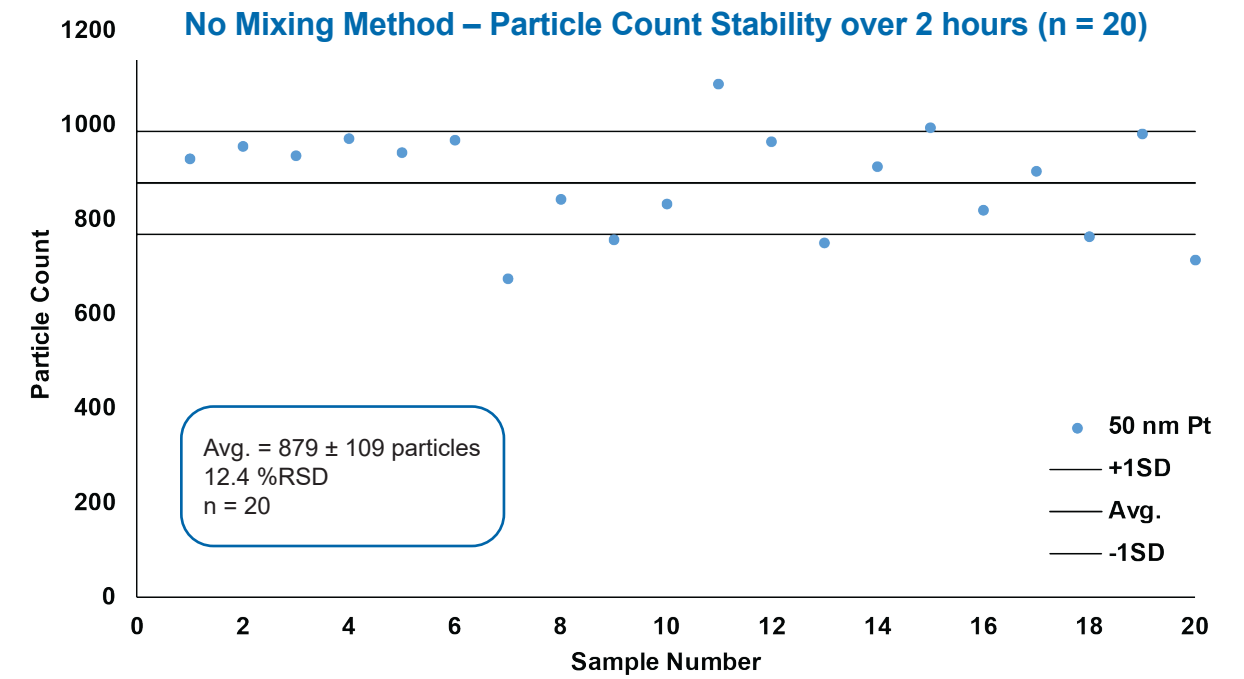
Ta-Tagged PBMC



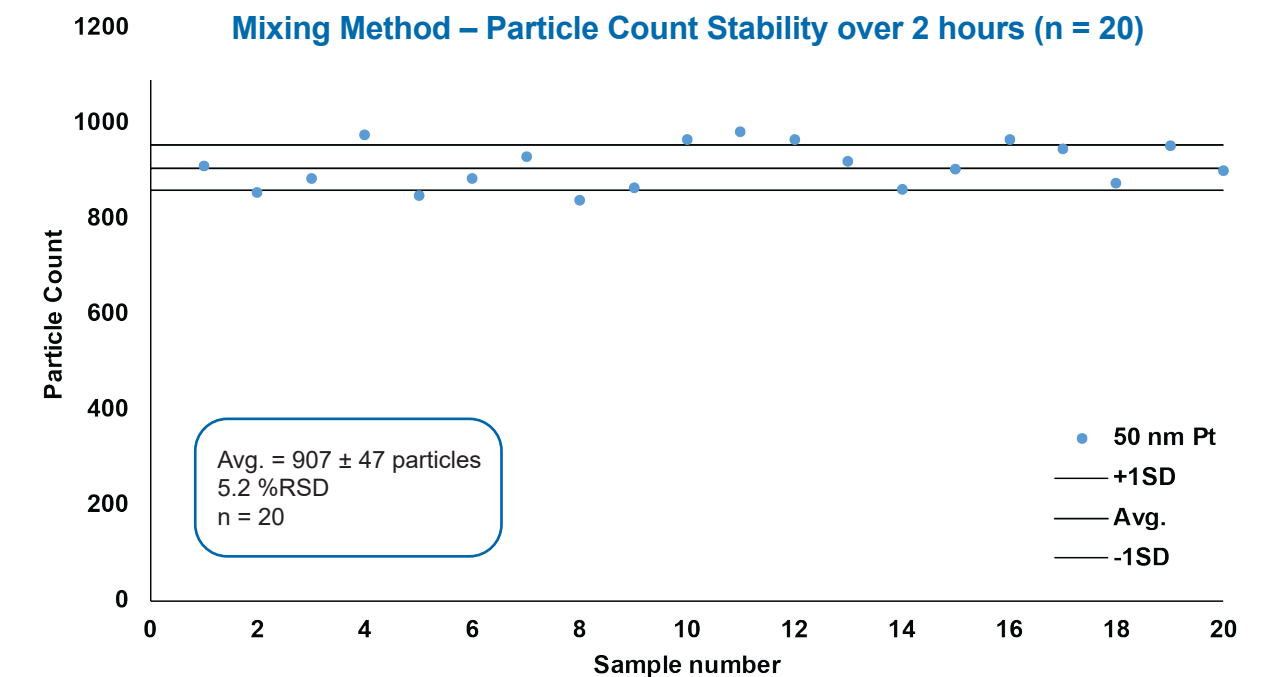
PBMC = peripheral blood mononuclear cell

Ta-Tagged cells were prepared in PBS buffer. The plot above demonstrates replicate measurements from a single sample. Cell transport efficiency will vary depending on cell type and cell stability.

Advantage of the microFAST's Sample Mixing Method



Particle count for 50 nm Pt NPs analyzed over a 2 h time period from 20 identically prepared samples in separate vials using the no mixing method. The analysis time was set to ensure the 20 samples took 2 h to complete.



Particle count for 50 nm Pt NPs analyzed over a 2 h time period from 20 identically prepared samples in separate vials using the mixing method. The analysis time was set to ensure the 20 samples took 2 h to complete.

microFAST SingleCell Features

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Optional ULPAclean 10 Filter

- Removes 99.9995% of airborne particles

AutoAlign Arm

- Self-realigns after encountering capped sample tube

Exhausted Enclosures

- Three side easy access doors

Carrier and Working Solution

Sample Containers

- 0.5 mL vials to 30 mL tubes
- Microplates

Syringes

- High precision syringes
- Stable injection at low flow rates (e.g. 10 μ L/min)

PTFE Autosampler Deck

CytoSpray

- Specifically designed for single cell and nanoparticle applications
- Designed for high-transport efficiency

One-piece ICPMS Torch

- Simple and direct connection to CytoSpray

CytoNeb

- Low backpressure and dead volume
- Unmatched nebulization efficiency

Magnetic SnapValves

Fluoronetic Rail

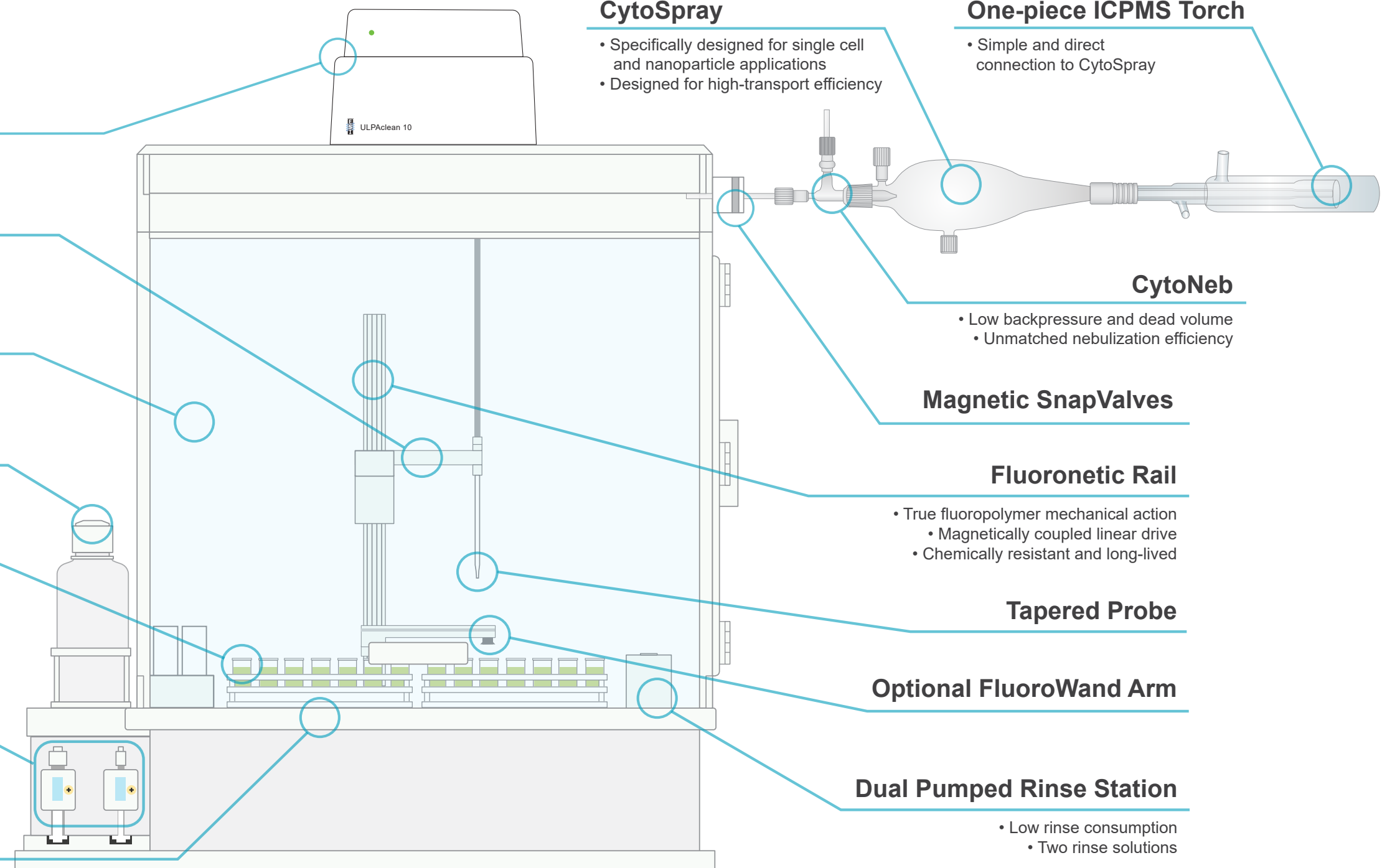
- True fluoropolymer mechanical action
- Magnetically coupled linear drive
- Chemically resistant and long-lived

Tapered Probe

Optional FluoroWand Arm

Dual Pumped Rinse Station

- Low rinse consumption
- Two rinse solutions



microFAST SingleCell Autosampler

System

microFAST SingleCell Autosampler

Part Number

MF-SC2-79

Sample Introduction Kit

Single Cell Sample Introduction Kit for Agilent 7900/8900

CytoNeb 50-79
CytoNeb 50 Meinhard Glass Nebulizer with PFA Gas Line

T20-79
One Piece Torch/Injector for Single Cell 2 mm injector ID, quartz

SC-CytoC-79
CytoSpray Chamber for Agilent 7900/8900

ES-2501-PPF2
CTFE peripump fitting, female, barbed

ES-2501-PPM2
CTFE peripump fitting, male, barbed

ES-2044-0005
CytoSpray Chamber Drain Line

S250825
CytoSpray Chamber Make-Up Gas

S033254
PFA CytoNeb Sample Line with barbed connection to Peripump

ES-4397-3019
PVC Flared Tubing, 3-stop, 0.19 mm ID, (orange/red/orange), 12/pk

ES-4398-4130
Santoprene Tubing, 3-stop, 1.30 mm ID, (gray/gray/gray), 12/pk

MF-5037-3151-060
Manual Sampling Line, 0.15 mm ID

ESI Elemental Scientific

Kit

Single Cell Sample Introduction Kit for Agilent ICPMS

Part Number

SC-SI-79

Total Metals Upgrade Kit

microFAST SingleCell (MFTM-0370-79)
Total Metals Upgrade Kit

(MPP-038-F-PVC)
MP2 Peripump Tubing Flared (org/grn) 12/pkg

(ICN50-79)
PFA ICN Nebulizer

(SC-0318-02)
Sample Loop, Fluoropolymer, 200µL

(SC-0318-05)
Sample Loop, Fluoropolymer, 500µL

(SC-0318-10)
Sample Loop, Fluoropolymer, 1 mL

(SC-5037-4502-C)
Carrier Probe Line Kit

ESI Elemental Scientific ph: 402.991.7800 | fax: 402.991.7799 | sales@icpms.com | www.icpms.com

Kit

Includes ICN50-79 nebulizer to use with instrument standard spray chamber to run FAST sample analysis on the microFAST SingleCell autosampler

Part Number

MFTM-0370-79



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