Raman-Activated Microfluidic Sorter

RAMS MM96 | **Brochure**

Reveal Cellular Complexity with Light

Automate Cell Sorting with AI



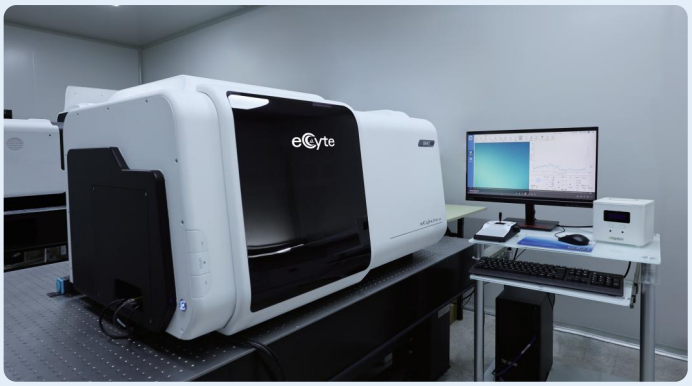
Functional Single Cells at Your Fingertips

eCyte

Raman-Activated Microfluidic Sorter (RAMS)

Raman-Activated Microfluidic Sorter (RAMS) is a single-cell profiling and sorting instrument that integrates single-cell Raman spectroscopy, cell imaging, and microfluidic cell manipulation technologies. With multimodal Raman and image measurements, the system simultaneously captures the metabolic functional phenotypes and morphological features of individual cells with minimal sample preparation. Optical tweezers enable the precise capture and sorting of target cells into 96-well plates, allowing seamless integration with downstream single-cell cultivation and multi-omics analyses.

RAMS collects unique, multidimensional datasets at single-cell resolution, encompassing metabolic function, morphology, pure culture, and genomic information, and delivers technical support and comprehensive solutions for life science research, disease control and prevention, probiotic discovery, and biomanufacturing process monitoring.



Multimodal synchronous detection captures information more comprehensively

Innovative 3-in-1 detection mode simultaneously acquires single-cell Raman spectra, cell images, and fluorescence signals, enabling the collection of metabolic, morphological, and biomarker information without complex sample preparation. It links multidimensional characteristics to each sorted cell for downstream analysis and validation.

AI-guided Exhaustive Cell Identification

Equipped with intelligent cell identification and continuous sample switching, RAMS can characterize every cell in a sample without frequent chip changes, making it well suited for low-abundance and rare-cell samples.

Precise microfluidic cell control and efficient collection in 96-well plates

Using precise microfluidic cell manipulation, target cells can be deposited in a 96-well plate at one cell per well, enabling seamless integration with downstream single-cell cultivation and multi-omics research.

AI-guided Automated Cell Sorting and Data Analysis with Low Operational Barrier

By integrating an automated operation module with RamanAI data analysis platform, RAMS enables end-to-end automation for cell identification, data acquisition, intelligent analysis, and precise cell collection.

Multi-dimensional Phenotyping at Single-cell Resolution

In-depth studies of individual cells continue to reveal key biological insights that are obscured by population-average measurements. However, limitations in current single-cell measurement technologies hinder comprehensive capture of the multidimensional relationships between cellular function and morphology, and restrict in-depth analysis of cellular heterogeneity.

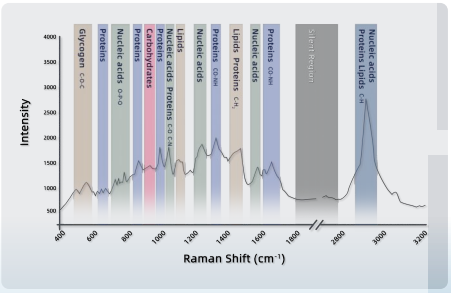
Raman-Activated Microfluidic Sorter integrates three core measurement modes to comprehensively characterize multidimensional single-cell phenotypes.

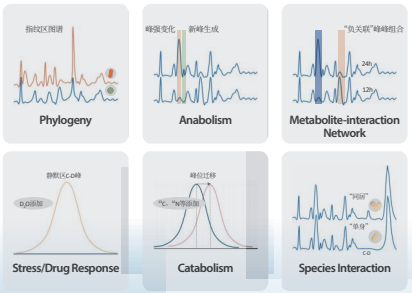
Raman Measurement

Provides label-free metabolic 'molecular fingerprints' and chemical composition of cells

Label-free Sample Preparation | ***in-situ* Metabolic Function Measurement** | **Fast Non-destructive Measurement**

Single-cell Raman spectroscopy characterizes phenotypic features of biological systems, with each spectral peak corresponding to a specific chemical bond. Spectral analysis can readily reveal the composition and abundance of intracellular metabolites, substrate utilization, and cellular stress response.



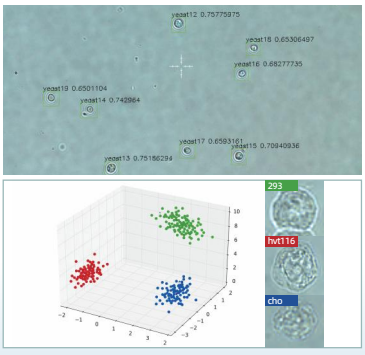


Bright-field Imaging

Captures Key Cell Features including Size and Morphology

Cell Morphology | **Cell Clustering**

High-resolution imaging captures complete morphological features of cells and characterizes cell samples, enabling precise classification of target cells using deep learning image recognition algorithms.

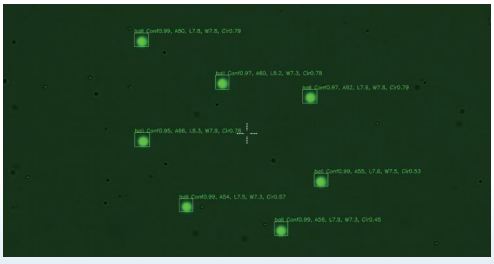


Fluorescence Imaging

Precise Identification of Target Biomarkers

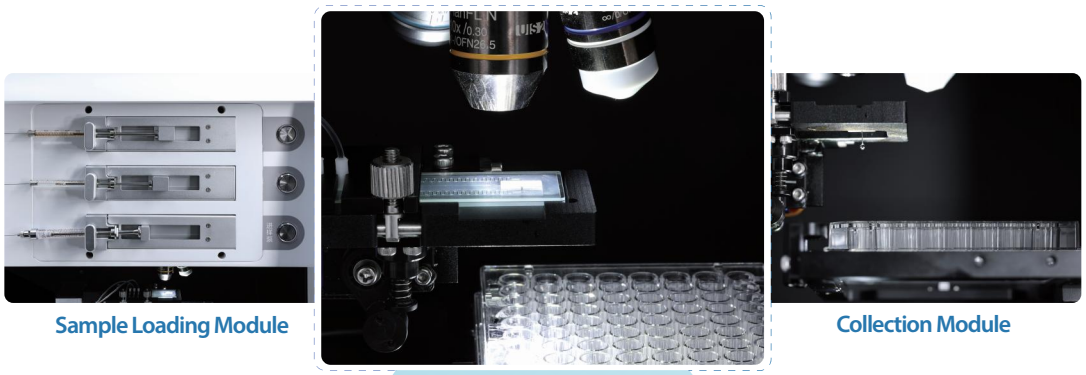
Biomarker Identification

Fluorescence module for rapid identification of cells with specific biomarkers.

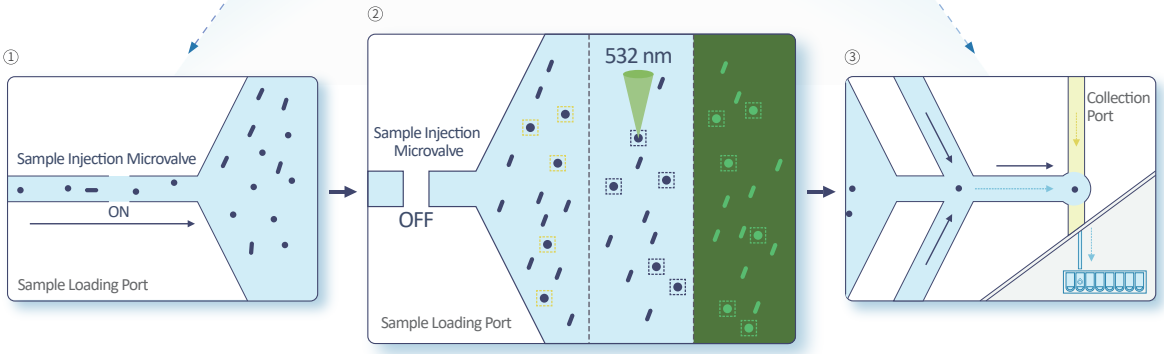


Multi-dimensional phenotypic information transforms single-dimensional cell profiling into panoramic analysis, resulting in a cell profiling and sorting system that integrates metabolic functions, morphology, and fluorescent labeling.

Microfluidic Cell Manipulation for Precise Sorting



The entire process of single-cell identification, detection, isolation, and collection is carried out on a single microfluidic chip.



1 Sample Loading or Continuous Sample Exchange

- Control of sample entry and exit through micro-valve switching, enabling automatic sample loading
- Better suited for low-abundance, high-volume samples

2 Multimodal Single-cell Profiling

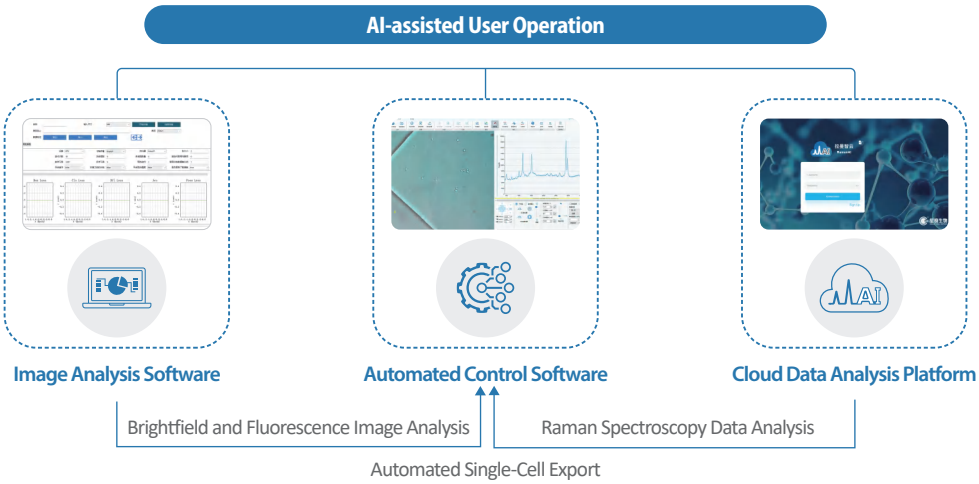
- AI-guided recognition of all cells in a sample, along with the simultaneous collection of single-cell Raman spectra, cell morphology, and fluorescence information
- Enables integration of multi-dimensional data from cells

3 Single-cell Isolation and Collection

- Intelligent obstacle avoidance of target cells, precise microfluidic cell manipulation, and efficient cell collection in uniform droplets into a 96-well plate
- Seamless integration with downstream single-cell cultivation or multi-omics research

Automated Control and Intelligent Data Analysis Platform

The RAMS platform, supported by AI-assisted software, enables automated workflows for cell recognition, measurement, identification, isolation and export. Data interoperability among its three software modules ensures efficient multi-dimensional data acquisition and precise target cell sorting.



One-Stop Cloud-based Raman Spectroscopy Expert System (RamanAI)

Data Preprocessing



Built-in spectral data preprocessing and data QC modules ensure efficient data clean-up.

Data Analysis and Modeling



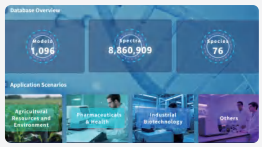
Multiple internally developed AI algorithms (e.g. TransformLSTM-KAN) support er-KAN and spectral modeling.

Expert Q&A



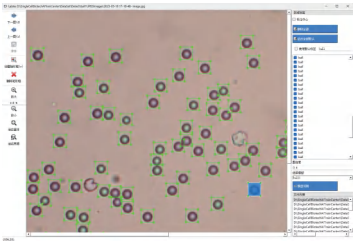
An expert system with intelligent Q&A and guided wizard support provides professional assistance for data analysis.

Cloud Storage and Model Sharing



20GB of cloud storage and ready-to-use models for typical application scenarios

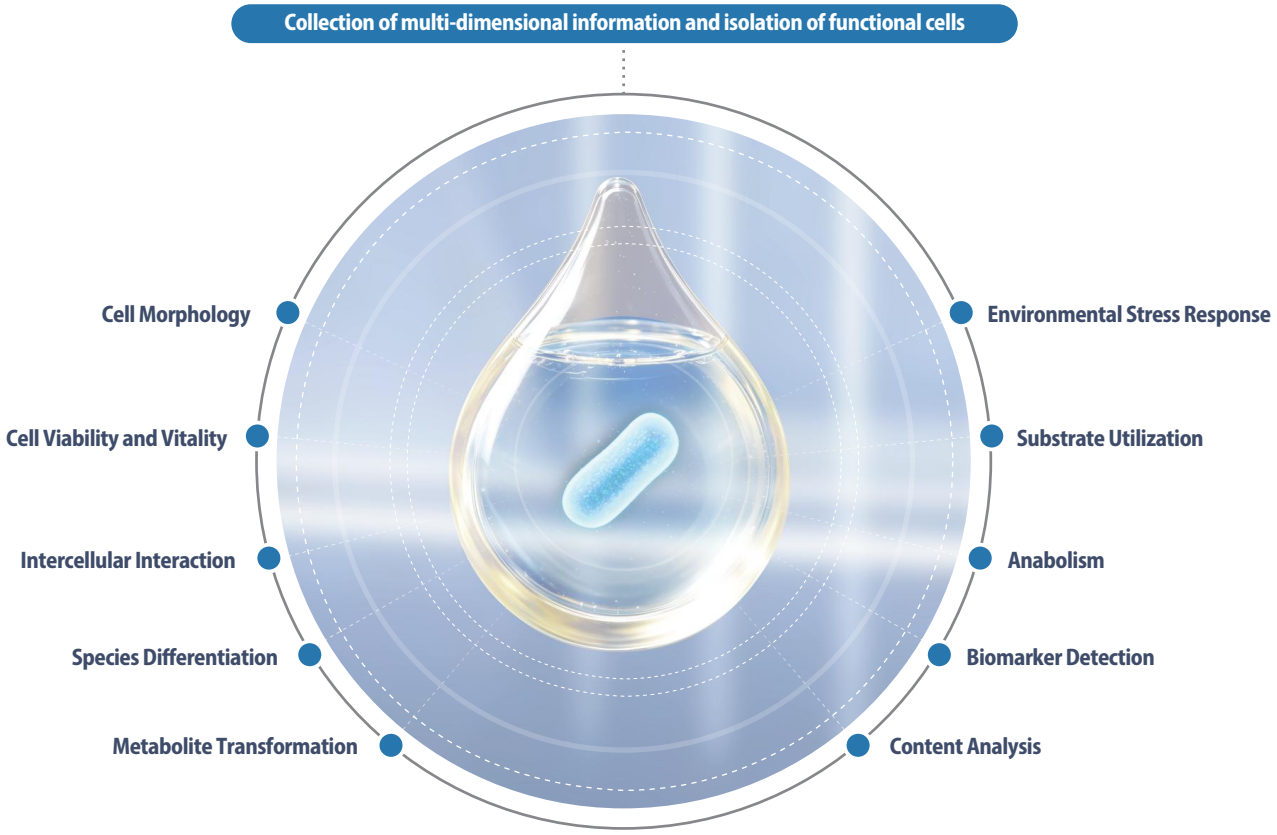
Image Analysis Software (AI Training Center)



An AI algorithm trained on massive cell images automatically identifies and analyzes cell morphological features (bright-field/fluorescence), accurately distinguish different types of cells, and eliminate debris and background interference.

Additional research on RAMS-sorted cells

RAMS integrates Raman spectroscopy, brightfield microscopy, and fluorescence microscopy, creating a multimodal platform for single-cell phenotypic analysis and sorting. By combining single-cell cultivation or sequencing, phenotypic and genotypic information can be obtained simultaneously along with live cells.

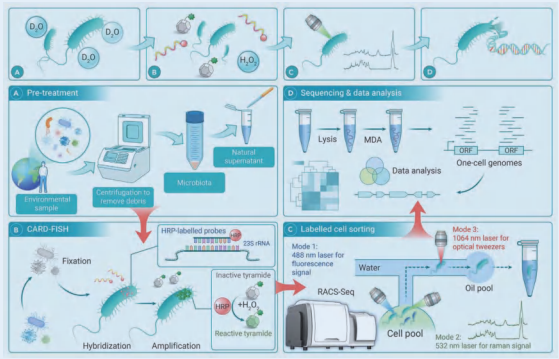


Raman-Activated Microfluidic Sorter — Applications

Species-Metabolism Dual-Targeted Functional Microorganism and Enzyme Mining for Cyclohexane Degradation

Microorganisms and their enzymes drive key ecological processes. A major challenge is efficiently identifying cells with specific *in situ* metabolic functions. Here, we developed FISH-scRACS-seq, a "species-metabolism" dual-targeting technology that isolates active bacteria degrading cycloalkanes from the ocean. Using single-cell genomics, we discovered cycloalkane-degrading P450 enzymes in cold marine environments worldwide.

This approach links ecological functions, *in situ* metabolism, genome sequences, and enzyme activities at single-cell resolution across entire ecosystems, offering a novel strategy for mining functional microorganisms and enzymes.

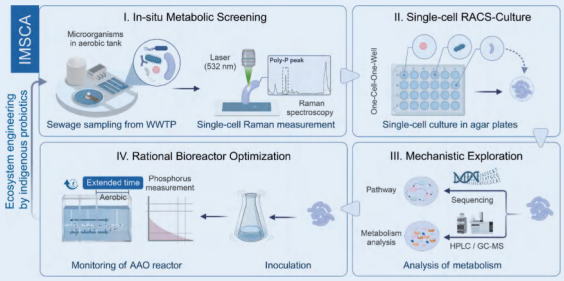


▪ Jing XY, et al., ***Innovation***, 2025, 6(3):100759

Mining of Robust Phosphorus-Accumulating Organisms for Sewage Treatment

To address the bottleneck in rapidly identifying and isolating in-situ functional bacteria for ecological remediation, researchers developed an "*In situ* Metabolism-Targeted Functional Bacteria Screening, Cultivation, and Enhancement" (IMSCA) strategy, which is based on the combination of Raman-activated cell sorting and single-cell cultivation (scRACS-Culture).

A new, efficient phosphorus-accumulating organism (PAO) was successfully isolated from activated sludge in urban sewage treatment plants, and its application in wastewater treatment was validated. This demonstrated the effectiveness of the IMSCA strategy for environmental remediation and ecosystem engineering.



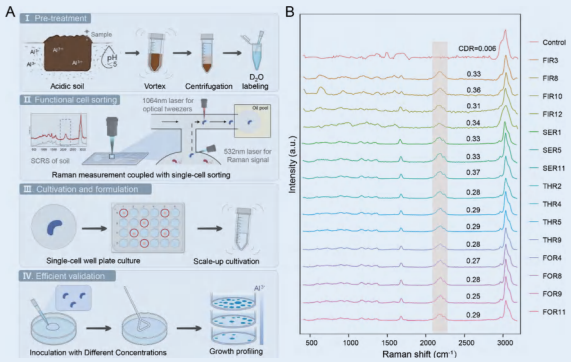
▪ Jing XY, et al., ***Water Res***, 2025, 284:124025

Raman-Activated Microfluidic Sorter — Applications

Screening of Aluminum-Tolerant Microorganisms in Acidic Soil

The soil microbiome is an important component of Earth's ecosystems, and its *in situ* functions are critical for life science research and practical applications.

In this study, an artificial intelligence-assisted Raman-activated cell sorting system was combined with the Raman-D_2O approach to automatically and efficiently sort specific functional (aluminum-tolerant) microbial cells from complex soil samples while preserving their *in situ* metabolic functions, providing strong support for exploration and utilization of microbial resources.

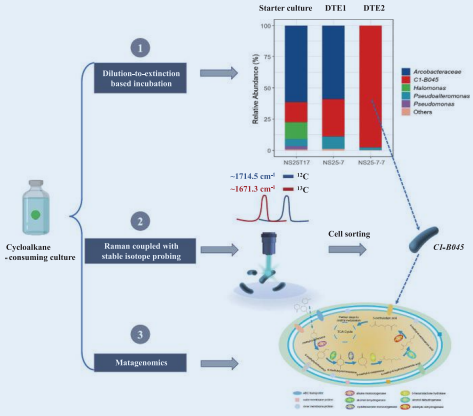


▪ Diao ZD, et al., ***Anal Chem***, 2024, 96(46):18416-18426

Mining of Cycloalkane-degrading Marine Microorganisms

Cycloalkanes are common in marine oil pollution, but little is known about how marine microorganisms degrade cycloalkanes.

In this study, researchers used single-cell Raman spectroscopy to discover a previously uncultivated new genus of marine bacteria, C1-B045, which can efficiently metabolize methylcyclohexane (MCH) and degrade cycloalkanes in cooperation with other species. This discovery helped us better understand the structure and function of microbial communities in the marine environment, and provided a novel technology to address future oil pollution.



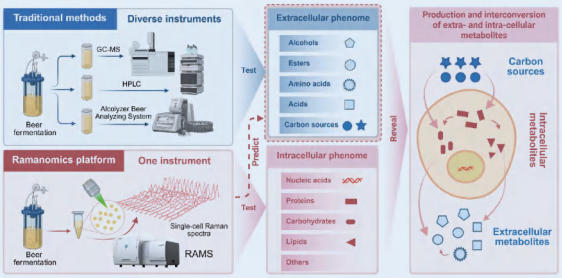
▪ Cui ZS, et al., ***J Hazard Mater,*** 2024, 469:133904

Raman-Activated Microfluidic Sorter — Applications

Tracking of Metabolite Transformation during Beer Fermentation with Ramanomics

Beer flavor largely depends on alcohols, esters, and acids from yeast fermentation. Traditional monitoring detects these separately using multiple instruments—a cumbersome, slow, and costly approach unable to capture real-time yeast metabolism and cell-to-cell differences. This study applies the "Process Ramanome" technology for rapid, non-invasive, and label-free single-cell metabolic phenotyping. It simultaneously monitors yeast metabolic states and heterogeneity, along with dynamic changes of key flavor compounds in fermentation broth.

By overcoming the limitations of bulk average measurements, this method offers an innovative tool for precise process control in industrial fermentation.

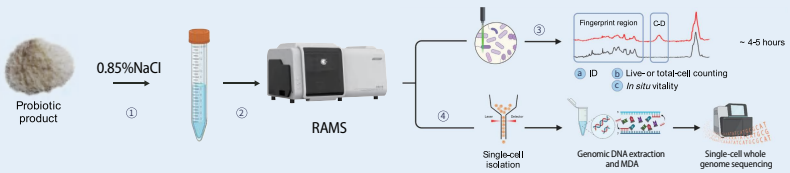


▪ He Y, et al., ***Bioresource Technology***, 2025, 443:133788

Rapid Strain Identification and Viability / Vitality Testing of Probiotic Products

Conventional probiotic QC methods like cultivation and sequencing are slow, costly, and fail to assess cell vitality. Here, researchers developed SCIVVS, a Ramanomics-based single-cell method. Without plating or nucleic acid extraction, it uses heavy water labeling and high-throughput Raman spectra to identify species and quantify metabolic activity. It also enables sorting of viable cells for downstream analysis.

Compared to traditional methods, SCIVVS is over 20 times faster and 10 times cheaper, offering rapid, accurate, and automatable QC. This technology provides a one-stop, culture-free solution for live cell counting and vitality measurement.



▪ Zhang J, et al., *iMeta*, 2023, 2(3):e117

Raman-Activated Microfluidic Sorter — Specifications

Specifications

Applicable Cell Size and Type	Suitable for 1-30 μm bacterial, archaeal, fungi, and microalgal cells; also applicable to plant, animal, and human cells
Sample Volume	Minimum sample volume of 200 μL, supports continuous sample loading
Continuous Sample Loading	The sorting chip is equipped with a built-in microvalve, which enables automatic switching to ensure a continuous and stable sample replacement process
Detection method	Raman spectroscopy (supporting Raman imaging), bright field imaging, fluorescence (optional)
Single cell sorting speed	20-40 cells/minute
Single-cell droplet volume	≤ 200 nL
Cell collection method	Single well single (or multiple) cells, supporting custom cell count within the well
collection plate	Suitable for 96 well plates
Single cell information traceability	The collected individual cells can be matched one-to-one with Raman spectra and images.
Intelligent planning of sorting paths	Equipped with automatic path planning and cell loss detection functions, the sorting process automatically avoids cells and impurities in the sample. If a cell falls off, it can automatically return to the recognition area and capture the next cell
Automation and intelligent platform	Support intelligent recognition of cells, automatic data collection, intelligent analysis and discrimination of multidimensional phenotype groups, precise collection of target single cells, and full process automation
Instrument size	1184×796×616 mm
weight	130 kg
power supply	AC 220 V ± 10%, 50 Hz ± 10%, maximum power ≤ 150 W

Product Catalog

Item Number	Product Name	Specifications
SCD004001	Raman-Activated Microfluidic Sorter	ea
SCC001101	Raman-Activated Microfluidic Sorting Kit	4 chips

References

- Using RAMS, an *in situ* metabolite detection method for coral samples was developed, revealing the patterns of carbon and nitrogen transfer and cycling among corals, zooxanthellae, and symbiotic bacteria.
  Shu Y, et al., *Microbiome*, 2026, 14(1): 103

- Developed Process Ramanomics single-cell metabolic phenotyping technology, enabling rapid, non-destructive, and label-free detection of metabolic states and heterogeneity in brewing yeast cells, while simultaneously monitoring the dynamic changes of key flavor compounds in fermentation broth.
  He Y, et al., *Bioresource Technology*, 2025, 443: 133788

- Developed an In-situ Metabolism driven Sorting, Culture and Augmentation (IMSCA) strategy based on single-cell Raman coupled cultivation (scRACS-Culture), successfully isolated a novel high-efficiency phosphorus-accumulating microorganism (PAO) from activated sludge, and verified its high-efficiency phosphorus removal activity in industrial wastewater treatment.
  Jing X, et al., *Water Res*, 2025, 284: 124025

- Developed a novel technology for species-metabolism dual targeted microbial cell and enzyme mining
  Jing X, et al., *The Innovation*, 2025, 6(3): 100759

- Efficient detection and isolation of aluminum tolerant microorganisms in soil
  Diao Z, et al., *Anal Chem*, 2024, 96(46): 18416-18426

- Mining of Cyclohexane-Degrading Microorganisms in the Ocean
  Cui Z, et al., *J Hazard Mater*, 2024, 469: 133904

- A novel probiotic single-cell QC method, SCIVVS, based on Raman spectroscopy
  Zhang J, et al., *iMeta*, 2023, 2(3): e117

- Single-cell Raman-Activated Cell Sorting coupled Cultivation technology (scRACS-Culture) for efficient mining of microbial resources
  Jing X, et al., *ISME Commun*, 2022, 2: 106

- Developed Raman-based single-cell metabolic profiling and genomics method to reveal the SAR11 taxa involved in in-situ photosynthetic carbon sequestration in ocean
  Jing X, et al., *BioDesign Res*, 2022, 2022: 9782712

- Established a Helicobacter pylori diagnosis method at single-cell resolution, and an integrated identification-drug sensitivity-source tracking process CAST-R-HP
  Liu M, et al., *Clin Chem*, 2022, 68(8): 1064-1074

- Rapid measurement of single-cell metabolic phenotypes, supporting algae metabolic phenotyping and cultivation monitoring during the development of the "blue light super microalgae" strain
  Zhang P, et al., *Nat Commun*, 2022, 13(1): 1664

- Explored the metabolic activity of live bacteria on unstable carbon after soil displacement using heavy water-probed single-cell Raman spectroscopy
  Ni H, et al., *ISMEJ, 2021*, 15(9): 2561-2573

- Full Raman spectrum measurement (for metabolic activity, carotenoid production, etc.) and high-coverage genome sequencing of a single bacterial cell from a complex environmental sample (soil microbiome)
  Jing X, et al., *mSystems*, 2021, 6(3): e00181-21

- Demonstrated the application of heavy water-probed single-cell Raman spectroscopy to measure the sensitivity of Acinetobacter baumannii to tigecycline
  Hua X, et al., *Emerg Microbes Infect*, 2021, 10(1): 1404-1417

- Published the first microalgae Raman spectroscopy database, and demonstrated rapid microalgae species identification and metabolic function profiling at single-cell resolution using machine learning
  Baladehi M, et al., *Anal Chem*, 2021, 93(25): 8872-8880

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techsupport@ecytebio. com | www.ecytebio.com
eCyte, Inc. 880 W Maude Ave, Sunnyvale, CA 94085-2920

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