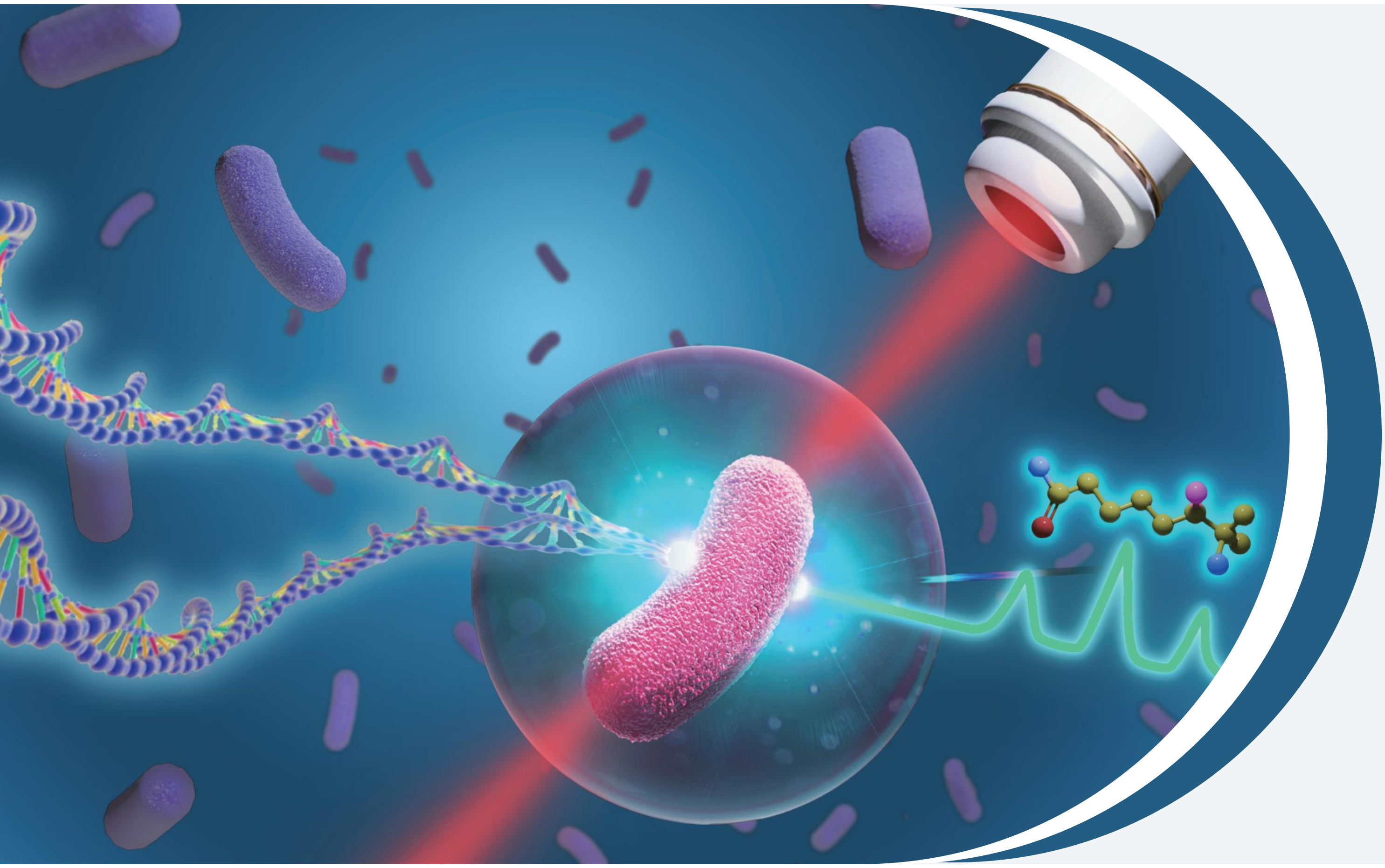
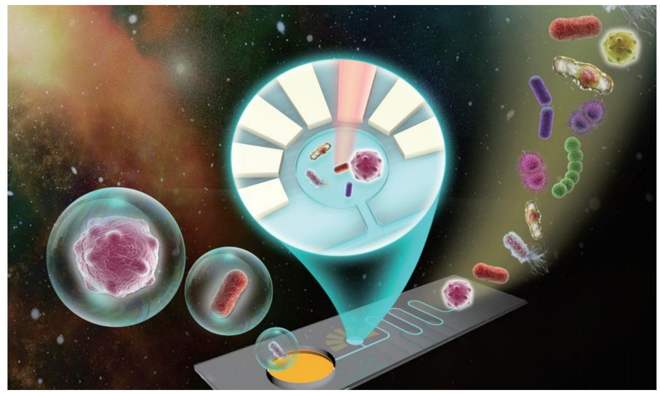
Raman-activated Cell Sorting (RACS) Instrument Series

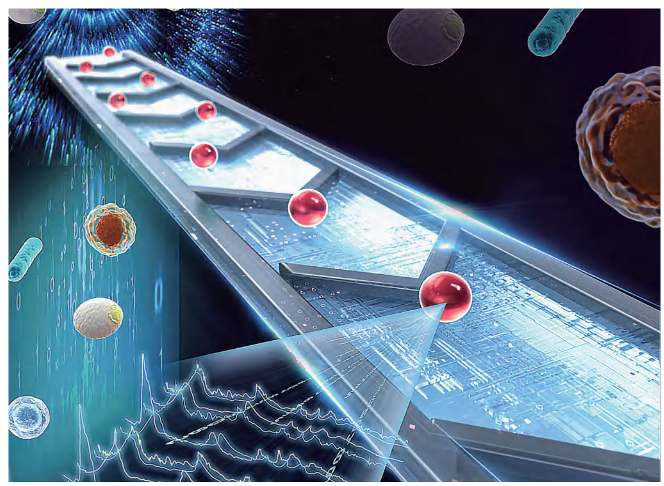


eCyte, Inc. | Functional Single Cells at Your Fingertips

Our Technology

Raman spectroscopy is a spectroscopic technique relying on Raman scattering, the inelastic scattering of photons. When light interacts with molecular bonds, a shift in energy reflects the characteristics of the molecular structure. This phenomenon is known as Raman scattering. Therefore, Raman spectrum from a sample provides valuable information about its chemical composition and molecular structure within the sample.





When used on a single cell, Raman spectrum reflects the biochemical composition, or **metabolic phenotype** of that cell at the moment of Raman analysis. A collection of multiple single-cell Raman spectra, "**Ramanome**", represents a group of metabolic phenotypes at single-cell resolution.

Ramanome allows us to quantitatively profile various metabolic phenotypes for individual cells, including measuring substrate utilization rates, determining the diversity and content of intracellular products, characterizing environmental stress responses, detecting intercellular metabolic interactions, and reconstructing intracellular metabolite conversion networks. It can also differentiate between microbial species or cell lineages.

To acquire specific metabolic phenotypes from cell populations or communities for sequencing or cultivation, we have developed a series of single-cell analysis and sorting instruments based on Raman spectroscopy, including **FlowRACS**® (a high-throughput, flow-based system), **RACS-Seq**® and **RAMS** (cell sorting in static liquid environment). **RamanEye**® further seamlessly integrates SCRS technology with bioreactors, enabling real-time monitoring of cellular metabolic states during fermentation processes. **DCP** complements functional cell sorting with highly parallelized cell cultivation in microchambers, offering multimodal de-duplication and contact-free export of target clones. Additionally, **EasySort Compact** provides a cost-effective solution for sorting single cells using optical tweezers in combination with brightfield and fluorescence microscopy.

Our ultimate goal is to empower researchers with a simple, universal tool to rapidly uncover cellular metabolic phenotypes and functions - without the need for labeling or disrupting the cells.

Contents

FlowRACS®
Flow Cytometric Raman-Activated Cell Sorter

- Non-destructive analysis of live cells without labeling
- High-throughput, fully automated single-cell analysis and sorting
- High-quality Single-cell Raman Spectra (SCRS) acquisition
- Minimal impact on biological activity of sorted cells

FlowRACS® is a high-throughput flow cytometer featuring metabolic phenotype-based cell characterization and sorting with single-cell Raman spectroscopy. Inside FlowRACS®, cells are analyzed and sorted without labeling or staining. Using a patented technology, cells are aligned and passed sequentially through a checkpoint, where Raman spectrum of each cell is accurately determined. Live cells with targeted Raman spectra or metabolic functions can then be collected for desired downstream analysis.

No cell labeling required

FlowRACS® utilizes Raman spectroscopy without the need for any invasive or potentially harmful labeling such as fluorescent labeling to identify the metabolic phenotypes of target cells, expanding the scope of its applications.

Maintaining cell viability and vitality

Raman spectrum acquisition and cell sorting are carried out in an aqueous environment, minimizing impact on cell viability and genome integrity.

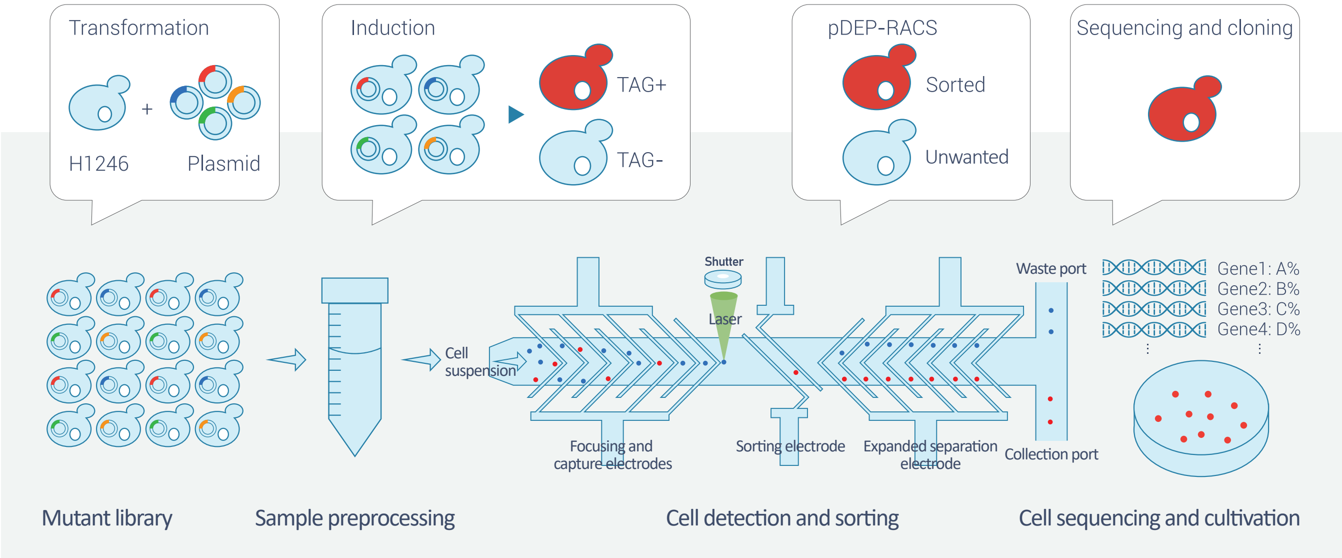
Acquisition of high-quality SCRS

FlowRACS® allows fast moving cells to be briefly trapped at a detection point for accurate Raman analysis, maximizing the throughput of cell characterization and sorting.

High-throughput, automated and intelligent cell sorting based on SCRS

Experience one-click, fully automated cell sorting with throughput of up to 2,000 events/min with minimal human intervention. Benefit from real-time intelligent Raman spectrum analysis following data acquisition, enabling effortless, fully automated cell sorting.

Workflow of FlowRACS®



Applications

High-throughput Label-free Profiling for Astaxanthin-producing *H. pluvialis*. Ramanome for >20,000 *H. pluvialis* cells is acquired within 15 mins, revealing inter-cellular astaxanthin-content heterogeneity within population.

Function-based Mining of Enzymes and Cells. Yeast cells expressing functional DGATs (enzymes that produce triacylglycerols or oil) are screened directly with single-cell Raman spectra. FlowRACS represents 100 to 1,000 - fold acceleration over traditional approaches in screening enzyme activity *in vivo*.

Metabolic Phenome Profiling. Detection of TAG productivity, degree of unsaturation value and metabolic activity for oleaginous yeast.

Cancer Cell Line Profiling. Human bladder (T24), lung (A549), renal (OSRc-2) and breast (MCF-7) cancer cell lines are accurately identified at a rate of 90.7-99.4%, with an average of 96.9%, along with analysis of metabolite-conversion networks.

Antimicrobial Susceptibility Tests. FlowRACS is capable of distinguishing microbial species and state-specific features (e.g. drug responses), facilitating high-throughput identification and classifications of drug response mechanism.

Technical Specifications

Parameter	Specification
Cell Type	Wild-type or engineered bacterial, yeast, algal, plant and mammalian cells
Sortable Cell Size	1 - 40 µm
Sample Loading Concentration	100 - 10,000 cells/mL
Analysis Rate	60 - 3,000 events/min
Sorting Rate	60 - 2,000 events/min
Dimensions (W × D × H)	1145 × 770 × 645 mm

RAMS
Raman-Activated Microfluidic Sorter

- Multi-modal measurements: Raman, brightfield, fluorescence
- Automated continuous sample reload
- Precise single-cell sorting into 96-well plates
- Intelligent, end-to-end automated workflow

RAMS integrates Raman spectroscopy, cell imaging, and precision microfluidics into a single platform for high-content single-cell analysis and sorting. Using multi-modal "Raman + imaging + fluorescence" measurements, RAMS captures each cell's metabolic fingerprints and morphological features with simplified sample preparation. Enabled by precision microfluidic cell manipulation, the system performs high-efficiency cell capture sorting, with sorted cells seamlessly coupled to downstream single-cell cultivation or multiomic workflows.

Simultaneous Multimodal Measurement for Comprehensive Information Capture

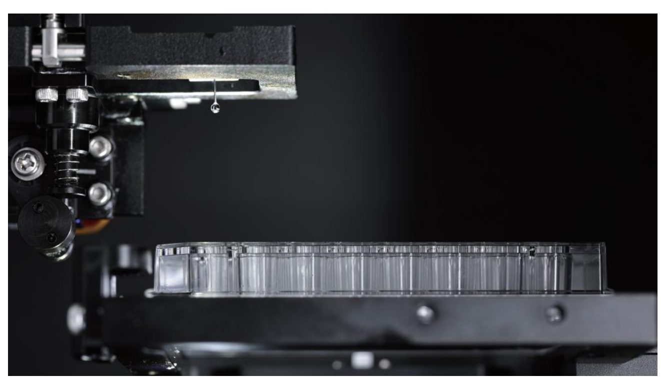
Unique 3-in-1 detection of Raman spectra, cell images and fluorescence signals enables simultaneous acquisition of single-cell metabolic, morphological and biomarker information without complex sample preparation. Multidimensional characteristics correspond to each sorted cell.

Precise Microfluidic Control and Efficient 96-Well Plate Collection

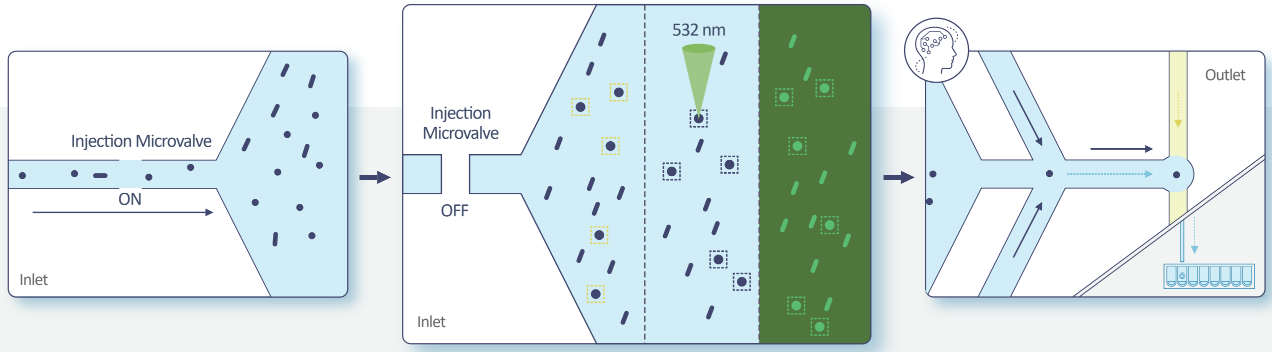
Precise microfluidic manipulation allows direct collection of target cells into 96-well plates at one cell per well, supporting seamless integration with downstream single-cell culture and multi-omic studies. Intelligent cell identification and continuous automatic sample reloading make it ideal for low-abundance and rare samples.

AI-Powered Automated Sorting and Data Analysis

Integration with automated modules and RamanAI data analysis platform enables end-to-end automation of cell identification, data acquisition, intelligent analysis, and precise collection, significantly lowering the operational barrier.



Workflow of RAMS



① **Automated Sample Loading or Continuous Exchange**

② **Multimodal Single-Cell Analysis**

③ **Intelligent Single-Cell Isolation and Collection**

Applications

Cyclohexane-degrading Microorganisms Mining. Using dual-targeting (species + metabolism) Raman-activated sorting, RAMS isolated cycloalkane-degrading γ-proteobacteria from marine samples, identified cold-adapted P450 enzymes, and established a single-cell multi-dimensional information linkage framework.

Wastewater Treatment Phosphorus-accumulating Organisms Mining. Novel phosphorus-accumulating organism *Micrococcus luteus CI5-8* was screened via Raman-activated cell sorting. Pilot testing raised phosphorus removal from 45% to 89%, offering a new strategy for water purification.

Acidic Soil Aluminum-tolerant Microbes Screening. Using D_2O-labeled single-cell Raman spectroscopy, 13 aluminum-tolerant strains were isolated from acidic red soil, including two *Burkholderia* strains tolerant to 50 mM Al^{3+}.

Marine Cycloalkane-degrading Bacteria New Genus Discovery. Combined with stable isotope-labeled single-cell Raman spectroscopy, a novel uncultured genus C1-B045 was identified from Yellow Sea & Bohai Sea. It degrades methylcyclohexane via the ε-caprolactone pathway.

Tumor Organoid Detection and Raman Imaging. Using D_2O-labeled single-cell Raman spectroscopy, RAMS enabled D_2O labeling and Raman imaging of tumor organoids, paving the way for downstream drug sensitivity testing.

Technical Specifications

Parameter	Specification
Cell Size and Type Compatibility	1–30 μm bacteria, archaea, fungi, microalgae, plant, animal and human cells
Detection Methods	Raman spectroscopy (supports Raman imaging), bright-field imaging, and fluorescence imaging (optional)
Cell Collection Method	Customizable cell numbers (one or multiple cells) per well
Collection Plate	96-well plate
Cell Traceability	Each collected cell can be traced back to its corresponding Raman spectral and imaging information
Dimensions(W×D×H)	1184×796×616 mm

RACS-Seq®

Raman-activated Optical Tweezers-based Cell Sorter

- Accurate cell characterization and sorting using optical tweezers within the microscopic field
- High-quality Single-cell Raman Spectra (SCRS) acquisition – functional information at single-cell resolution
- Intact sorted cells are compatible with single-cell sequencing or cultivation

RACS-Seq® is an integrated single-cell analyzer and sorter capable of cell metabolic phenotype profiling, Raman-activated cell sorting, and sample preparation for single-cell genome sequencing and cultivation. Based on single-cell Raman spectroscopy, RACS-Seq® allows direct identification of microbial species and measurement of a wide range of metabolic phenotypes and intercellular heterogeneity in a culture-free manner.

Rapid, label-free profiling of metabolic phenotypes at single-cell resolution ▼

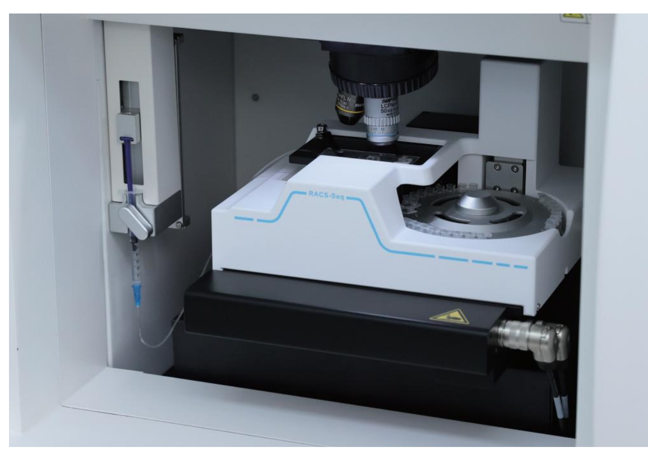
SCRS can readily distinguish microbial species and reveal catabolism, anabolism, metabolite-interaction network, stress/drug response, and interaction of cells simultaneously.

Single-cell DNA/RNA extraction and amplification with low bias and high genomic coverage ▼

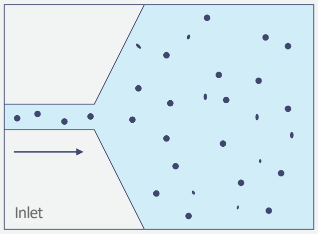
Cells isolated with RACS-Seq® are ideal for single-cell sequencing with reduced MDA amplification bias. The genome coverage of single *E. coli* cells can reach up to 99.5%, a significant increase over classical approaches (23%) .

Precise and automated acquisition of target cells while maintaining biological activity ▼

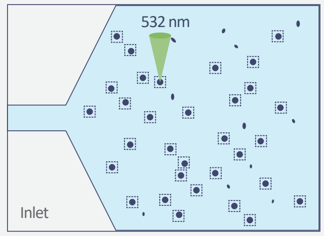
Maintain full visibility throughout the process. RACS-Seq® can precisely control the movement trajectory of target cells with optical tweezers, and encapsulate each cell into a microliter-scale microdroplet with minimal impact on biological activity.



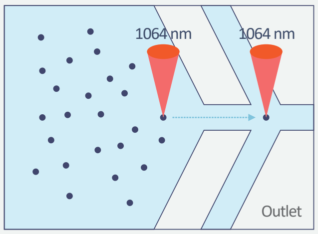
Workflow of RACS-Seq®



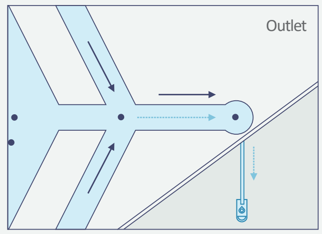
① **Autosampling/ Continuous Sampling**



② **Cell Identification / Raman Detection**



③ **Cell Sorting**



④ **Single-cell Collection**

Applications

Soil Microbiome Analysis. Active microorganisms from soil samples were isolated, followed by single-cell genome sequencing. Low-abundance species such as *Corynebacterium* spp., *Clostridium* spp., and *Pseudomonas* spp. were revealed, providing insights into soil microbiota.

Active Bacteria Indentification in Seawater. Bacteria involved in carbon fixation and metabolism in marine water were analyzed and sorted. Notably, we identified dominant species such as *Synechococcus* spp. and *Pelagibacter* spp., unraveling marine carbon cycling.

Efficiently Mining of Microbial Resources. We have efficiently employed RACS-Seq to identify, sort, and culture microbes capable of *in situ* phosphate solubilization and cycloalkane degradation.

Rapid Antimicrobial Sensitivity Testing (AST) for Oral Microbiota. Rapid drug sensitivity testing for common oral pathogens, including *Enterococcus faecalis* and *Candida albicans*, helps improve oral health.

AST and Source Tracking of *H. pylori* in Gastric Mucosal Samples. *H. pylori* can be identified, their susceptibility determined and sorted by RACS-Seq. The genomes of sorted single cells can be sequenced with high coverage.

Quality Inspection of Probiotic Products. Rapid strain identification, viability & vitality tests, and source tracking of probiotic products can be performed on RACS-Seq.

Technical Specifications

Parameter	Specification
Sample Type	Environmental, marine, and soil microbial samples, isolated strains, mammalian cells
Cell Size	0.5 - 50 μm
Sample Requirements	Optimal loading concentration: 10^6 to 10^7 cells/mL. Recommended volume: ≥ 10 μL.
Sorting Environment	Aqueous environment
Single-cell Recovery Rate	≥ 90%
Dimensions (W × D × H)	1166 × 787 × 690 mm

EasySort Compact
Single-cell Microdroplet Sorting System

- Precise cell acquisition within the microscopic field: AI-enabled targeting and sorting of specific cells
- Fully visualized cell sorting process
- Non-destructive sorting and collection of single cells
- Intelligent obstacle avoidance

EasySort Compact is a standalone instrument equipped with an integrated brightfield / fluorescent microscope for cell visualization and sorting. It features precise cell sorting, reliable encapsulation of target cells into microdroplets, and minimal impact on biological activity of sorted cells. EasySort Compact provides a simple and complete solution for single-cell sorting into 96-well microtiter plates.

Sorting single cells while preserving functional activity ▼

Cell sorting is carried out in an aqueous environment, minimizing impact on cell viability and genome integrity.

Fully visualized cell sorting process ▼

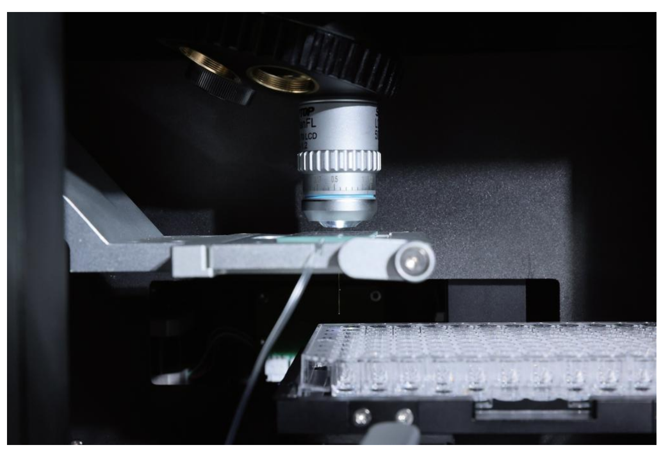
EasySort Compact sports a highly visualized workflow, allowing users to observe cell phenotype information and fluorescence signals under 10 x / 50 x microscopic imaging.

Image-based deep learning algorithm and automation ▼

With a cutting-edge AI algorithm, EasySort Compact can automatically identify target cells with desired phenotypes, including cell size, shape, and fluorescence signal, enabling a fully automated intelligent cell sorting workflow.

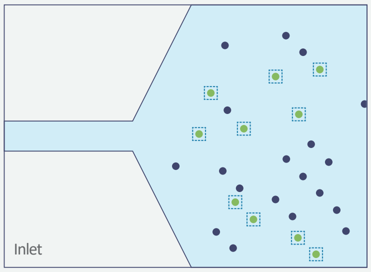
Intelligent obstacle avoidance and user-friendly interface ▼

Intelligent obstacle avoidance capability significantly reduces manual intervention and improves efficiency. Minimal training is needed for proper operation.

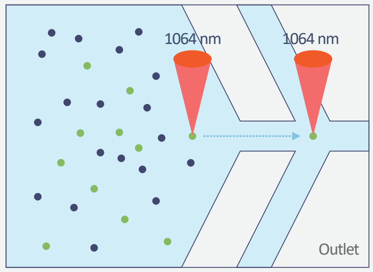


Workflow of EasySort Compact

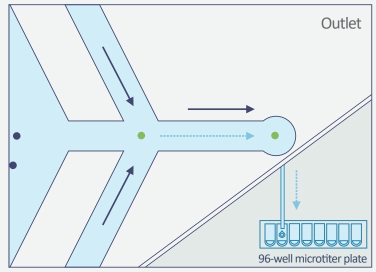
① Intelligent Cell Identification (Brightfield or fluorescence)



② Non-destructive Cell Sorting



③ Automatic Cell Collection



Applications

Microbial Single-cell Sorting. Utilizing deep learning algorithms and microscopic imaging, EasySort Compact intelligently sorts single cells of varying sizes and shapes automatically. What you see is what you get!

Anaerobic Microbiome Sorting. When used with an anaerobic workstation, EasySort Compact enables sorting of anaerobic microorganisms from gut and environmental samples.

Plant Genetic Resource Conseration. EasySort Compact intelligently sorts cells with specific shape and color from sources including marine water, rice protoplasts, maize root, stem, and leaf tissues.

Mammalian Cell Precision Sorting. Leveraging AI analysis and multi-color fluorescence imaging, EasySort Compact non-destructively and accurately sorts unlabeled and fuorescently labeled cells, while preserving high cell viability.

Extreme Microorganism Exploration: Whether in caves or hot springs, EasySort Compact allows ultra-low sample input down to microliters, enabling *in situ*, non-destructive, and high-viability sorting of rare cells for downstream sequencing and cultivation experiments.

Technical Specifications

Parameter	Specification
Sample Type	Isolated strains/fluorescent cells, human cells, environmental, marine, and soil microbiome samples
Cell Size	0.5 - 50 μm
Detection Mode	Brightfield or fluorescence (center wavelength of the excited light: 380 nm, 480 nm, 550 nm)
Sample Requirements	Optimal loading concentration: 10^6 to 10^7 cells/mL Recommended volume: ≥ 10 μL
Sorting Environment	Aqueous environment
Cell Collection	96-well microtiter plate
Sorting Collection Speed	30 min per 96-well microtiter plate
Dimensions (W × D × H)	745 × 501 × 402 mm

DCP
Digital Colony Picker

- ▸ Automated physical isolation of single cells into picoliter microdroplets
- ▸ Real-time monitoring and screening of single-cell-resolved morphological, developmental, and fluorescence phenotypes within each microdroplet
- ▸ AI-based de-duplication of microdroplet clones using single-cell multimodal phenotypes, followed by contact-free, high-throughput export of target clones

Digital Colony Picker (DCP) enables large-scale, parallelized physical separation of target single cells with specific functions from a genetically heterogeneous cell population. It supports microdroplet-based cultivation, phenotypic monitoring of each microdroplet during the cultivation process, and fully automated selection of droplets containing pure cultures that exhibit desired phenotypes. This instrument can be widely applied to parallelized cultivation of various cell types, as well as the intelligent, automated selection of desired clones.

High-Efficiency Intelligent Screening ▾

AI-based image recognition (brightfield/fluorescence) enables automatic and precise targeting of desired chambers, and one-click export of target clones.

Ultra-Low Consumable Usage ▾

5,000+ single clones (equivalent to 50+ agar plates) can be recovered from each chip, with significant reduction in experimental costs.

Cultivation in Independent Chambers ▾

Cultivation of single cells in independent chambers effectively minimizes interference from fast growing cells.

Flexible Reagent Exchange ▾

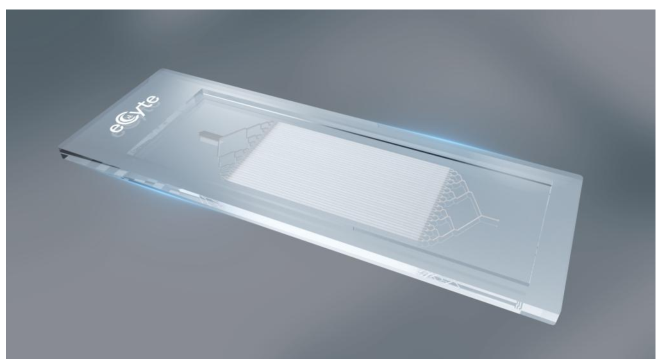
Streamlined reagent exchange within chambers enables a wide range of experimental designs.

Intuitive Data Visualization and Traceability ▾

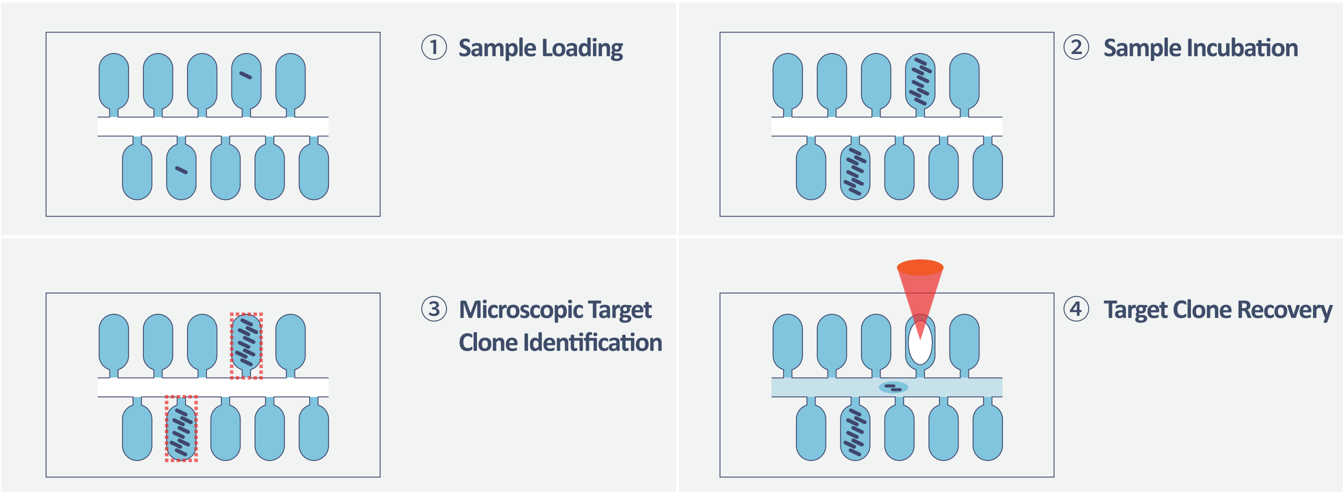
Offers multiple data visualization options, field-of-view toggling capability, and high-magnification imaging to observe cultivation chambers.

Reduced Contamination Risk ▾

Non-contact colony recovery and water-in-oil microdroplet collection reduce the need for frequent consumable changes and minimize aerosol contamination.



Workflow of DCP



Applications

High-throughput screening of lactic acid-producing strains. Fluorescence intensity from a product-specific fluorescent sensor was used as the sorting criterion for lactic acid yield. In a sample containing approximately 1% target cells, a strain with a 17.6% higher lactic acid yield compared to the original strain was obtained after a single round of screening.

Screening of fast-growing strains. The colony area observed under bright-field microscopy was used as a metric for growth rate. After four rounds of screening under stress conditions, a fast-growing strain was obtained, with a specific growth rate 69.6% higher than that of the original strain.

Cultivation of low-abundance microorganisms. Starting from an environmental microbial sample, individual cells were cultivated in microchambers, leading to the successful isolation of multiple low-abundance strains. DCP reduced the cultivation time by two-thirds compared to conventional agar plate-based methods.

Microscopic de-duplication of clones. Environmental microbial community samples were directly introduced into an array chip. The detailed information on cell growth, development, and reproduction observed under the microscope was used to differentiate the strains. A single chip revealed seven distinct morphological types, and sequencing of the selected colonies confirmed that they represent seven different strains.

Technical Specifications

Parameter	Specification
Cell types	Bacterial, archaeal, and fungal cells; expandable to microalgae, plant, animal, and human cells
Sample volume requirement	Sample volume > 20 µL
Excitation wavelength	Blue-green light with center wavelengths of 470 nm and 530 nm
Number of microchambers on chip	16,000 microchambers (expandable), pL-volume for each microchamber
Colony identifcation approach	AI-assisted image recognition (brightfield/fluorescence)
Colony identifcation speed	800 chambers per minute
Colony recovery speed	1,000 colonies per hour
Collection plate	96 - well microtiter plates for PCR or cultivation
Dimensions (W x D x H)	870 × 505 × 390 mm

RamanEye®
Fermentation Single-cell Metabolism Monitoring System

- Direct integration with fermenters
- On-line sampling and dilution
- On-line flow-based single-cell Raman spectral measurement and analysis
- Label-free, non-destructive, and panoramic on-line process monitoring

RamanEye® is a real-time monitoring system for fermentation processes. Leveraging the single-cell Raman spectroscopy technology, it enables real-time monitoring of metabolic functions at single-cell resolution during fermentation. RamanEye requires no labeling and provides non-destructive, comprehensive insights into cellular metabolic states. Accurate monitoring data generated by the system support the optimization of production efficiency and product quality. It is broadly applicable across food, pharmaceutical, and agricultural industries.

Compatible with multiple cell types ▼

Broadly applicable to various fermentation systems including bacteria, fungi, and microalgae, and can be directly connected to fermenters.

Automated on-line sampling and dilution ▼

Equipped with fully automated sampling and dilution capabilities to streamline operations and enhance measurement efficiency.

High-throughput flow-based measurement and analysis ▼

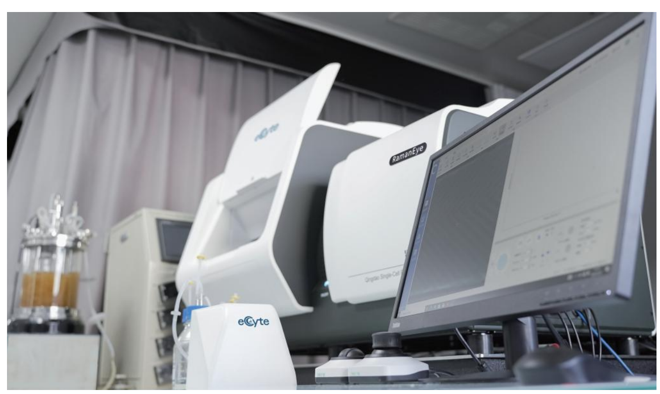
Supports high-throughput cell analysis of up to 3,000 events/min.

Monitoring at single-cell resolution ▼

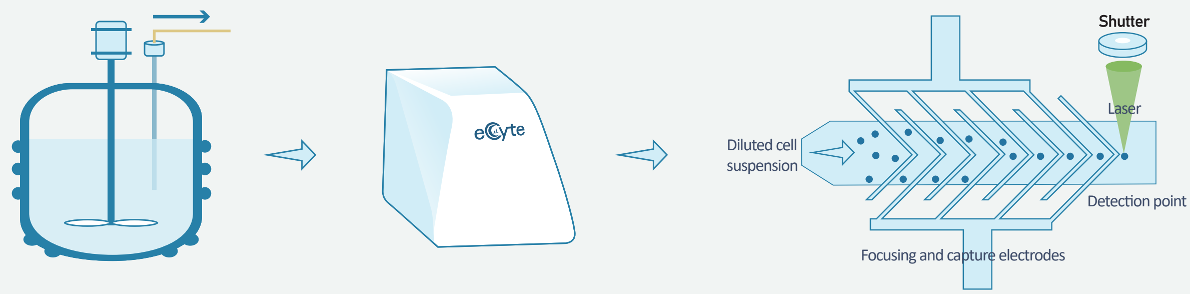
Accurately captures the metabolic states of individual cells, providing panoramic metabolic phenotypic data.

Real-time data feedback ▼

Obtains real-time single-cell phenotypic data from the fermenter, enabling continuous on-line monitoring of changes in fermentation.



Experimental Workflow



① On-line Sampling ② On-line Dilution ③ On-line Flow-based Single-Cell Analysis

Applications

Dynamic Heterogeneity Analysis of Astaxanthin Production in *Haematococcus pluvialis*. Monitoring of astaxanthin production at single-cell resolution revealed a significant time-dependent heterogeneous distribution of astaxanthin accumulation in *Haematococcus pluvialis* during the fermentation process.

Simultaneous Multi-parametric Metabolic Phenotyping of *Saccharomyces cerevisiae*. During yeast fermentation, two key metabolic phenotypes - neutral lipid content and neutral lipid degree of unsaturation - were simultaneously measured to reveal intercellular heterogeneity. Based on these metabolic phenotypes, fermentation stages of cells can be predicted with an accuracy of 96%.

Real-Time Monitoring of Lipid Biosynthesis in Lipid-Producing Yeast. RamanEye enables quantitative characterization of intracellular lipid content dynamics throughout the entire fermentation cycle of oleaginous yeast.

Prediction of Xylitol Fermentation Stage of Thermotolerant Yeast. In a high-temperature fermentation system using *Kluyveromyces marxianus*, single-cell Raman spectroscopy enabled prediction of critical fermentation time points with an accuracy of 83%.

Dual-Parameter Prediction of Tryptophan Production in *Escherichia coli*. Based on single-cell Raman spectroscopy, the average accuracy for predicting fermentation time points reached 95%, while the accuracy for predicting tryptophan yield reached 93%. Intracellular product levels serve as good predictors of extracellular product yields.

Technical Specifications

Parameter	Specification
Applicable fermentation systems	Compatible with bacterial, fungi, and microalgal fermentation systems; capable of direct connection to fermenters < 100 L
Interface type	PG 13.5/Φ25 standard connector (customizable upon request)
Fermentation broth sampling volume	fixed volume (1 mL) + variable volume (1 mL × tubing length in meters)
Dilution range	Adjustable from 10-fold to 10^8-fold
Diluent volume per sampling	7 mL for initial 10-fold dilution; additional 5mL (water + buffer) for each subsequent 10-fold dilution
Automated tubing cleaning	Uses cleaning solution of choice at adjustable frequency, with cleaning efficiency > 90%
Measurement speed	Up to 3,000 events/min

Applications & References

Industrial Biotech

- Using FlowRACS, the yield of lycopene in cells was directly quantified, revealing that carbon starvation induces the differentiation of Saccharomyces cerevisiae into two metabolic subpopulations. Carbon source optimization allows directional regulation of metabolic subpopulation dynamics, thereby improving the production of target products. FlowRACS
  Savigny J, *et al., Nat Commun*, 2026, 17(1):645

- A technical platform integrating stable isotope probing, Raman spectroscopic identification, and single-cell sorting was established for high-temperature Daqu, enabling accurate quantification and precise sorting of the in situ viability and metabolic activity of yeasts during high-temperature Daqu fermentation. RAMS
  Zhang H, *et al., Bioresour Technol*, 2025, 443:133803

- The "process Ramanome" single-cell metabolic phenotyping technology was proposed and validated, enabling rapid, non-destructive, label-free detection of intracellular metabolic states and heterogeneity of yeast cells during beer fermentation, as well as real-time monitoring of dynamic changes in key flavor compounds in the fermentation broth. RAMS
  H Y, *et al., Bioresour Technol*, 2025, 443:133788

- A mutant library of Zymomonas mobilis was screened using the Digital Colony Picker (DCP). Under lactic acid stress, a "super strain" was successfully isolated and obtained. DCP
  Diao Z, *et al., Nat Commun*, 2025, 16:8769

- Through combined mutagenesis and high-throughput flow Raman sorting, a mutant strain of Saccharomyces cerevisiae with a lipid content of up to 40.26% was successfully obtained, and its lipid accumulation mechanism was revealed. FlowRACS
  Ji X, *et al., Biotechnol Biofuels Bioprod*, 2025, 18:75

- The power of a novel Raman flow cytometry sorting technology was demonstrated through the identification of high DHA producing strains by rapid screening of a Schizochytrium mutant library. FlowRACS
  Wang X, *et al., Proc Natl Acad Sci U S A*, 2025, 122(22): e2503641122.

- A Raman flow cytometry-based rapid probiotics detection technology enabled accurate and rapid classification, enumeration, and viability assessment of strains in probiotic products. FlowRACS
  Zhang J, *et al., iMetaOmics*, 2025: e70024.

- Metabolic reprogramming coupled with RamanEye (FlowRACS) led to a breakthrough in sustained high level siderophore production via iron-derepressed fungal fermentation. RamanEye
  Kang X, *et al., ACS Synth Biol*, 2025, 14(5): 1625-1637.

- Single-cell Raman spectroscopy enabled simultaneous assessment of viability and cryotolerance in industrial yeast strains. FlowRACS
  Sun X, *et al., Synth Syst Biotechnol*, 2024, 10(1): 110-118.

- Developed an optics-based targeted droplet release system to achieve the selective recovery of desired droplets from static droplet arrays (SDA). DCP
  Diao Z, *et al., Biosens Bioelectron*, 2023, 240: 115639.

- A Ramanome-powered single-cell QC platform revolutionizes probiotic analysis by integrating real-time viability testing, metabolic activity profiling, and strain traceability at single-cell resolution. RACS-Seq
  Zhang J, *et al., iMeta*, 2023, 2(3): e117.

- The high-throughput and highly stable Raman flow cytometry technology, pDEP-DLD-RFC, was introduced for metabolic monitoring of plant and yeast biomanufacturing processes, as well as for rapid discrimination of tumor cells and bacterial drug sensitivity testing. FlowRACS
  Wang X, *et al., Adv Sci*, 2023, 10(16): e2207497.

- The intelligent and automated Single-cell Microdroplet Sorting System, EasySort AUTO, was introduced to enable the full process of single-cell sorting, sequencing, and cultivation using yeast and *E. coli* as examples. EasySort
  Diao Z, *et al., mLife*, 2022, 1(4): 448-459.

- The Optical tweezer-assisted Pool-screening and Single-cell Isolation (OPSI) technology was developed for single-cell sorting, enabling "what you see is what you get" selection of individual cells while maintaining their *in situ* viability, and high-quality single-cell genomics and transcriptomics. EasySort
  Xu T, *et al., Lab Chip*, 2022, 23(1): 125-135.

- Rapid detection of metabolic phenotypes and monitoring of cultivation processes in the construction of "blue light super microalgae" strains was enabled by single-cell Raman spectroscopy. RACS-Seq
  Zhang P, *et al., Nat Commun*, 2022, 13(1): 1664.

- The Intra-Ramanome Correlation Analysis (IRCA) algorithm was developed to construct a metabolite conversion network from a specific instance of one isogenic cell sample. FlowRACS/RACS-Seq
  He Y, *et al., mBio*, 2021, 12(4): e01470-21.

- FlowRACS, one of the first flow-based Raman-activated cell sorter (RACS), was introduced to support high-throughput discovery and screening of enzymes and cell factories, without requiring fluorescent labeling of cells or proteins. FlowRACS
  1 Wang X, *et al., Sci Adv*, 2020, 6(32): eabb3521.

Environment and Agriculture

- Using D_2O-labeled single-cell Raman spectroscopy to assess the active phenotypes of soil microorganisms, thereby investigating the impact of microplastic-derived dissolved organic matter (MP-DOM) on soil carbon cycling. FlowRACS
  Wang J, *et al., Environ Sci Technol*, 2025, 59:17334-17348

- Using D_2O-labeled single-cell Raman spectroscopy to identify single bacterial cells with in situ short-cut denitrification function in constructed wetland environments. FlowRACS
  Xie Y, *et al., Bioresour Technol*, 2026, 444:133899

- An "in situ metabolism‑targeted screening, cultivation, and enhancement of functional bacteria" strategy was developed based on single‑cell Raman coupled cultivation technology. A novel and highly efficient polyphosphate‑accumulating organism (PAO) was successfully mined from activated sludge of municipal wastewater treatment plants, and its practical application in water purification was verified. RACS-Seq
  Jing X, *et al., Water Res*, 2025, 284:124025

- Using EasySort, single *E. coli* cells expressing glycerol dibiphytanyl glycerol tetraether (GDGT) synthases were successfully isolated, advancing research on archaeal transmembrane lipids. EasySort
  Chen H, *et al., mLife*, 2025, 4(2): 193-204.

- FISH-scRACS-seq, a phylogeny-metabolism dual-directed single-cell genomics method, directly linked functional cells to their enzyme-coding genes in complex environment. RACS-Seq
  Jing X, *et al., Innovation*, 2025, 6(3): 100759.

- AI-RACS integrates artificial intelligence with Raman-activated cell sorting to automatically recover aluminum-tolerant microbial cells from soil samples while maintaining their native metabolic states. RACS-Seq
  Diao Z, *et al., Anal Chem*, 2024, 96(46):18416-18426.

- Using single-cell sorting technology, unculturable acetonitrile-degrading microorganisms were discovered in activated sludge samples. EasySort
  Xuan Y, *et al., Bioresour Technol*, 2024, 401:130686.

- Single-cell Raman sorting coupled with sequencing facilitates the mining of microbial resources for Cycloalkane degradation. RACS-Seq
  Cui Z, *et al., J Hazard Mater*, 2024, 469:133904.

- The single-cell Raman-activated cell sorting coupled with cultivation (scRACS-Culture) technology was invented to enable efficient microbial resource mining. RACS-Seq
  Jing X, *et al., ISME Commun*, 2022, 2(1): 106.

Applications & References

- A Raman-mediated targeted single-cell genome technology was developed to reveal the SAR11 taxa for their *in situ* photosynthetic carbon sequestration function in seawater. RACS-Seq
  Jing X, *et al., Biodes Res*, 2022, 2022: 9782712.

Medicine

- A rapid antimicrobial susceptibility testing technology (R-AST) based on single-cell Raman spectroscopy was developed. It enables accurate identification of carbapenem-resistant Klebsiella pneumoniae and its enzyme type within only 2 hours, seizing the critical time window for clinical anti-infective therapy. RACS-Seq
  Ding J, *et al., World J Microbiol Biotechnol*, 2025, 41(5):158

- Using the Digital Colony Picker (DCP), quantitative detection, species identification, and antimicrobial susceptibility analysis of pathogenic bacteria in untreated whole blood samples can be accomplished within 12 hours, significantly shortening the detection period. DCP
  Diao Z, *et al., Sens Acutuators B-Chem*, 2025, 442:138183

- Based on optical tweezer-assisted single-cell sorting technology, a novel ultrasensitive detection method for *Helicobacter pylori* was developed. EasySort
  Wang Z, *et al., Sens Acutuators B-Chem*, 2024, 412:135838.

- A rapid antimicrobial susceptibility testing (AST) technology for fast-growing mycobacteria was developed, reducing the detection time from 3–5 days (the conventional gold standard) to 24 hours only. RACS-Seq/FlowRACS
  Ren W, *et al., Ann Clin Microbiol Antimicrob*, 2023, 22(1):94.

- A medical instrument, Clinical Antimicrobial Susceptibility Test Ramanometry for *H. pylori* (CAST-R-HP), was introduced as a powerful new tool for the diagnosis and treatment of *H. pylori* infections. RACS-Seq
  Liu M, *et al., Clin Chem*, 2022, 68(8): 1064-1074.

- The automated version of CAST-R was developed, reducing the antimicrobial susceptibility testing time for common bloodstream pathogens to 3 hours—achieving a 10-fold acceleration. RACS-Seq/FlowRACS
  Zhu P, *et al., mLife*. 2022, 1(3):329-340.

- Heavy water (D_2O) probed Raman microspectroscopy was demonstrated to be effective in assessing the sensitivity of *Acinetobacter baumannii* to tigecycline. RACS-Seq/FlowRACS
  Hua X, *et al., Emerg Microbes Infect*, 2021, 10(1): 1404-1417.

- The MIC-MA concept and the CAST-R instrument were introduced as a universally applicable approach for rapid antimicrobial susceptibility testing and quantitative assessment of drug efficacy based on metabolic activity inhibition at single-cell resolution. RACS-Seq/FlowRACS
  Tao Y, *et al., Anal Chem*, 2017, 89(7): 4108-4115.

- Raman Barcode of Cellular-response to Stress (RBCS) was proposed to profile and distinguish drug response mechanisms via Ramanome, aiding in antibiotics evaluation, screening of drug-resistant bacteria, and studies of cell-drug interactions. RACS-Seq/FlowRACS
  Teng L, *et al., Sci Rep*, 2016, 6: 34359.

- Heavy water (D_2O)-probed Raman microspectroscopy was used to identify and sort active microbial cells in mouse cecum samples in the presence of various carbohydrates. RACS-Seq/FlowRACS
  Berry D, *et al., PNAS*, 2015, 112(2): e194-203.

Ordering Information

Instruments	Catalog Number
FlowRACS® Flow Cytometric Raman-Activated Cell Sorter	SCD003002
RAMS Raman-Activated Microfluidic Sorter	SCD004001
RACS-Seq® Raman-activated Optical Tweezers-based Cell Sorter	SCD002001
EasySort Compact Single-cell Microdroplet Sorting System	SCD001003
DCP Digital Colony Picker	SCD006001
RamanEye® Fermentation Single-cell Metabolism Monitoring System	SCD005001
Consumables	**Catalog Number**
FlowRACS Single-cell Sorting Kit (1 chip)	SCC007101 , SCC007201
FlowRACS Single-cell Assay Kit (1 chip)	SCC007301
RAMS Single-cell Sorting Kit(4 chips)	SCC001101
RACS-Seq Single-cell Sorting Kit (4 chips)	SCC005101
EasySort Compact Single-cell Sorting Kit (4 chips)	SCC004101
DCP Colony Cultivation and Recovery Reagent kit (4 chips)	SCC008101
RamanEye Single-cell Raman Detection Reagent Kit (1 chip)	SCC012101

Technical Support and Customer Care

We are committed to providing exceptional post-sales customer service to our customers to ensure a seamless experience with our product. Our technical support team is ready to assist you with any inquires or issues.

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