Ball Wave

CES INNOVATION AWARDS 2023 HONOREE

Device for Sniffing Chemicals in the Air

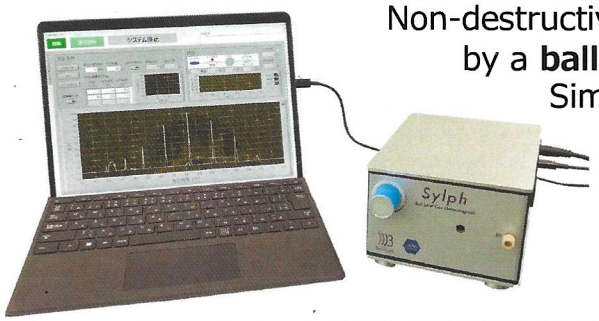
Sylph

Micro Gas Chromatograph

Ball Wave Inc.

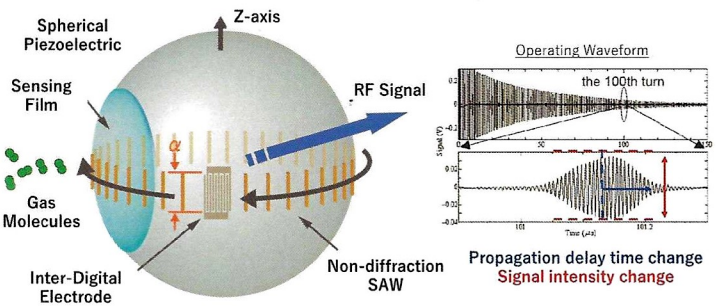
Easier Gas Chromatograph Analysis, closer to you !

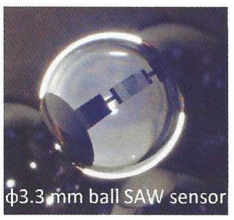
2 kg and A5 size foot print ! ⇒ Portable to everywhere !
Equivalent sensitivity to FID GC ! ⇒ On-site analysis available !
Automatic sampling with a **concentrator** ⇒ No complicated pretreatment required
3 types of **compact column** ⇒ Flexible choice for your analysis
Non-destructive detection by a **ball SAW sensor** ⇒ Connectable to other detectors (Mass spectrometer, sniffer, etc.)
Simple operation ⇒ Easy to use even for beginners

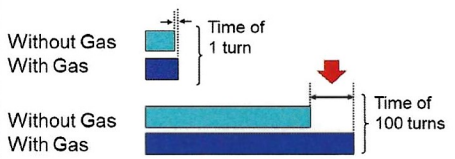


Principle of ball SAW sensor

A surface acoustic wave (SAW) is excited by applying a high-frequency signal to an interdigital electrode (IDT) placed on the surface of a spherical piezoelectric material. In general, waves diverge and lose energy as they propagate due to diffraction, but the surface of a sphere has the effect of geometrically converging waves. A SAW excited by an IDT, which is theoretically designed to keep a balance between divergence and convergence, makes multiple round trips on the surface of the sphere without diffraction. When gas molecules are adsorbed on the sensitive film formed on the SAW propagation path, the SAW propagation delay time and signal intensity are changed. These changes, which are cumulated with the number of round trips, make highly sensitive gas detection enable. The ball SAW sensor uses a spherical crystal quartz with a diameter of 3.3 mm and operates at room temperature, so it is tiny and low power consumption.

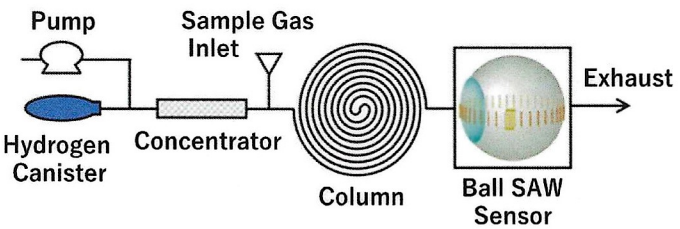






How Sylph works

Sylph has an automatic sampling system with a concentrator as a standard. At first, a sample gas is sucked by a pump through the concentrator filled with adsorbent for a while. Just after the flow direction is reversed by valves the concentrator is rapidly heated. Then the sample gas is desorbed from the adsorbent and injected into a column by a carrier gas supplied from a hydrogen storage alloy canister The gas components separated by the column are detected non-destructively by a ball SAW sensor and are exhausted.



Measurement Flow

Startup

Initial sequence starts with a start button
- Concentrator Baking
- System Warming up

⇒Completed within 10 minutes

Condition Setting

Set measurement parameters
It is also possible to save and recall set parameters.

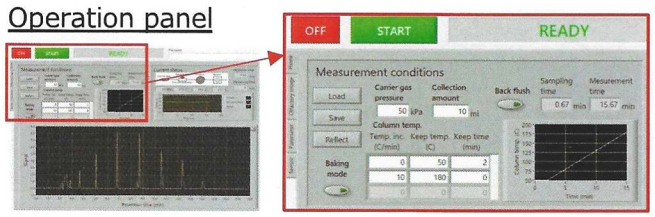
Measurement

Start measurement sequence with a measurement start button
1. Sample gas collection
2. Injection
3. Measurement
4. (Backflush)
5. Column cooling

Results

Output chromatogram and peak data in CSV format

Operation panel

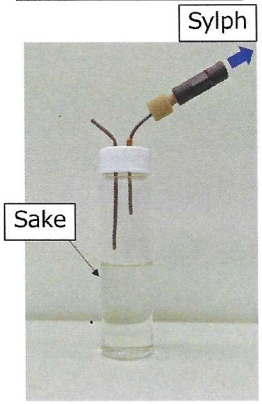


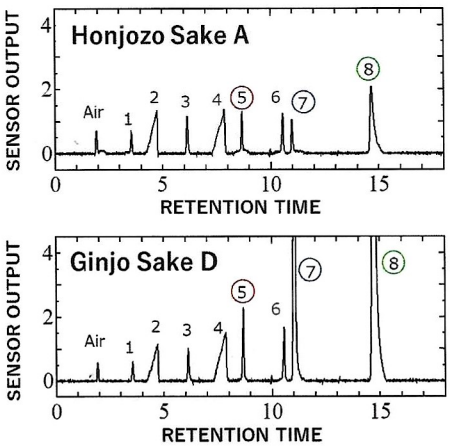
The operation panel is simple but has necessary and sufficient functions, so that even beginners can easily operate.

Analysis example① : Headspace gas analysis of Japanese liquor

Japanese liquor (Sake) is placed in a vial bottle and its headspace gas was analyzed, and multiple aroma components including isoamyl acetate, ethyl caproate, and ethyl caprylate, which are known as characteristic aroma components of Japan sake, were detected. Comparing the peak areas of the main aroma components by different brew methods such as "Honjozo" and "Ginjo" of different brands, there were distinctive differences between brands.

Headspace analysis

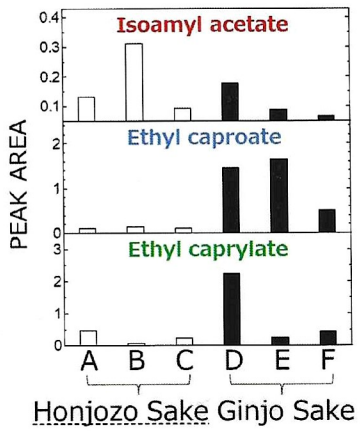




Measurement conditions

Collection volume : 50 mL
Carrier gas pressure : 50 kPa
Column : High polarity (PEG)
Column temp. : 40 ℃(5 min)-
10 ℃/min-140 ℃(5 min)

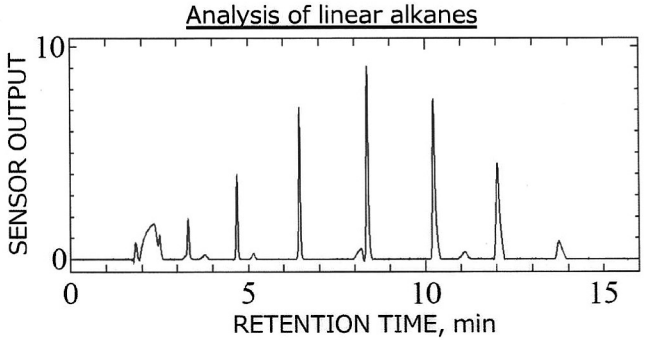
1 : Ethyl acetate
2 : Ethanol
3 : Unidentified
4 : Water
5 : Isoamyl acetate
6 : Isoamyl alcohol
7 : Ethyl caproate
8 : Ethyl caprylate



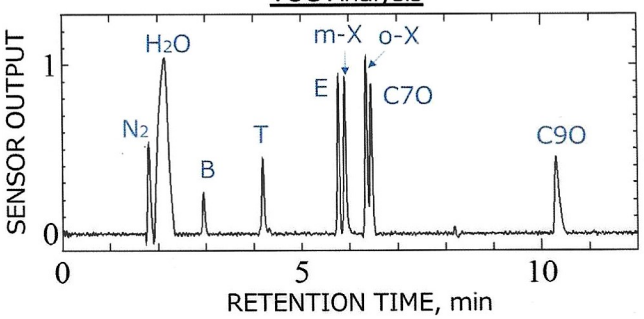
Analysis example ② : Qualitative analysis

It is possible to estimate compounds from retention time measured by the ball SAW sensor, that is similar to common gas chromatographic detectors such as hydrogen flame ionization detectors (FIDs) and thermal conductivity detectors (TCDs). Retention index that standardize the retention time of the peak of interest from the retention time of linear alkanes can be compared with measurements under various conditions. For each peak in the chromatogram, Sylph automatically saves peak height and retention time in csv format, so you can calculate a retention index from those values. Retention index can be obtained from the literature, column-related technical documentation, or commercially available GC and GC-MS analysis software.

Analysis of linear alkanes



VOC Analysis



Measurement conditions

Collection volume : 5 mL
Carrier gas pressure : 50 kPa
Column : Low polarity
Column temp. : 50 ℃(2 min)-
10 ℃/min-180 ℃(5 min)

Gas	Retention time [min]
Hexane(C6)	2.51
Heptane(C7)	3.31
Octane(C8)	4.69
Nonane(C9)	6.45
Decane(C10)	8.36
Dodecane(C11)	10.23
Undecane(C12)	12.03
Tridecane(C13)	13.74

Retention Index

Retention index I_i of unknown component i is expressed as follows.

$$I_i = 100\left[n + \frac{t_i - t_n}{t_{n+1} - t_n}\right]$$

t_i : Retention time of component i
t_{n+1}, t_n : Retention time of n-linear alkanes

Gas	Retention time [min]	Retention Index (Test result)	Retention Index (Literature)
B	2.95	655	659
T	4.19	764	767
E	5.76	861	864
m-X	5.91	869	871
o-X	6.35	894	897
C7O	6.45	900	901
C9O	10.30	1104	1102

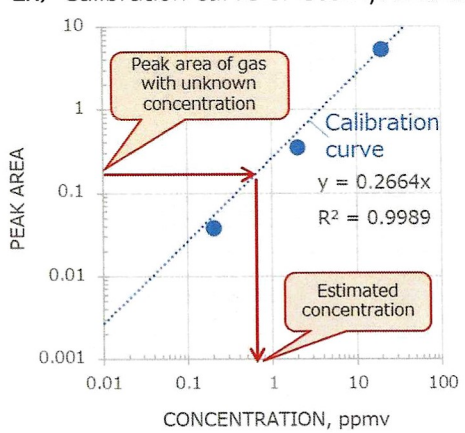
Analysis example ③ : Quantitative analysis

Since each peak area is also calculated and saved automatically, a calibration curve can be created by measuring a relationship between known concentration of the gas and the peak area. Based on the calibration curve, quantitative evaluation of the target gas is possible.

Peak data output

	①Peak #	②Retention	③Peak Height	④Peak area	⑤FWHM	F
1	#	Retention	PeakHeig	PeakArea	fwhm(min)	
2	1	1.68858	0.76641	0.04568	0.06149	
3	2	1.89489	1.3469	0.29417	0.17748	
4	3	2.91202	2.55413	0.14113	0.05406	
5	4	3.71554	2.15904	0.12219	0.05777	

Ex) Calibration curve of isoamyl acetate



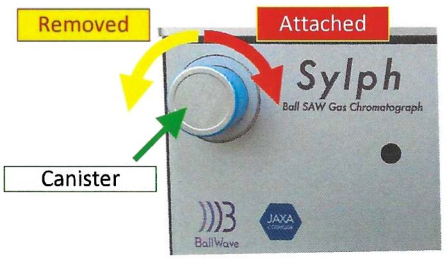
Specification

Main body	Model	SY-402
	Size	W133 mm×H88 mm×D174 mm (Protrusions not included)
	Weight	2 kg
	Power Requirements	DC24 V (port 5.5×2.1 mm) ※AC Adaptor 100~240 VAC、50/60 Hz included.
	Power Consumption	Max. 72 W
	Connection	USB
	Environment	10 ℃~40 ℃、with no water condensation
	Gas inlet	Connector: 10-32 coned
	Gas outlet	Connector: 10-32 coned、 Smell-sniffing nose patch connectable (Option)
Control	PC	Surface Pro, Windows 11
	Operation	Built-in control program
	Start-up time	Approx. 10 min after launching operation (including backflush)
	Shut-down time	Approx. 5 minutes from stop operation
	Data output	CSV file format
Carrier gas	Type of gas	Hydrogen[1)]
	Flow rate	1 mL/min
	Supply method	Hydrogen storage alloy canister[2,3)]
	Capacity	10 L
	Estimated time of use	130 hours/canister
Concentrator	Adsorbent	Choice from Tenax®TA or Tenax TA+Carboxen®1000
	Captured volume	1~1000 mL、programmable
	Injection temperature	Up to 240 ℃
	Cleaning	Automatic at start-up and after measurement
Column	Stationary layer	Choice from High polarity, Mid polarity or Low polarity type[4)]
	Temperature range	40 ℃~200 ℃, programmable
	Heating rate	Max. 20 ℃/min、programmable
	Cooling rate	Approx. 5 min from 200 ℃ to 50 ℃
	Cleaning	With backflush feature
Detector	detector	Ball SAW sensor
	Sensing film	Polydimethylsiloxane
	Operating frequency	150 MHz

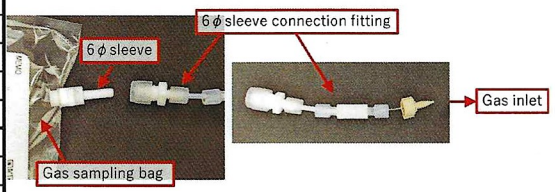
Accessories

(1)	Control PC (Built-in control software)	1unit
(2)	AC adaptor for control PC	1pcs
(3)	AC adaptor for SYLPH main body	1pcs
(4)	USB cable	1pcs
(5)	Metal hydride storage canister	2pcs
(6)	6 mmΦ sleeve connection fitting	1pcs
(7)	Carrying case	1pcs

Metal hydride storage canister



6 mmΦ sleeve connection fitting



1) Carrier gas can be changed by a cylinder adapter (optional).
2) For filling hydrogen to a canister, please prepare a hydrogen cylinder or a hydrogen generator at the customer.
3) Long-term usage can cause binder components inside the canister to be detected. We recommend replacing it after about 1 year of use.
4) Column types shown in the table below are available as standard products. If you would like to request another type of column, please contact us.

Type	Stationary phase	Length	I.D.	Film thickness	Applications
High polarity	Polyethylene glycol (PEG20M)	30 m	0.25 mm	0.25 μm	General analysis, Ester, perfume, Alcohol, Aromatic
Middle polarity	6%Cyanopropylphenyl - 94%polydimethylsiloxiane	30 m	0.25 mm	1.0 μm	VOC、Alcohol analysis
Low polarity	5%diphenyl - 95%polydimethylsiloxane	30 m	0.25 mm	0.5 μm	General analysis, Halogen compounds, Phenol
Non polarity	100%polydimethylsiloxane	30 m	0.25 mm	0.5 μm	General analysis, hydrocarbon, Phenol

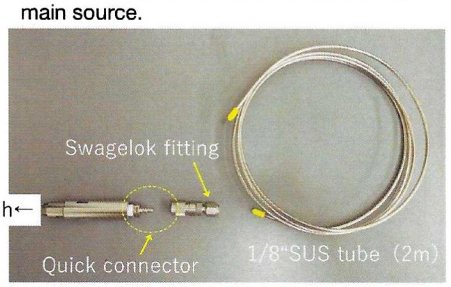
Option

Hydrogen filler

It is used to fill hydrogen in a metal hydride storage canister. (HYDROFIL manufactured by Horizon)

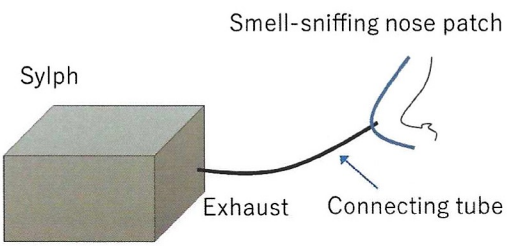
Cylinder Adapter

It is used to be connected when supplying carrier gas from a source other than a hydrogen storage alloy canister.
A 1/8" SUS tube can be connected to the main source.



Connection tube for smell-sniffing nose patch

It is used to connect a smell-sniffing nose patch with the gas exhaust port.
Commercially available disposable nose patches can be easily used.



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