Elemental Scientific

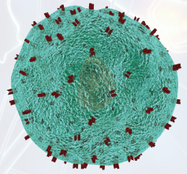
microFAST SingleCell

Complete Solution for Single Particle and Single Cell ICPMS Applications

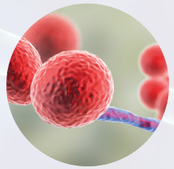
Automated sample introduction system for Thermo ICPMS

Learn More

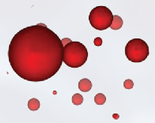
Biological Size Scale



HIV



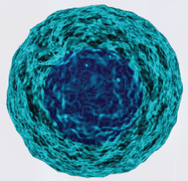
Fungal Cells



Red Blood Cells

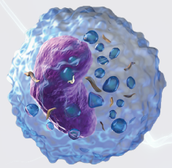
10 nm | 150 nm | 1 µm | 5 µm | 10 µm

Exosomes



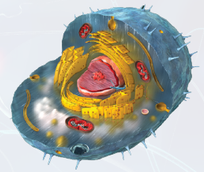
Bacteria

Small Lymphocytes



Yeast Cells

Eukaryotic Cells



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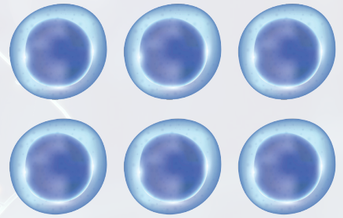
Biological Size Scale



Large Lymphocytes

15 µm | 20 µm | 100 µm

The micro*FAST* 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

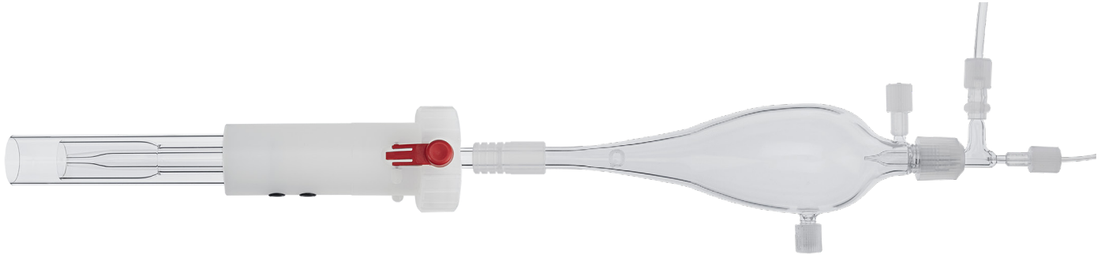
The ability to introduce single cells into an ICPMS and measure the elemental content in each cell, or tagged to each cell, accurately takes a dedicated, well-designed sample introduction system. Having this ability allows for investigators to better understand how much of a specific nanoparticle, metallodrug, 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 µm'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 – µL 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:

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



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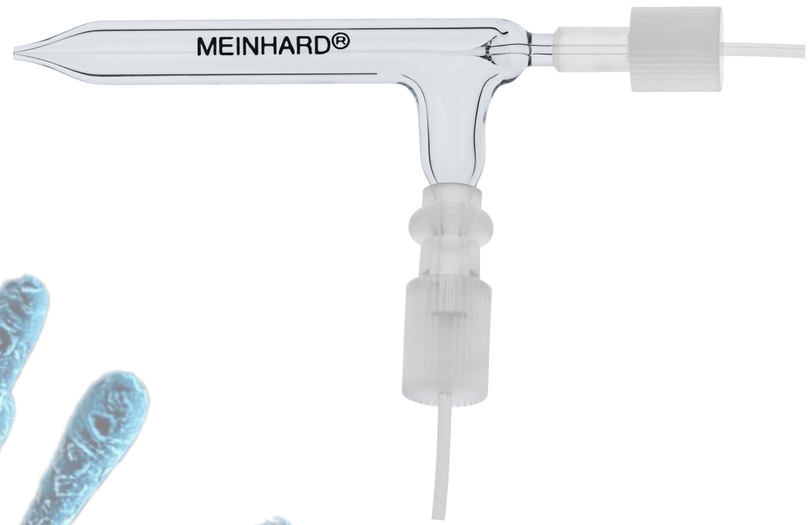
micro*FAST* SingleCell

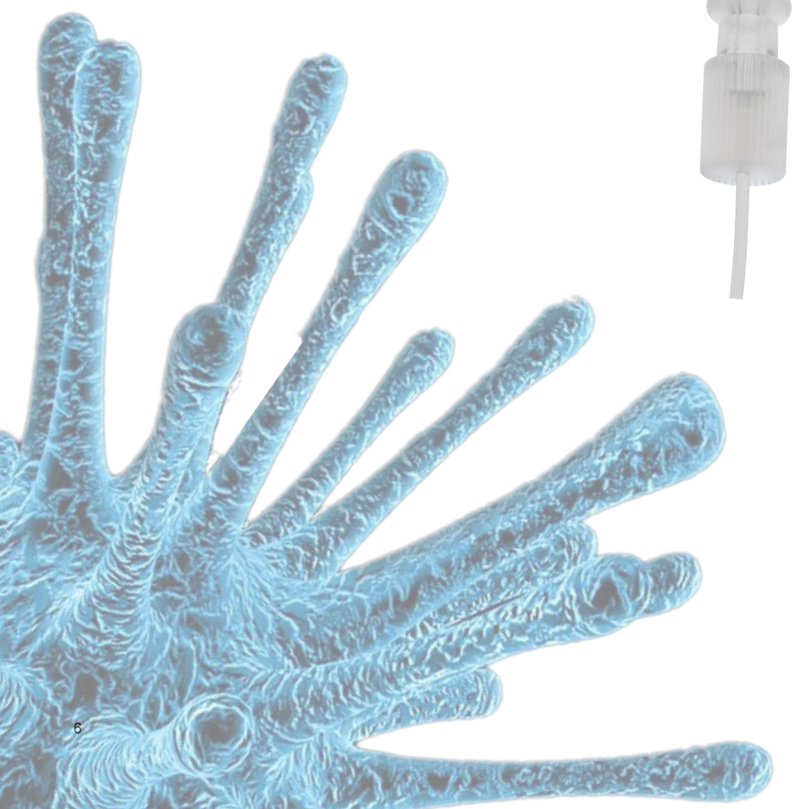
micro*FAST* SingleCell Automated
Sample Introduction System for Thermo ICPMS
Part Number: MF-SC2-73

CytoNeb and CytoSpray

CytoNeb

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





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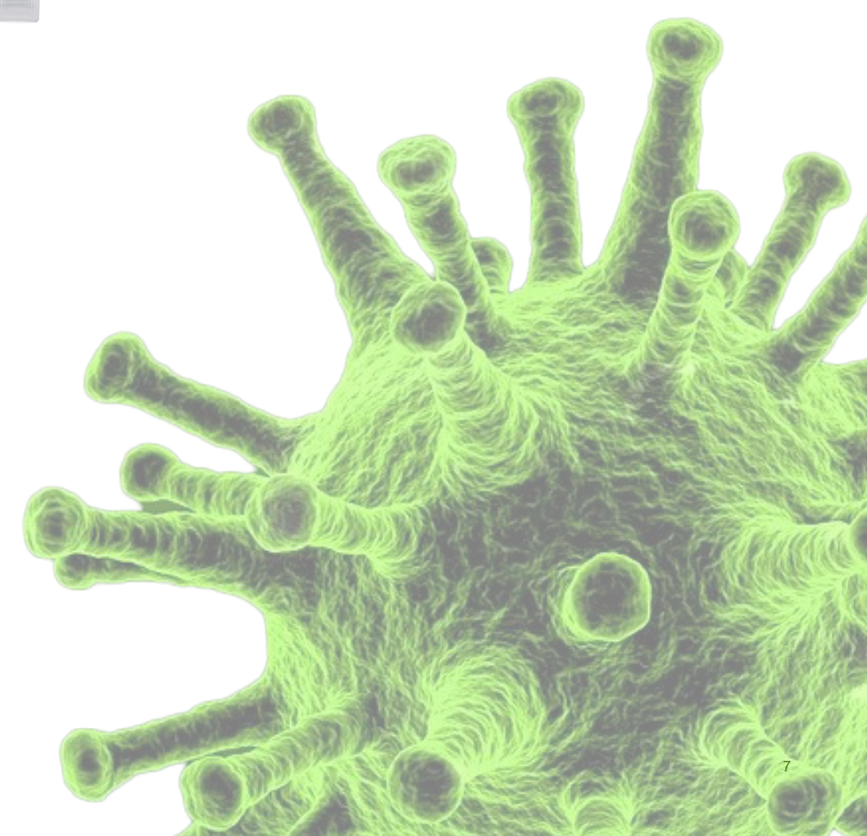
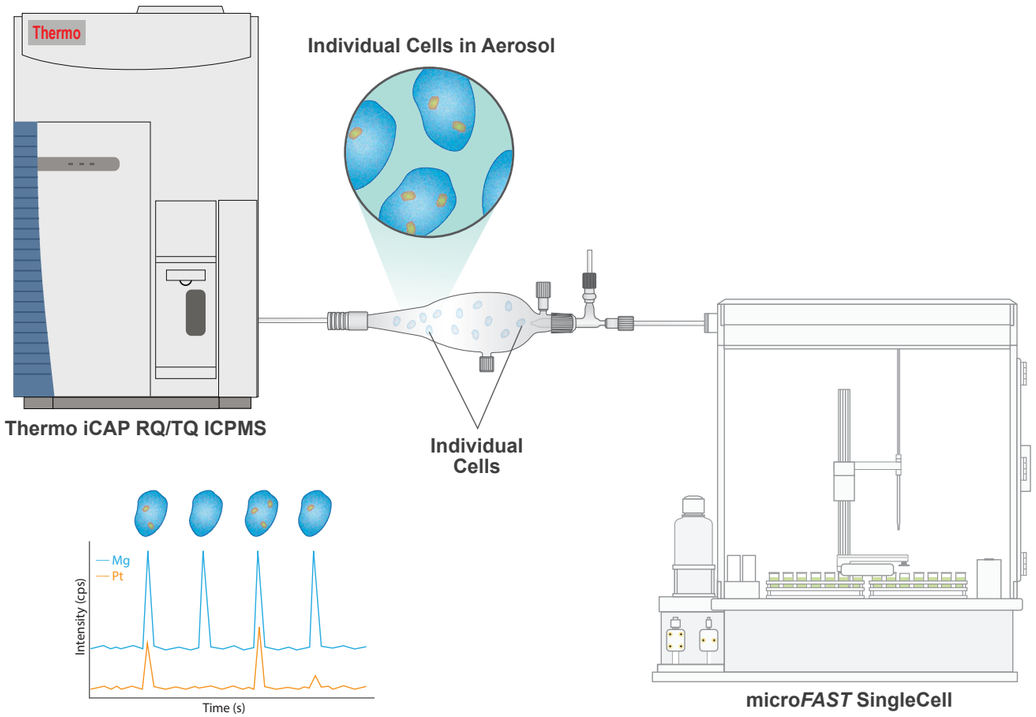
CytoNeb and CytoSpray

CytoSpray

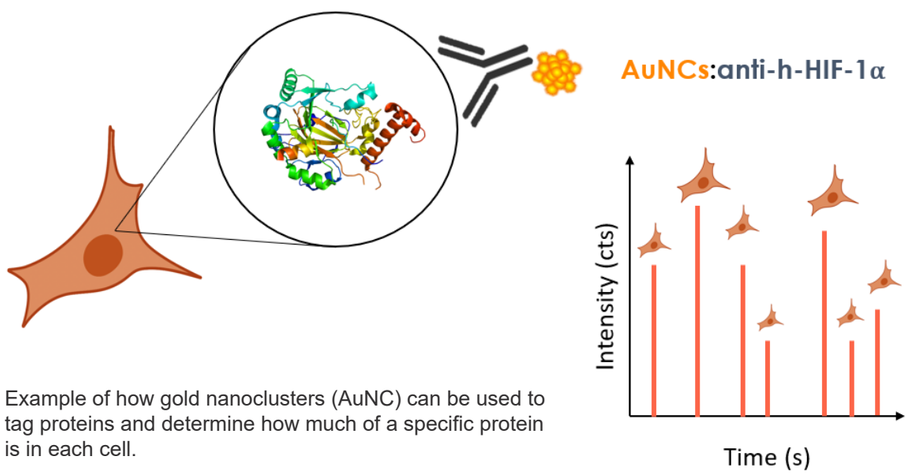
- Spray chamber designed specifically for single cell and nanoparticle applications
- High-transport efficiency
- Separate make-up gas for better transport efficiency
- Includes one-piece ICPMS torch for simple and direct connection to the CytoSpray



microFAST SingleCell System



Simple Schematic of the setup for measuring Pt in cells



Example of how gold nanoclusters (AuNC) can be used to tag proteins and determine how much of a specific protein is in each cell.

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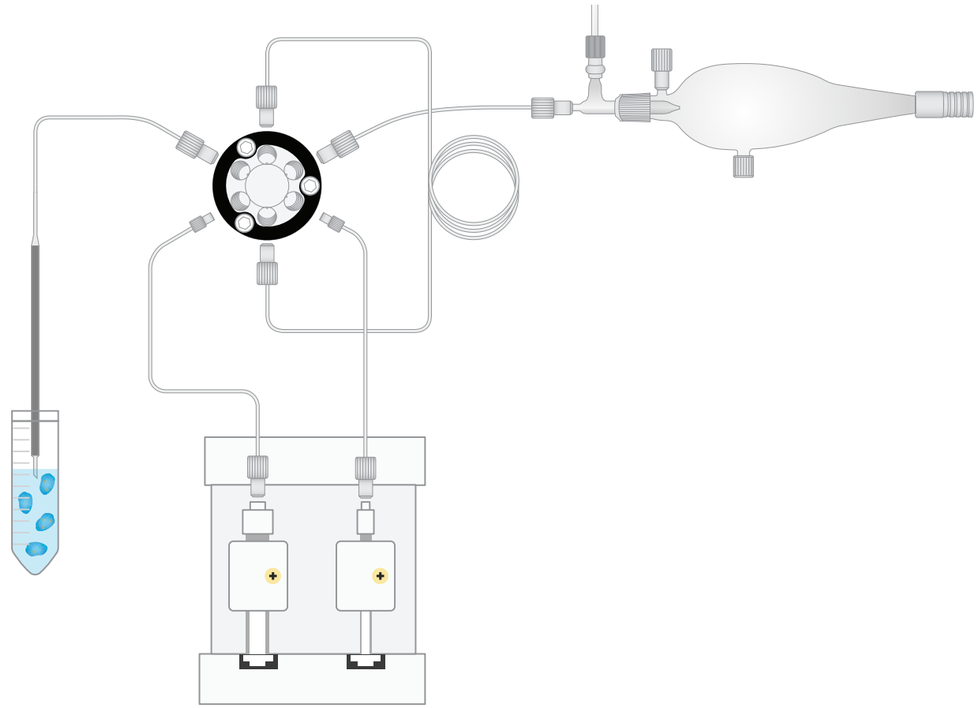
microFAST SingleCell System



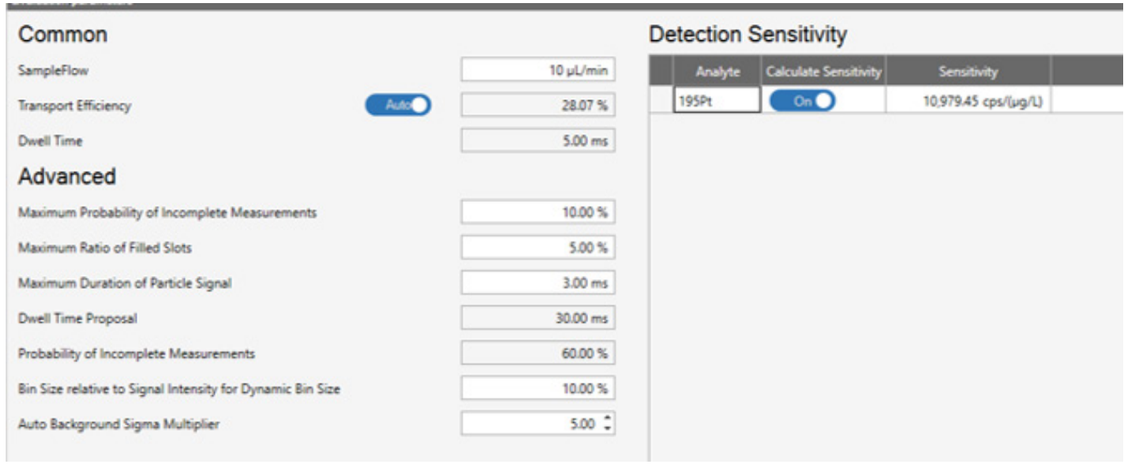
microFAST SingleCell flow path with syringe carrier and sample loading

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.

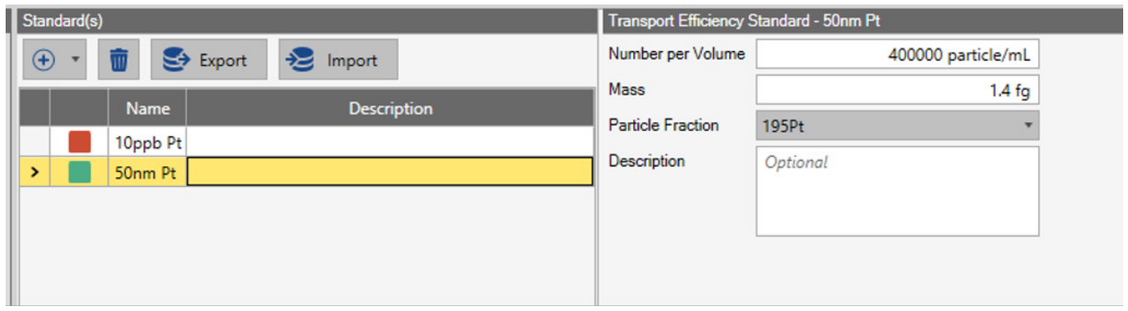
- Fast sample-to-sample times. For example, at 20 µL/min flow rate:
  - <3 min, when utilizing a 30 s ICPMS measurement time
  - <4 min, when utilizing a 100 s ICPMS measurement time
- High-flow sample loop washout
- Simple conversion for total metal analysis using *FAST* system
  - Vacuum or syringe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

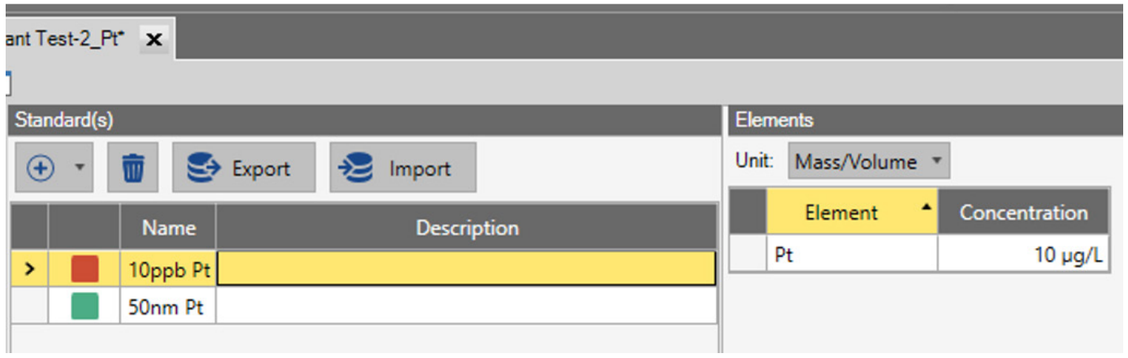
Thermo Method Setup

Analysis Options



Define Standards





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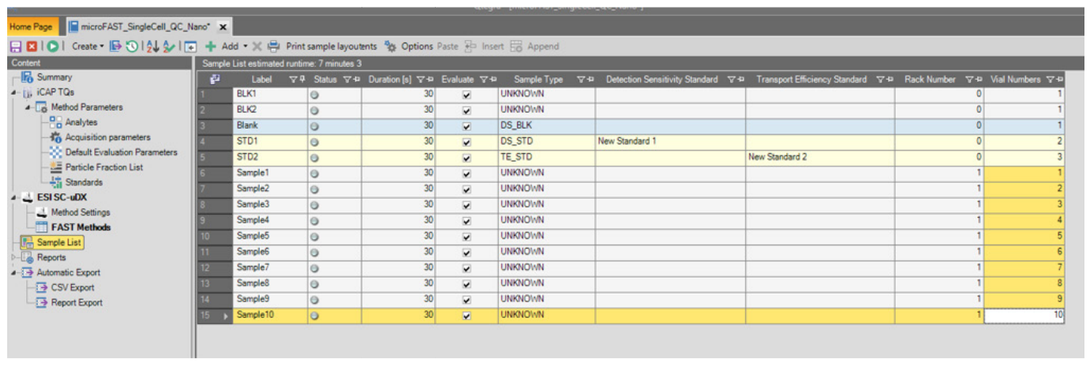
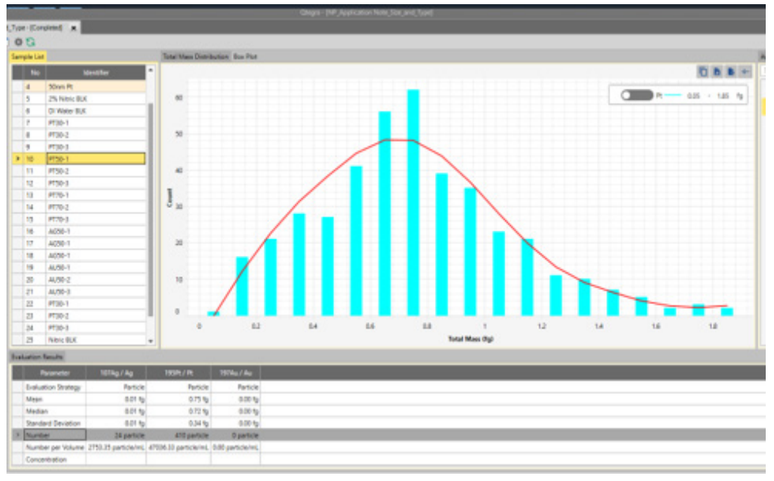
Thermo Method Setup

Sample List

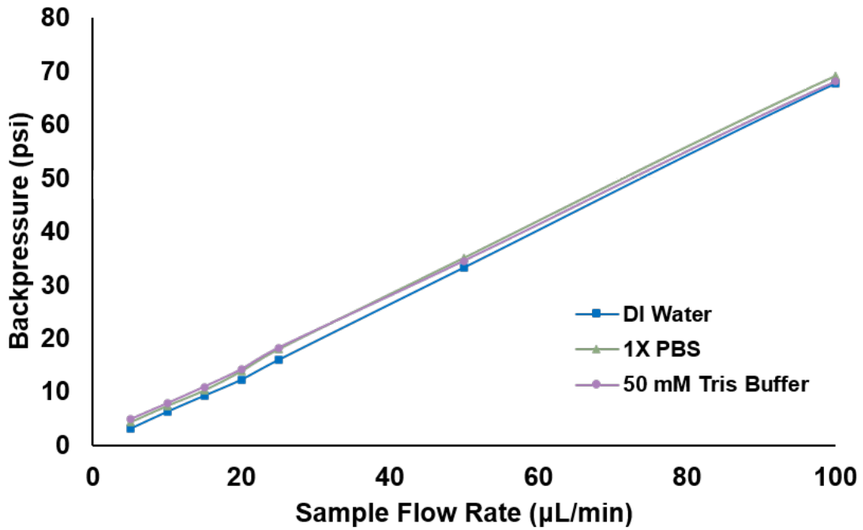


Example Histogram

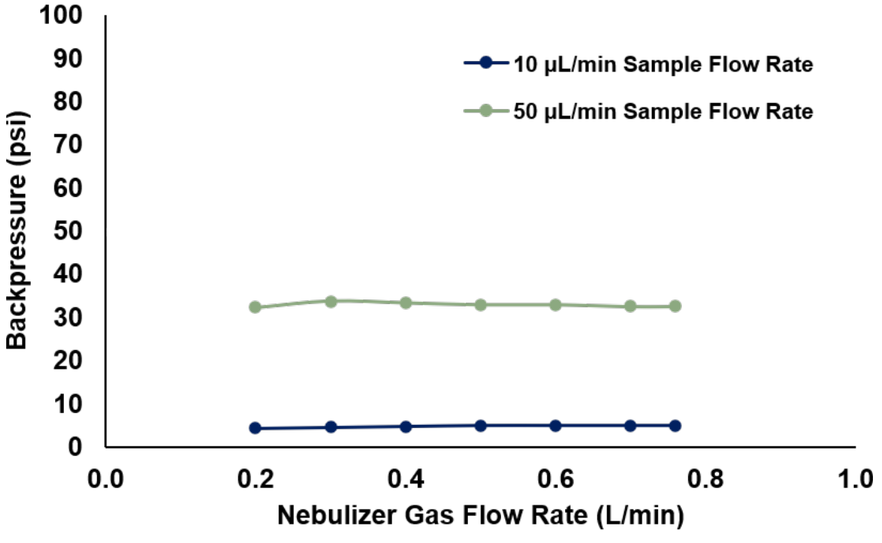
50nm Pt	Mean Size (nm)
Run 1	45.2
Run 2	44.8
Run 3	45.0
Average	45.0
STD Dev.	0.2
%RSD	0.5



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).

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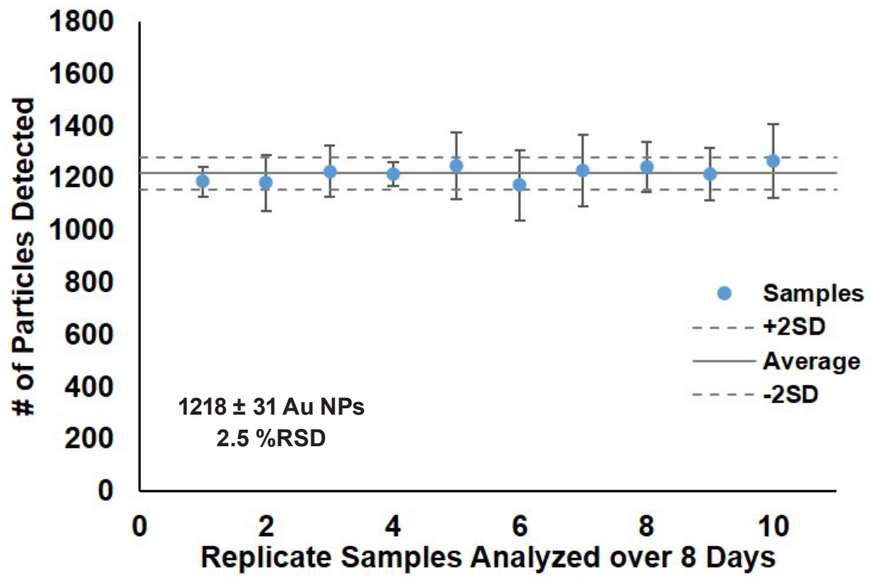
Nanoparticle Performance

50 nm Au NPs

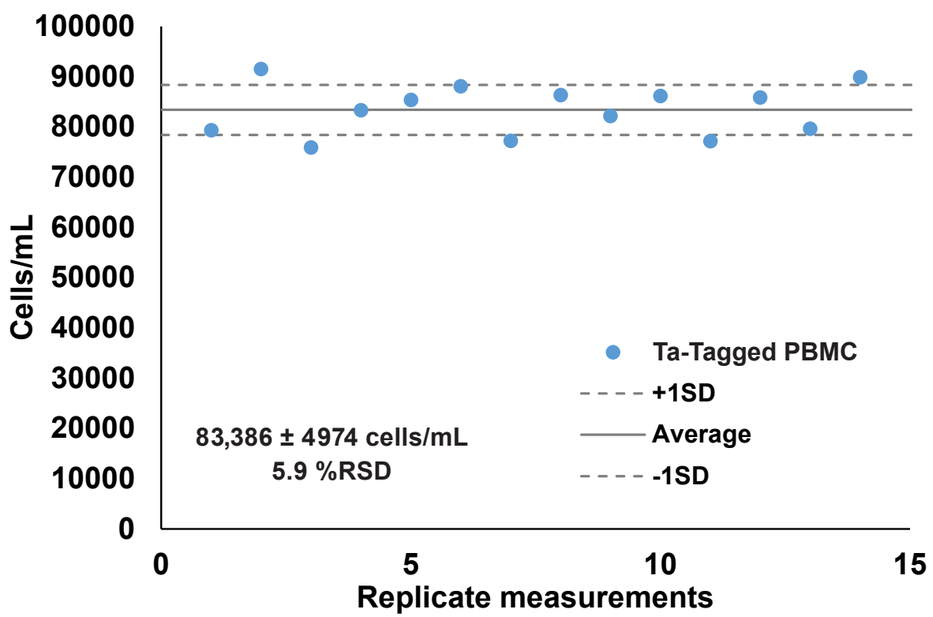
Typical Transport Efficiency for 50 nm Au NPs = ~80% or greater



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.

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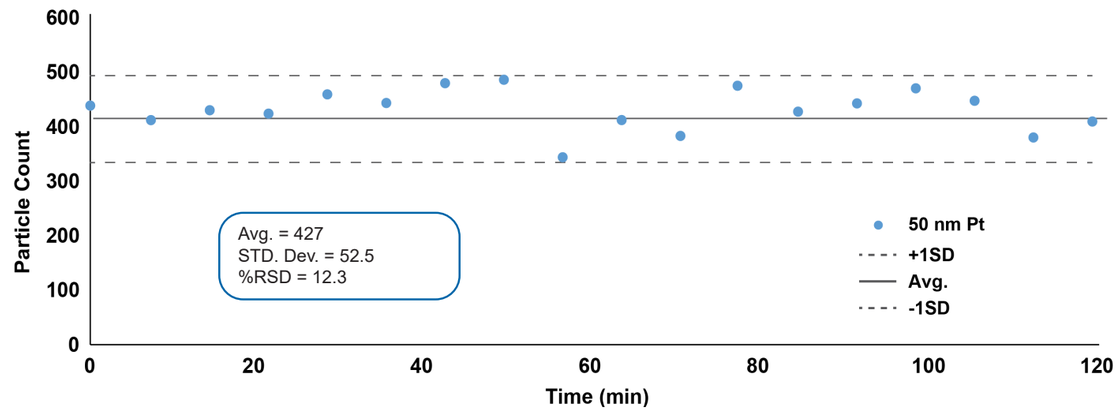
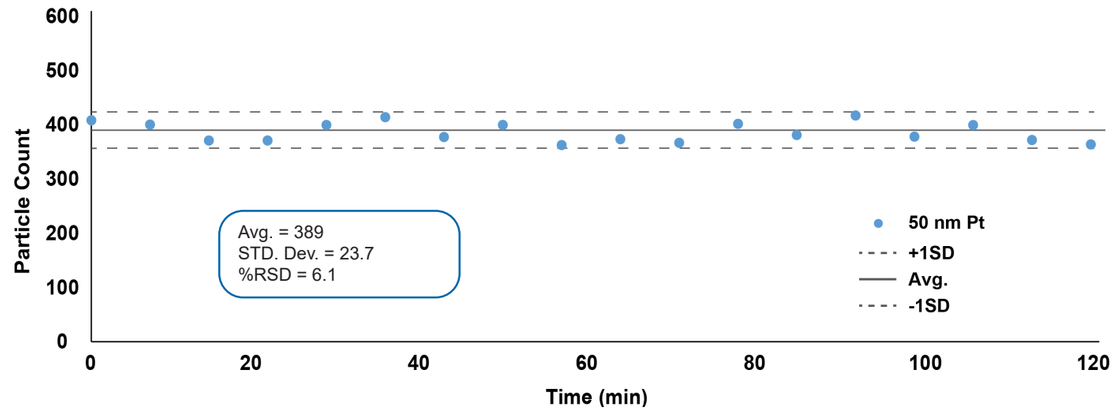
Advantage of the micro*FAST*'s Sample Mixing Method

No Mixing Method – Particle Count Stability over 2 hours (n = 20)



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.

Mixing Method – Particle Count Stability over 2 hours (n = 20)



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

One-piece ICPMS Torch

• Simple and direct connection to CytoSpray

CytoSpray

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

CytoNeb

• Low backpressure and dead volume
• Unmatched nebulization efficiency

Magnetic SnapValves

Carrier and Working Solution

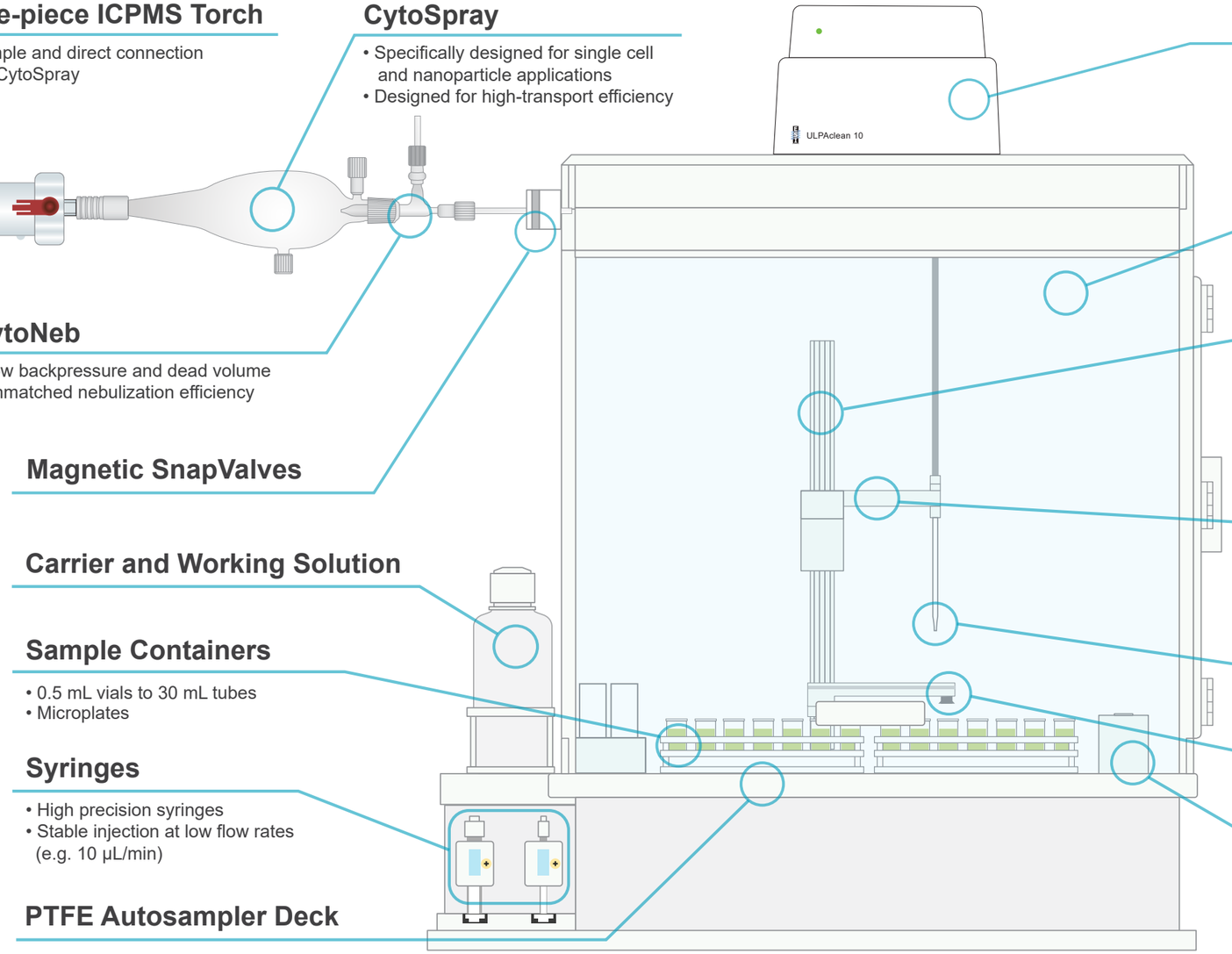
Sample Containers

• 0.5 mL vials to 30 mL tubes
• Microplates

Syringes

• High precision syringes
• Stable injection at low flow rates (e.g. 10 µL/min)

PTFE Autosampler Deck



microFAST SingleCell Features

Optional ULPAclean 10 Filter

• Removes 99.9995% of airborne particles

Exhausted Enclosures

• Three side easy access doors

Fluoronetic Rail

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

AutoAlign Arm

• Self-realigns after encountering capped sample tube

Tapered Probe

Optional FluoroWand Arm

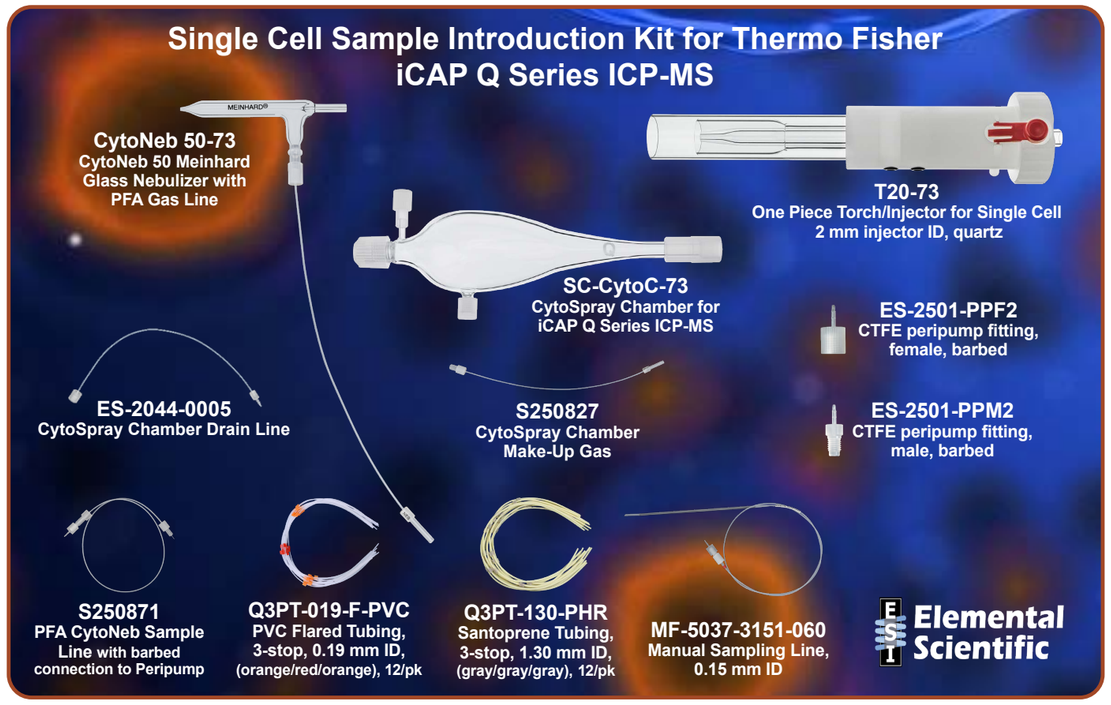
Dual Pumped Rinse Station

• Low rinse consumption
• Two rinse solutions

microFAST SingleCell Autosampler

System	Part Number
microFAST SingleCell Autosampler	**MF-SC2-73**

Sample Introduction Kit



Kit	Part Number
Single Cell Sample Introduction Kit for Thermo ICPMS	**SC-SI-73**

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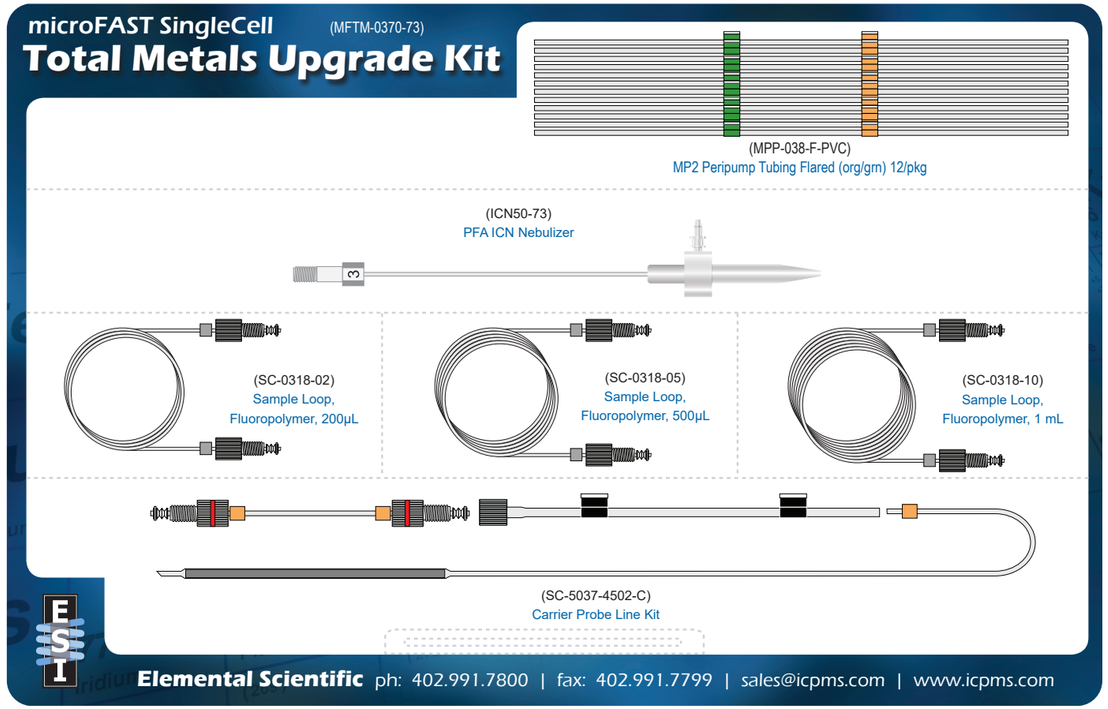
FAST Conversion Kit



Kit	Part Number
Includes ICN50-73 nebulizer to use with instrument standard spray chamber to run *FAST* sample analysis on the micro*FAST* SingleCell autosampler	**MFTM-0370-73**

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