

AS **ALS PRODUCT CATALOG** **2012**



PDF version



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Spectroelectrochemistry

Instrumentation

Working Electrodes

Counter Electrodes

Reference Electrodes

Voltammetry Cells

Flow Cells

Others

• Product appearance, specifications and price may change without notice for improvement. • The product color could be different from the printed photo. • The dimensions mentioned in the catalog are not guaranteed as the dimensions of the actual products. • The contents of this catalog is current as of May 2012.

Spectroelectrochemistry & Electrochemical Instrumentation

1

Spectroelectrochemistry

Spectroelectrochemistry (SEC) is aimed at the investigation of electrochemical reaction mechanism and the interface structure between electrolyte solution and electrode. Remarkable progress in this field and related technology enables SEC to be applied in wide areas. Nowadays, the relation between absorbance and potential for reversible or quasi-reversible system is theoretically elucidated, on which basis the analysis of electrochemical characteristics becomes possible for the system otherwise difficult with only the result of voltammogram. Typical example is redox enzyme cytochrome c and methylene blue.

Application

- Real-time monitoring of chromatic change by redox reaction
- Analysis of the charge transfer at the electrode/liquid surface
- Spectrometric measurement of near/surface of electrodes
- Absorbing spectrum of the product and intermediate
- Parameters: concentration, diffusion coefficient and life time

Spectroelectrochemical cell

SEC-C Thin Layer Quartz Glass Spectroelectrochemical cell kit uses platinum or gold mesh electrode as a working electrode. We offer 0.5 and 1.0 mm optical path length cells. After setting the mesh electrode, the activity area for the cell is about 6 mm diameter with a center at 15 mm of the bottom. For reference electrode, the RE-1B or RE-7 is recommended.

Feature

- Two variety optical path length (0.5 and 1.0 mm)
- Designed to use the 6.0 mm reference electrode
- Two variety of working electrodes (Au or Pt)
- Be able to use in a standard spectrometer

Set up

SEC-C Thin Layer Quartz Glass Spectroelectrochemical cell Kit



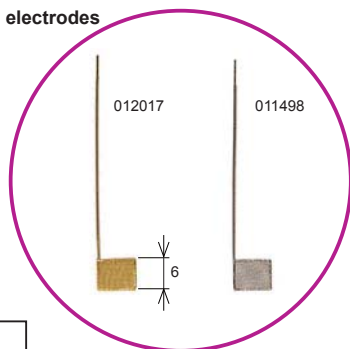
SEC2000-US/VIS Spectrometer System

SEC2000-US/VIS Spectrometer is specially designed for spectroelectrochemical measurements. In the light source, the lens was incorporated to the light in a small module, then the fiber optics needed is eliminated.

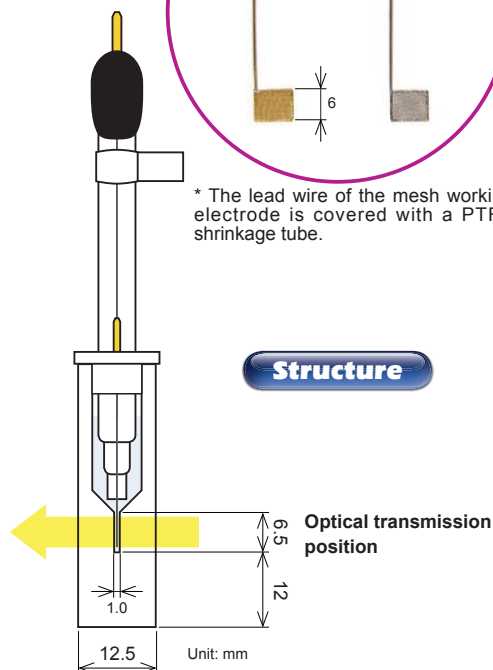


Optical path length 1.0 mm cell

Kinds of working electrodes



* The lead wire of the mesh working electrode is covered with a PTFE shrinkage tube.



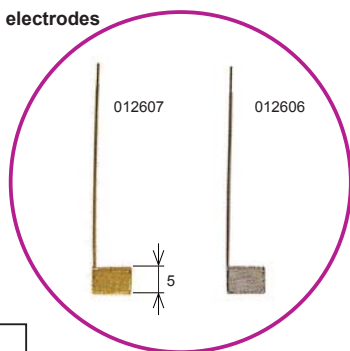
Optical path length 1.0 mm cell

The optical path length 1.0 mm is most suitable for basic spectrum electrochemistry measurements. Theoretically, it is possible to get the same result as for 0.5 mm with a half concentration sample.

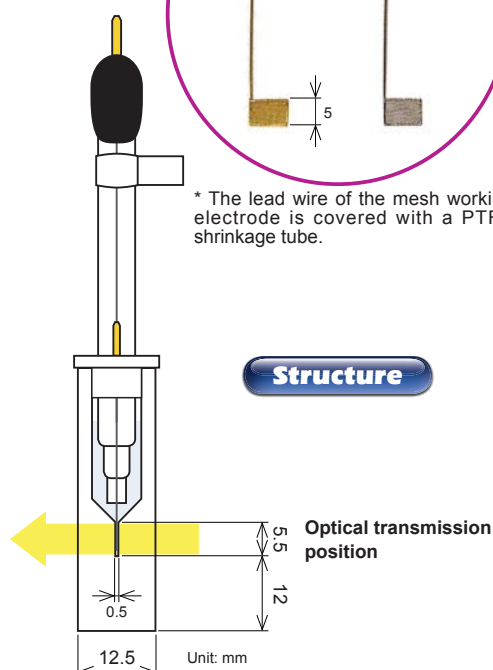
Catalog No.	Description
012904	SEC-C Thin Layer Quartz Glass Spectroelectrochemical cell Kit (Pt)
012905	SEC-C Thin Layer Quartz Glass Spectroelectrochemical cell Kit (Au)
Common Components	
012906	SEC-C Pt counter electrode
012907	SEC-C Thin Layer Quartz Glass cell
011501	SEC-C Teflon Cap
(010537)	Purging tube 10 cm
Working Electrodes	
011498	SEC-C Pt Gauze working electrode
012017	SEC-C Au Gauze working electrode
Optional items	
012167	RE-1B Silver-Silver chloride reference electrode
012171	RE-7 Non Aqueous reference electrode

Optical path length 0.5 mm cell

Kinds of working electrodes



* The lead wire of the mesh working electrode is covered with a PTFE shrinkage tube.



Optical path length 0.5 mm cell

The optical path length 0.5 mm has an electrolysis time shorter than 1.0 mm cell. The stability short time for the electrolysis makes possible to have a stable result as for, measurement of the high volatile organic solvent, detection of the unstable electrolysis products, and others.

* There is a specific working electrode for 0.5 mm optical path length. The working electrode for 1.0 mm optical path length can not be used in 0.5 mm optical path length quartz cell.

Catalog No.	Description
012813	SEC-C05 Thin Layer Quartz Glass Spectroelectrochemical cell Kit (Pt)
012814	SEC-C05 Thin Layer Quartz Glass Spectroelectrochemical cell Kit (Au)
Common Components	
012609	SEC-C05 Pt counter electrode
012815	SEC-C05 Thin Layer Quartz Glass cell
011501	SEC-C Teflon Cap
(010537)	Purging tube 10 cm
Working Electrodes	
012606	SEC-C05 Pt Gauze working electrode
012607	SEC-C05 Au Gauze working electrode
Optional items	
012167	RE-1B Silver-Silver chloride reference electrode
012171	RE-7 Non Aqueous reference electrode

Comparison of 0.5 and 1.0 optical path length cell

The electrolysis stabilization time for the 0.5 mm optical path length cell is theoretically a half, compared with the 1.0 mm cell. It is the opposite, for the concentration, when the same result for the 1.0 mm cell is possible for a half of the concentration compared with the 0.5 mm cell. You could select the optical path length and the working electrode appropriate for your research purpose.

Optical path length	Merit	Demerit
0.5 mm	High electrolytic speed	Difficult maintenance
1.0 mm	Easy maintenance	Slow electrolytic speed

For the comparison of the 0.5 and 1.0 optical path length cells, there is a difference between the theoretical and experimental values. It is in consequence of the experimental conditions.



Fig.1-1. Absorbance for electrolysis performed with 0.5 mm optical path length cell

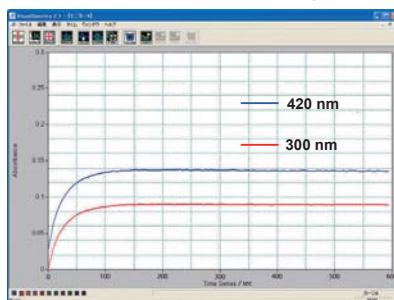
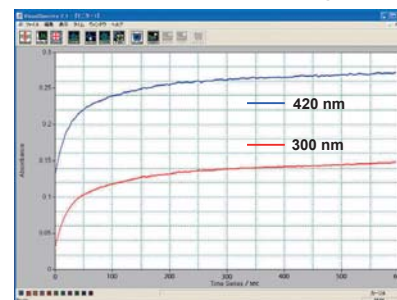


Fig.1-2. Absorbance for electrolysis performed with 1.0 mm optical path length cell



A 2 mM potassium ferrocyanide ($K_4[Fe(CN)_6]$) was subjected to an electrolysis reaction at 0.6 V until its stability, and 1 M KNO_3 was used as a reference. The oxidation reaction was monitored by the comparison of the absorbance in function of the time at wavelengths of 420 and 300 nm.

Measurement example using cuvette type spectroelectrochemical cell

UV-visible absorption spectrum and absorbance of the product of the electrode reaction, performed with optically transparent electrode (OTE), were measured. Gold or Platinum mesh electrode was used as an OTE. Absorbance (Figure 2-2) and the oxidation and reduction results (Figure 3-1, 3-2) of the 1 mM potassium ferrocyanide performed in a SEC-C Thin Layer Quartz Glass Spectroelectrochemical cell are shown below.

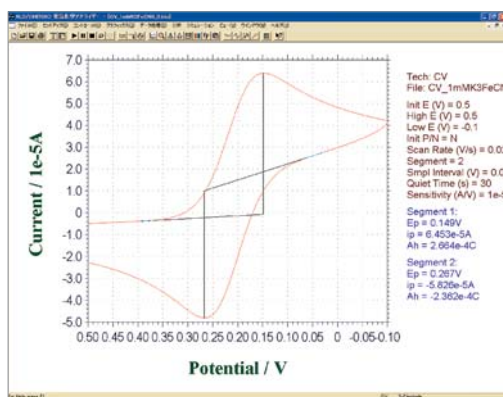


Fig.2-1. Cyclic voltammery for 1 mM potassium ferrocyanide.

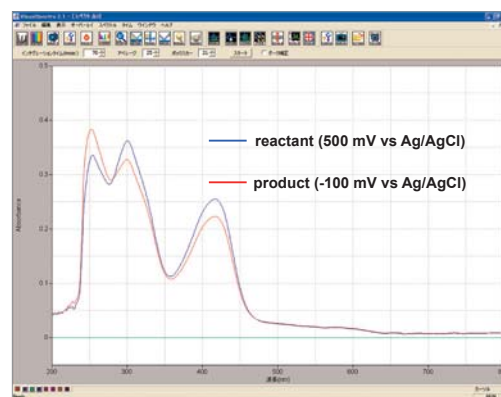


Fig.2-2. Absorbance for 1 mM potassium ferrocyanide.

Simultaneous measurements of the cyclic voltammery and absorbance as well a constant potential electrolysis measurement were also performed. The electrolysis, reduction (Figure 3-1) and oxidation (Figure 3-2), of the potassium ferrocyanide solution are shown below.

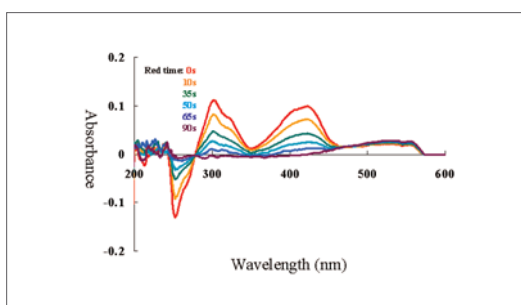


Fig.3-1. Absorbance changes for the reduction of the potassium ferrocyanide.

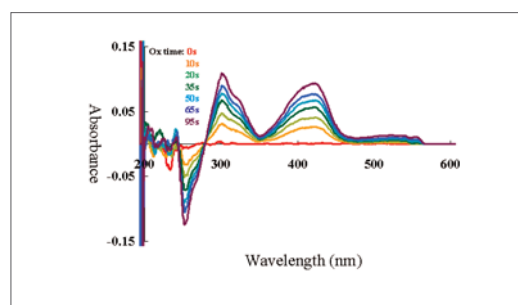


Fig.3-2. Absorbance changes for the oxidation of the potassium ferrocyanide.

SEC2000 Spectrometer System

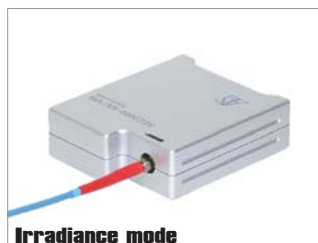
One system for three measurement modes: Transmittance, Fluorescence, Irradiance.



Transmittance mode



Fluorescence mode



Irradiance mode

SEC2000 Spectrometer, a multi-channel spectrometer, is specifically designed for spectroelectrochemical measurements. The combination of the spectrometer and light source allows having UV/VIS and VIS/NIR modes. In the light source, the lens is incorporated to the light in a small module, then it eliminates the need of fiber optics.

Feature

- Three modes in one system
- Real-time analysis
- Quantitative analysis (Linear equation and Automatic calculation of correlation function)
- Accurate and fast analysis
- Small, light and best price

Application

- Spectroelectrochemical measurements
- Analysis of solution properties
- Film thickness/composition
- Fluorescence detection
- Environmental (water and soil) analysis

Model	SEC2000-UV/VIS	SEC2000-VIS/NIR	
Catalog No.	012838	012598	
Specification			
Spectrometer	Description	SEC2000-UV/VIS	SEC2000-VIS/NIR
	Detector	2048 pixels CCD array	
	Wavelength range	220 - 800 nm	500 - 1000 nm
	Grating	Blazed at 400 nm	Blazed at 750 nm
	Resolution	1.8 ± 0.2 nm: standard slit (50 x 1000 μm) *1	
	Accuracy	< 1 % at a Abs	
	Dark noise	< 2 mAbs	
	A/D resolution	14 bit	
	Optical entrance	SMA905	
	Interface	USB 2.0	
	Operating system	Windows™ XP / 7	
	Size (W x D x H)	98 x 118 x 35 mm	
Cell holder			
	SEC2000-CUV	SEC2000-CUV-D	
Light source	Description	SEC2000-DH	SEC2000-TH
	Light type	deuterium & tungsten halogen*2	tungsten halogen*4
	Spectral range	200 - 1100 nm	360 - 2000 nm
	Power consumption (240 nM)	> 5×10 ⁻⁸ W/nmsr	-
	Stability	1×10 ⁻³ AU	-
	Drift	< 0.25 %/h	-
	Bulb life	> 1000 h (D2 lamp)*3 > 2000 h (halogen)	1500 h
	Lamp description	SEC2000-DH bulb	SEC2000-TH bulb
	Others	SEC2000-DH-RNG	SMA905
	Size (W x D x H)	98 x 118 x 35 mm	
Software	Visual Spectra		

*1. Slit could be selected from: 10, 25, 100, 200 μm. *2. Standard SEC2000-DH does not include optic fiber connector. Setting the SMA ring, it will be possible to connect the collimating lens (optional item) to have a SMA905 terminal for fiber connection. SEC2000-UV/VIS and VIS/NIR applied together, for the improvement of the measurement reliability, wavelength range is restricted. *3. Value for less than 50% power consumption of 240 nm. *4. SEC2000-TH includes optic fiber connector (SMA905).

Spectrometer



Cell holder



SEC2000-CUV



SEC2000-CUV-D

Lightsource



SEC2000-DH

SEC2000-DH-RNG



SEC2000-TH

Spectroelectrochemical Flow Cell

SEC-2F Spectroelectrochemical flow cell



Feature

- Thin-layer cell measurement
- Variety of working electrode
- Direct set to SEC2000 Spectrometer
- Connection with an optical fiber for Spectrometer other than SEC2000*

* Require additional optical fiber and collimating lens.

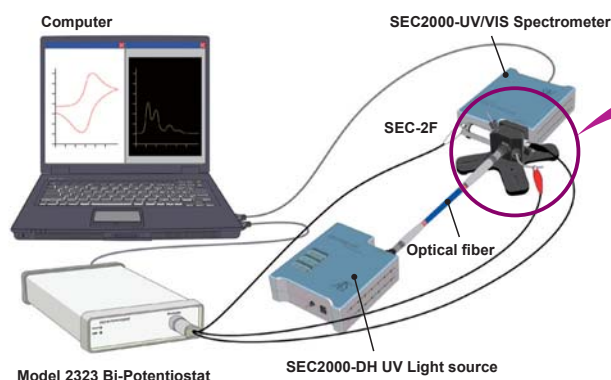
Catalog No.	Description
012660	SEC-2F Spectroelectrochemical flow cell

Using the spectroelectrochemical flow cell, it is possible to have a different optical path length changing the gasket. We offer, as an optional item, a silicon and Teflon gasket with a 100, 250 and 500 μm of the thickness.

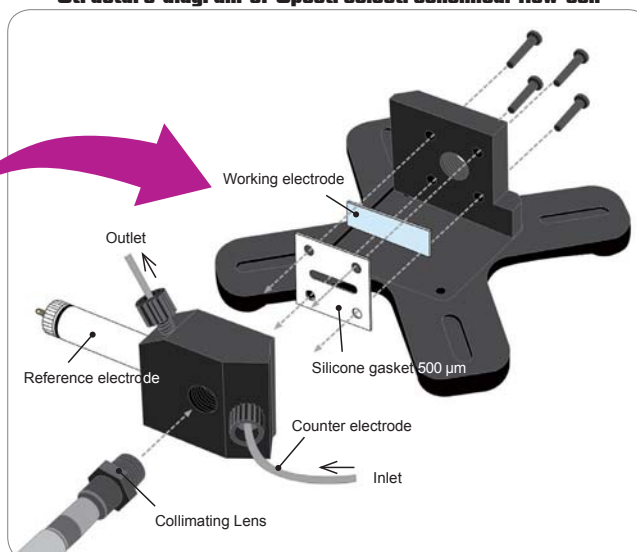
SEC-2F Spectroelectrochemical flow cell was designed to fit perfectly in the SEC2000 Spectrometer, and it eliminated the use of the optical fiber to connect the Spectrometer to the SEC-2F. Even for another brand of the spectrometer, you can connect the SEC-2F using the collimating lens and optical fiber.

Depending on the research purpose you can select the working and reference electrodes. For working electrode, we offer: ITO and platinum, gold or carbon grid electrodes. For reference electrode: RE-3V Ag/AgCl and RE-7V non-aqueous references electrodes.

Composition



Structure diagram of Spectroelectrochemical flow cell



Optional

1) Gasket

Catalog No.	Description	Thickness
012661	SEC-2F S500 Silicone Gasket, 4pcs	500 μm
012664	SEC-2F T500 Teflon Gasket, 4pcs	500 μm
012665	SEC-2F T250 Teflon Gasket, 4pcs	250 μm
012666	SEC-2F T100 Teflon Gasket, 4pcs	100 μm

2) The full list of the working electrodes are shown in the next page.

3) Reference electrode

Catalog No.	Description
012169	RE-3V Ag/AgCl reference electrode
012170	RE-3VP Ag/AgCl reference electrode
012173	RE-7V Non Aqueous reference electrode
012174	RE-7VP Non Aqueous reference electrode

4) Optical fiber

Catalog No.	Description
012667	SEC-2F 400 μm Optical Fiber SR 25 cm
012685	SEC-2F 400 μm Optical Fiber SR 2 m
012234	UV/VIS Collimating Lens, 200-2000 nm

Comparison of the absorbance for different gasket thickness

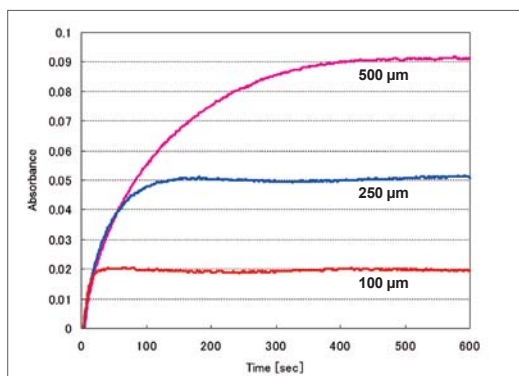


Fig.4-1. Changes of the equilibrium time in different gasket thickness.

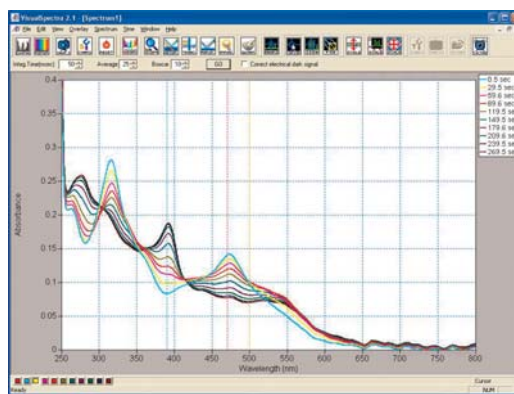


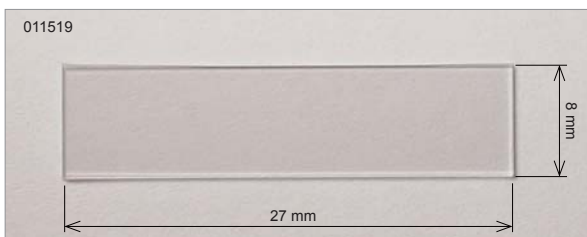
Fig.4-2. Electrolysis spectrum change of Vitamin B₁₂ derivative complex.

The absorbance stability, at 420 nm, of the electrolysis of the potassium ferrocyanide, in function of time, was investigated using 100, 250 and 500 μm thickness gasket. For the measured sample, using the 100 μm gasket, in 40 seconds the equilibrium was shown (Figure 4-1). The 250 μm gasket was used for the monitoring of the electrolysis spectrum of the vitamin B₁₂ derivative complex (Figure 4-2).

Spectroelectrochemical Electrodes

ITO Optically transparent electrode

ITO (Indium Tin Oxide) electrode is generally used for spectroelectrochemical measurements. ITO electrode transmits the light of the visible range, but do not transmit the light of ultraviolet range. The thickness of the ITO membrane is 100 ± 20 nm, and the resistivity is 20 Ω/sq*¹.



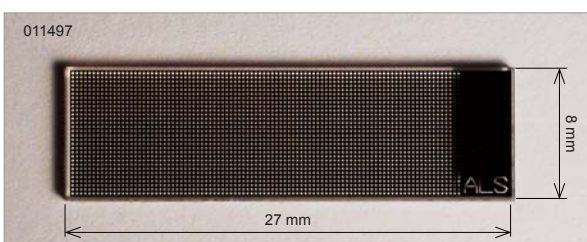
Catalog No.	Description	Qty
012658	SEC-2F ITO electrode, 8 x 27 x 1 mmt* ²	4
011465	IITO electrode, 8 x 27 x 0.5 mmt	12
Others* ³		
011827	ITO disk, 4 inch x 0.5 mmt	1
011233	ITO electrode, 10 x 10 x 0.5 mmt	30
010887	ITO electrode, 10 x 20 x 0.5 mmt	10

*1. The manufacturer guarantee value. *2. The substrate thickness for SEC-2F ITO electrode is 1 mm, otherwise is 0.5 mm.

*3. Custom-made ITO electrode is also available. Contact with the sales representative or local distributor for further information.

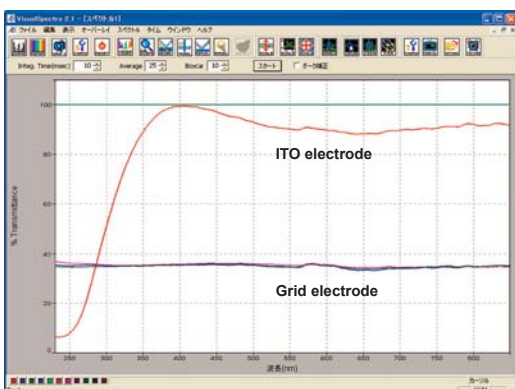
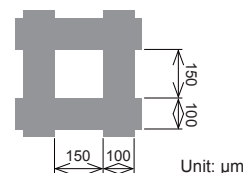
Grid Electrode

Grid electrode is produced by the deposition of the platinum, gold or carbon onto the quartz glass. The dimension of the glass is 8 x 27 mm, with a 1 mm of the thickness, and the grid line is 100 μm width with a distance of the 150 μm between lines.



Catalog No.	Description	Qty
012655	SEC-2F Pt grid electrode for flow cell	1
012656	SEC-2F Au grid electrode for flow cell	1
012657	SEC-2F Carbon grid electrode for flow cell	1

Schematic diagram of the grid



The light transmission rate was compared with ITO electrode and Grid electrode (Au, Pt and Carbon) on a quartz glass as a reference. For ITO electrode the light cannot be transmitted easily in an ultraviolet range. The transmittance is about 10% at 250 nm of the wavelength. For wavelength above 350 nm the transmission rate is above 90%. Compared with the quartz glass, the light transmission for grid electrode is about 35 – 40%, however it could be used in an ultraviolet range.

Reference data:

The light transmission is 50 – 55% for SEC-C Platinum mesh electrode.

2

Instrumentation

RRDE-3A Rotating Ring Disk Electrode Rotator

Detection of intermediate products by hydrodynamic voltammetry



Catalog No.	Description
012623	RRDE-3A Rotating Ring Disk Electrode Rotator Ver.1.2
Specification	
Rotational range	100 - 8,000 rpm
Setting resolution	1 rpm
Accuracy	< 0.1 %
Rotation control type	PLL (Phase-locked loop)
Band width	60 Hz at 3,500 rpm base and 1,000 rpm peak-to-peak modulation
Power	100 - 240 VAC, 50/60 Hz
Size (W x D x H)	185 x (Base: 230, Body: 120) x 400 mm
Weight	6 kg
Temperature	10 - 50 deg C
Accessories	
012632	Cell vial 100 mL
012631	Teflon cap for RRDE-3A
012064	Spin-coating adaptor
012065	Male connector for gas purge (PP)
010058	TYGON tubing, OD1/4 x ID1/8 (1.3m)
011169	RDE GCE Glassy carbon Disk Electrode
012167	RE-1B Reference electrode
002233	Pt Counter electrode 5 cm
012642	Silicon sheet 100 x 180 mm
	supply cable
	Instruction manual

RRDE-3A is a miniature rotator system for use constant in rpm and hydrodynamic modulation rotating ring disk electrochemistry. The RRDE-3A is electronically controlled by a proportional-integral closed loop circuit driving as a DC servomotor. Electrodes are small and rapidly interchangeable. The unit also provides an adjustable valve system for inert gas purging inside the cell vial.

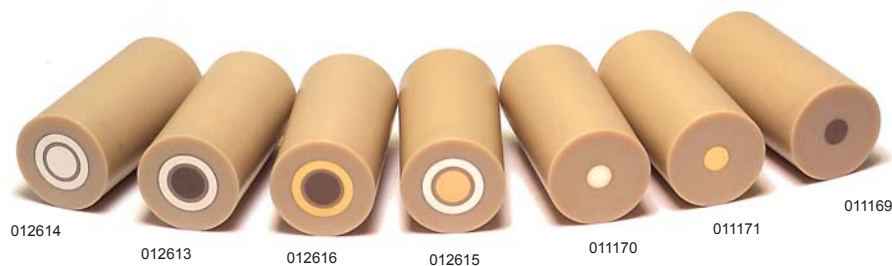
Feature

- Operatable as RDE and RRDE systems
- Remote and manual controlled rotation and gas purge
- Compact design & Easy operation
- Cell lead connects to all potentiostats

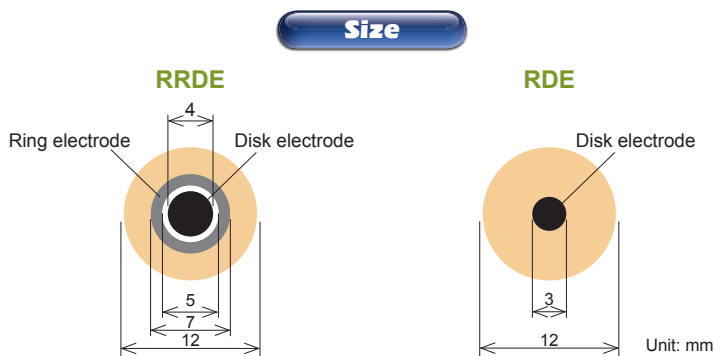
Option

Catalog No.	Description
012177	Sample holder dia 9 mm, 2 pcs
012171	RE-7 Non Aqueous reference electrode
012961	Pt counter electrode 23 cm
012962	Au counter electrode 23 cm
012963	Ni counter electrode 23 cm
012641	O-ring for RRDE-3A Bearing assembly, 10 pcs

Appendix. Electrodes and accessories



The Ring-Disk and Disk electrodes listed below are working electrodes for RRDE-3A Rotating Ring Disk Electrode Apparatus. Organic solvent resistant resin, PEEK, is used as an insulator, and it can be polished with PK-3 Electrode Polishing kit.



RRDE Ring disk electrode was improved to facilitate the handling to obtain a chemically modified electrode. Using the new RRDE Ring Disk Electrode, a dropped sample is kept on the disk, without spreading the sample to the ring electrode.

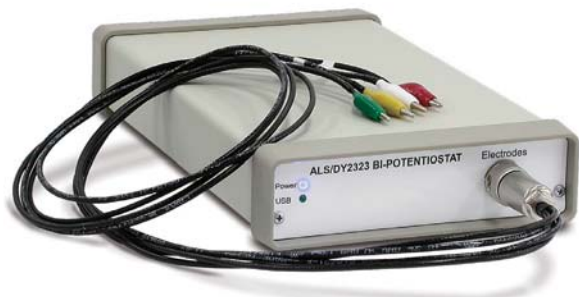
List

Catalog No.	Description	Electrode size		Isolation OD	Length
		Ring (OD/ID)	Disk		
Ring Disk Electrodes					
012613	RRDE Pt Ring/GC Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
012614	RRDE Pt Ring/Pt Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
012615	RRDE Pt Ring/Au Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
012616	RRDE Pt Ring/Au Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
012617	RRDE Au Ring/Pt Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
012653	RRDE Au Ring/Au Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
012618	RRDE GC Ring/GC Disk Electrode	7 mm / 5 mm	4 mm	12 mm	25 mm
Disk Electrodes					
011169	RDE GCE Glassy carbon Disk Electrode	-	3 mm	12 mm	25 mm
011170	RDE PTE Platinum Disk Electrode	-	3 mm	12 mm	25 mm
011171	RDE AUE Gold Disk Electrode	-	3 mm	12 mm	25 mm
011966	RDE ALE Aluminum Disk Electrode	-	3 mm	12 mm	25 mm
011967	RDE AGE Silver Disk Electrode	-	3 mm	12 mm	25 mm
011968	RDE CUE Copper Disk Electrode	-	3 mm	12 mm	25 mm
011969	RDE NIE Nickel Disk Electrode	-	3 mm	12 mm	25 mm
011970	RDE TAE Tantalum Disk Electrode	-	3 mm	12 mm	25 mm
011971	RDE TIE Titanium Disk Electrode	-	3 mm	12 mm	25 mm
011972	RDE WE Tungsten Disk Electrode	-	3 mm	12 mm	25 mm
011973	RDE CPE Carbon paste Disk Electrode*	-	3 mm	12 mm	25 mm

*001010 CPO Carbon paste is sold separately. Note that the carbon paste is not filled up.

Model 2323 Bi-Potentiostat

Low-price and high-performance electrochemical analyzer



Feature

- Bi-Potentiostat
- High-performance
- Compact design
- RRDE system control
- Wide applications

Model 2323 is a very low-price and high-performance Bi-Potentiostat based on modern semiconductor circuitry and advanced software technology.

Low noise, high speed and small space measurement were considered for the development of Model 2323. The user-friendly interface is designed for supporting wide applications.

Model 2323 is a bi-potentiostat whereas it is compact size. Seven steps sensitivity selection is possible for each channel. There are analog filter, high impedance voltage amplifier, and 16-bit DAC for each channel. 16-bit ADC is used for the data acquisition.

The software is designed as a user-friendly interface for experimental setup, graphic display, data analysis, and data file management. Low pass filter, smoothing, remove DC offset, plot segments, and fast Fourier transform are possible in the data processing function. Furthermore the rotation speed remote control for RRDE-3A Rotating Ring Disk Electrode System is possible.

Model 2323 can be applied in various experiments, such as RRDE, sensor development and spectroelectrochemical measurements, etc. It can be not only applied for research purpose, but also for student experiments and industrial applications due to the low-price and high-performance.

Catalog No.	Description
012269	Model 2323 Bi-Potentiostat
012800	Model 2323 Software
Specification	
Potential range	±4 V
Current range	±50 mA
Sensitivity range	1×10 ⁻⁷ - 0.05 A/V
Input impedance	1×10 ¹² Ω
Min. Potential Step	1.0 mV
Maximum sampling rate	10 kHz
Background current	< 0.2 nA
Current Resolution	3 pA
Scan rate (CV)	1×10 ⁻³ - 10 V/sec
Dimensions (W×D×H)	150 × 260 × 50 mm
Weight	1 kg
Operating system	Windows™ XP / Vista / 7
Software Techniques & Measurement range	
CV	1×10 ⁻³ - 10 V/sec
LSV	1×10 ⁻³ - 10 V/sec
i-t	1×10 ⁻⁴ - 10 sec (sampling interval)
OCP-T	1×10 ⁻⁴ - 10 sec (sampling interval)
RDE (0-10 V output)	0 - 10 V output

Software



Model 2323 is digital controlled by PC software, whereas its price is almost the same to the analog equipment. Dual channel CVs measured by Bi-Potentiostat can be plotted simultaneously on the software window. It is easy to overlay the CV curves for data comparison and the peak fitting function necessary for the data analysis is also included. In the setup screen, the rotation speed of the RRDE and gas purge ON/OFF can be controlled. The Model 2323 software is quite easy-to-use, even the beginners of the electrochemical measurements can easily work on it for the first time try.

CS-3A Cell Stand

Faraday cage for electrochemical measurements



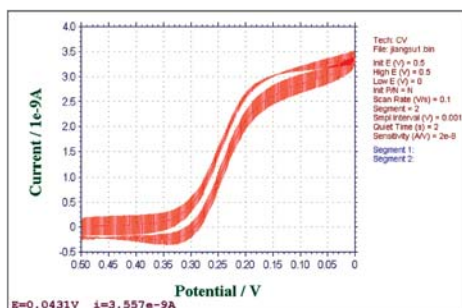
Feature

- Reduction of external electrical interference
- Gas purge ON/OFF remote control
- Manual and remote ON/OFF control of magnetic stirrer

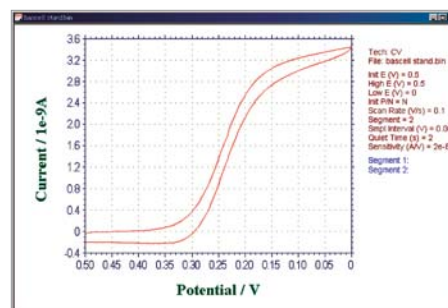
Catalog No.	Description
012779	CS-3A Cell Stand Ver.1.1
Specification	
Power supply	100 VAC - 240 VAC, 50/60 Hz
Fuse	1 A
Gas pressure	< 34 kPa
Size (W x D x H)	286 x 230 x 320 mm
Weight	3.8 kg
Temperature	10 - 50 deg C

CS-3A Cell Stand is specifically designed to use a variety of solid electrodes conveniently and cell accessories available from ALS. The working cell is enclosed in a Faraday cage to reduce electrical interference. A built-in gas control allows purging of the sample. Gas line is provided to purge the next sample, while analyzing the present sample separately, thus increasing productivity. Magnetic stirrer allows for controlling the mixing of the sample for experiments requiring mass transfer of electrolyte or analyte to the electrode surface.

CV measurement performed with Microelectrode



Noise level without CS-3A Cell Stand



Noise level with CS-3A Cell Stand

The measured current value using the Microelectrode is very small, and it becomes vulnerable for external noise. CS-3A could avoid the experimental irregular result, a result caused by the external noise.

Model 100 Syringe Pump 2 ch

Small size - light - high efficiency syringe pump



Feature

- Dual syringe pump
- Liquid crystal display
- Excellent operation of user interface
- Variety of syringes in different size
- Alarm verification

Model 100 applies a micro-step motor mechanism permitting the application at a low flow rate. The liquid crystal display makes easily the setup of the flow rate and operation time. It shows an excellent stability in the flow rate. The flow rate could be adjusted in range of 0.001 $\mu\text{L}/\text{min}$ to 90 mL/min. Because of the wide range of the flow rate, this pump could be applied in flow injection analysis, and sensor and microdialysis researches. The setup configuration is remained internally and it is possible to repeatedly investigate with the same conditions.

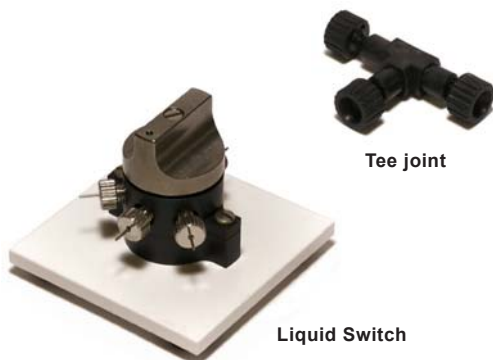
Name for each part

- | | |
|-------------------------|---------------------------------|
| 1. Push block | 6. Power Lamp |
| 2. Quick Release Nut | 7. Stop Pause and Start Buttons |
| 3. Spring Loaded Clamps | 8. Navigation Keypad |
| 4. Safety Nut | 9. LCD Interface |
| 5. Lead screw | 10. Numeric Keypad |



Push/Pull adaptor (optional)

The suction of the sample could be performed using the push/pull adaptor. It will reduce the backpressure which will prevent the leakage at the tube joint and avoid that the air bubbles enter.



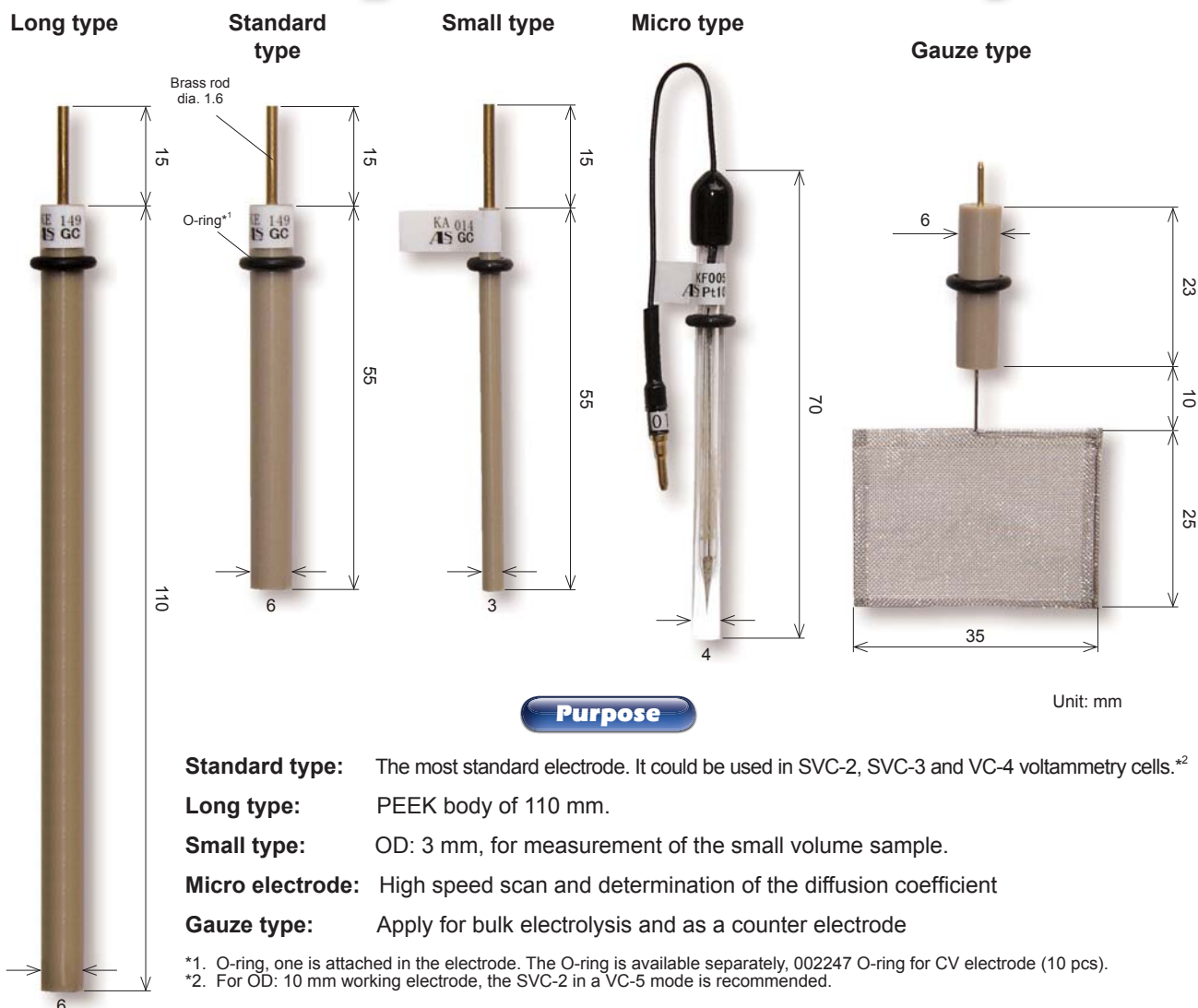
Specification	
Syringe size	0.5 μL - 60 mL
Power supply	AC100 - 240 V, 50/60 Hz
Mechanism	Stepping motor
Resolution	0.196 $\mu\text{m}/\text{step}$
Flow rate range	0.001 $\mu\text{L}/\text{min}$ (10 μL syringe) - 90 mL/min (60 mL syringe)
Size (W x D x H)	240 x 170 x 10 mm
Weight	2.6 kg
Temperature	-25 - 80 deg C
Humidity	20 - 80 % RH
Catalog No.	012654

Option		Qty
009019	ALS105 syringe 10 μL	1
009026	ALS105 syringe 250 μL	1
009021	ALS105 syringe 0.5 mL	1
009020	ALS105 syringe 1.0 mL	1
009022	ALS105 syringe 2.5 mL	1
009023	ALS105 syringe 5.0 mL	1
009521	FEP tubing, ID 0.12mm	1 m
009520	FEP tubing, ID 0.15mm	3 m
009500	Tubing adaptor	10
011621	Liquid Switch	1
012771	Push-Pull adaptor	1
000715	Tee joint	2

3

Working Electrodes

General Working Electrodes for Voltammetry



CPO Carbon Paste Oil



Carbon Paste Oil (CPO) is prepared by mixing uniform-sized graphite powder and paraffin oil. This product is applied to Carbon Paste Electrode to have:

- 1) simple enzyme electrodes
- 2) chemically modified electrodes

It could not be used in an organic solvent. Keep the container closed to avoid contamination.

How to prepare carbon paste electrode:

- 1) Mix and homogenize the compound to be analyzed in the CPO
- 2) Fill tightly into the electrode hole with a small spatula
- 3) Remove the excess CPO and polish the surface of the electrode with circular movement on the clean paper.

Catalog No.	Description
001010	CPO Carbon paste Oil Base 1 g

Full Listing of Working Electrodes

Catalog No.	Description	Isolation	Specification	
002250	Platinum gauze electrode	PEEK	80 mesh	35×25 mm
002251	Gold gauze electrode	PEEK	100 mesh	35×25 mm
012744	LGCE Glassy Carbon electrode	PEEK	OD: 6 mm	ID: 3 mm
002417	GCE Glassy Carbon electrode	PEEK	OD: 10 mm	ID: 5 mm
002012	GCE Glassy Carbon electrode	PEEK	OD: 6 mm	ID: 3 mm
012297	GCE Glassy Carbon electrode	PEEK	OD: 6 mm	ID: 1.6 mm
002411	GCE Glassy Carbon electrode	PEEK	OD: 6 mm	ID: 1 mm
012298	SGCE Glassy Carbon electrode	PEEK	OD: 3 mm	ID: 1.6 mm
002412	SGCE Glassy Carbon electrode	PEEK	OD: 3 mm	ID: 1 mm
002002	MCE Micro Carbon fiber electrode	Glass	OD: 4 mm	ID: 33 μm
002007	MCE Micro Carbon fiber electrode	Glass	OD: 4 mm	ID: 7 μm
012746	LAUE Gold electrode	PEEK	OD: 6 mm	ID: 3 mm
002418	AUE Gold electrode	PEEK	OD: 10 mm	ID: 5 mm
002421	AUE Gold electrode	PEEK	OD: 6 mm	ID: 3 mm
002014	AUE Gold electrode	PEEK	OD: 6 mm	ID: 1.6 mm
002314	SAUE Gold electrode	PEEK	OD: 3 mm	ID: 1.6 mm
002010	MAUE Micro gold electrode	Glass	OD: 4 mm	ID: 100 μm
002004	MAUE Micro gold electrode	Glass	OD: 4 mm	ID: 25 μm
002006	MAUE Micro gold electrode	Glass	OD: 4 mm	ID: 10 μm
012745	LPTE Platinum electrode	PEEK	OD: 6 mm	ID: 3 mm
002420	PTE Platinum electrode	PEEK	OD: 10 mm	ID: 5 mm
002422	PTE Platinum electrode	PEEK	OD: 6 mm	ID: 3 mm
002013	PTE Platinum electrode	PEEK	OD: 6 mm	ID: 1.6 mm
002313	SPTE Platinum electrode	PEEK	OD: 3 mm	ID: 1.6 mm
002009	MPTE Micro platinum electrode	Glass	OD: 4 mm	ID: 100 μm
002003	MPTE Micro platinum electrode	Glass	OD: 4 mm	ID: 25 μm
002015	MPTE Micro platinum electrode	Glass	OD: 4 mm	ID: 15 μm
002005	MPTE Micro platinum electrode	Glass	OD: 4 mm	ID: 10 μm
002416	AGE Silver electrode	PEEK	OD: 10 mm	ID: 5 mm
002419	AGE Silver electrode	PEEK	OD: 6 mm	ID: 3 mm
002011	AGE Silver electrode	PEEK	OD: 6 mm	ID: 1.6 mm
002315	SAGE Silver electrode	PEEK	OD: 3 mm	ID: 1.6 mm
002016	NIE Nickel electrode	PEEK	OD: 6 mm	ID: 1.5 mm
002273	MNIE Micro Nickel electrode	Glass	OD: 4 mm	ID: 100 μm
002252	PGBE Pyrolytic Graphite Electrode (Basal Plane)	PEEK	OD: 6 mm	ID: 3 mm
002253	PGE Pyrolytic Graphite Electrode (Edge Plane)	PEEK	OD: 6 mm	ID: 3 mm
002408	PFCE 3 Carbon electrode *1	PEEK	OD: 6 mm	ID: 3 mm
002409	PFCE 1 Carbon electrode *1	PEEK	OD: 6 mm	ID: 1 mm
011854	SPFCE 1 Carbon electrode *1	PEEK	OD: 3 mm	ID: 1 mm
002019	PDE Palladium electrode	PEEK	OD: 6 mm	ID: 1.6 mm
002319	SPDE Palladium electrode	PEEK	OD: 3 mm	ID: 1.6 mm
012585	FEE Iron electrode	PEEK	OD: 6 mm	ID: 3 mm
002018	FEE Iron electrode	PEEK	OD: 6 mm	ID: 1.5 mm
012584	CUE Copper electrode	PEEK	OD: 6 mm	ID: 3 mm
002017	CUE Copper electrode	PEEK	OD: 6 mm	ID: 1.6 mm
002271	MCUE Micro copper electrode	Glass	OD: 4 mm	ID: 25 μm
002272	MWE Micro tungsten electrode	Glass	OD: 4 mm	ID: 10 μm
002210	CPE Carbon paste electrode *2	PEEK	OD: 6 mm	ID: 3 mm
002223	SCPE Carbon paste electrode *2	PEEK	OD: 3 mm	ID: 1.6 mm

Customized electrode is also available

*1. Plastic Formed Carbon Electrode (PFCE) is created from a collaboration of MITSUBISHI PENCIL CO., LTD and National Institute of Advanced Industrial Science and Technology (AIST).

*2. 001010 CPO Carbon paste is sold separately.

Spectroelectrochemistry

Instrumentation

Working Electrodes

Counter Electrodes

Reference Electrodes

Voltammetry Cells

Flow Cells

Others

Lithography / Glass substrate Electrodes

Ring-Disk electrode

This ring-disk type electrode developed by NTT-AT is one type of printed electrodes. Users can choose Carbon, Gold and Platinum as a working electrode, use for radial flow cells, and achieve complete reduction/oxidation on the center disk at micro flow rate because of its fine coulometric electrolysis efficiency. This also enables to analyze subsequent reaction as well as identification and quantitation of the sample at the same time. Furthermore, this electrode becomes capable of measuring hydrogen peroxide at zero volt by immobilized Osmium Gel / Horse Radish Peroxidase (HRP) (developed by Prof. Adam Heller, Texas Univ.). Thus this Printed electrode comprises FIA (Flow Injection Analysis) system with combinations of various enzymes.

Feature

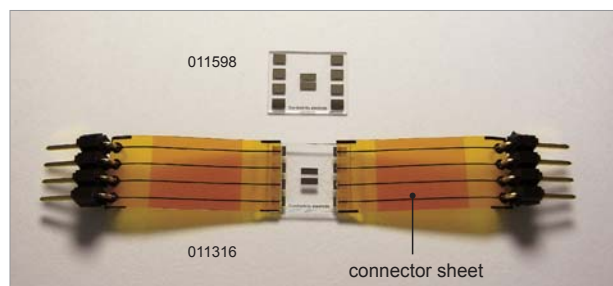
Catalog No.	Description	Qty
002081	Gold Ring disk electrode	3
002082	Platinum Ring disk electrode	3
002083	Carbon Ring disk electrode	3



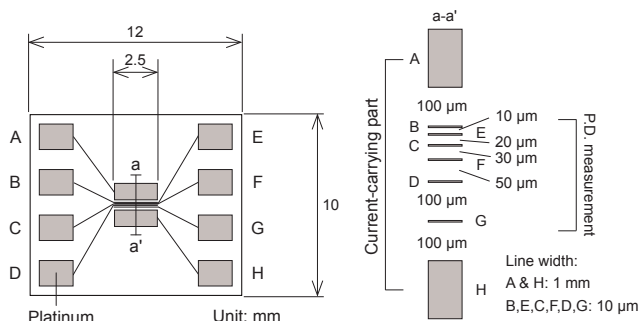
Size: 12.5 x 22 x 0.5 mm

Conductivity electrode

Platinum terminals are deposited on a fused quartz substrate as current supplying electrodes and potential difference probing electrodes. The distance between electrodes for potential difference are adjustable from 40 μm to 250 μm by changing the connect terminals.



Figure



Interval

Unit: μm

Point	B	C	D	E	F	G
B		40	140	10	80	250
C	40		90	20	30	200
D	140	90		120	50	100
E	10	20	120		60	230
F	80	30	50	60		160
G	250	200	100	230	160	

Catalog No.	Description	Qty
011316	Conductivity electrode with connector sheet*	1
011598	Conductivity electrode without connector sheet	3

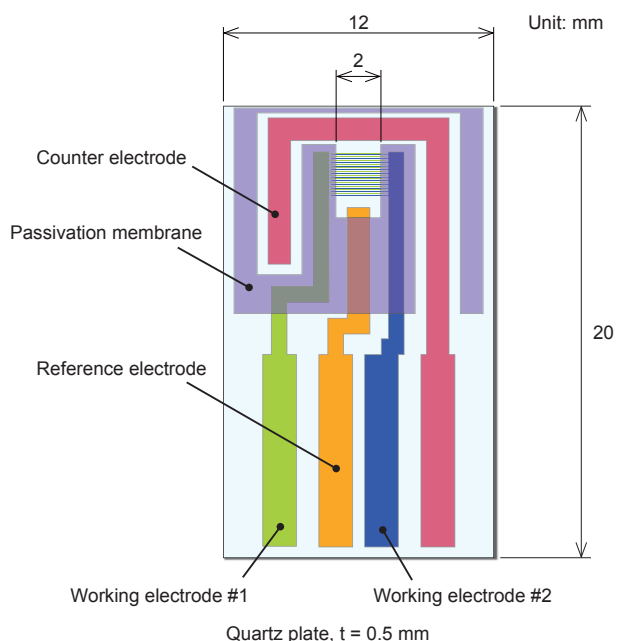
*The following connector is convenient for connection of the electrode with the connector sheet.

- 011839 Connector for printed electrodes
- 011840 IC clip for printed electrodes (4 pcs)

Spectroelectrochemistry
Instrumentation
Working Electrodes
Counter Electrodes
Reference Electrodes
Voltammetry Cells
Flow Cells
Others

IDA electrode

Interdigitated Array (IDA) electrode is an electrode developed for electrochemical measurements to be performed in a very small quantity of the sample. IDA electrode could be applied for the detection and reaction analysis of the compounds in a small quantity of the sample. IDA electrode is a microelectrode pattern fabricated by using the lithography technology. The Electrodes are composed of 65 pairs. In each one of the pair has a function of the oxidation and reduction electrodes.



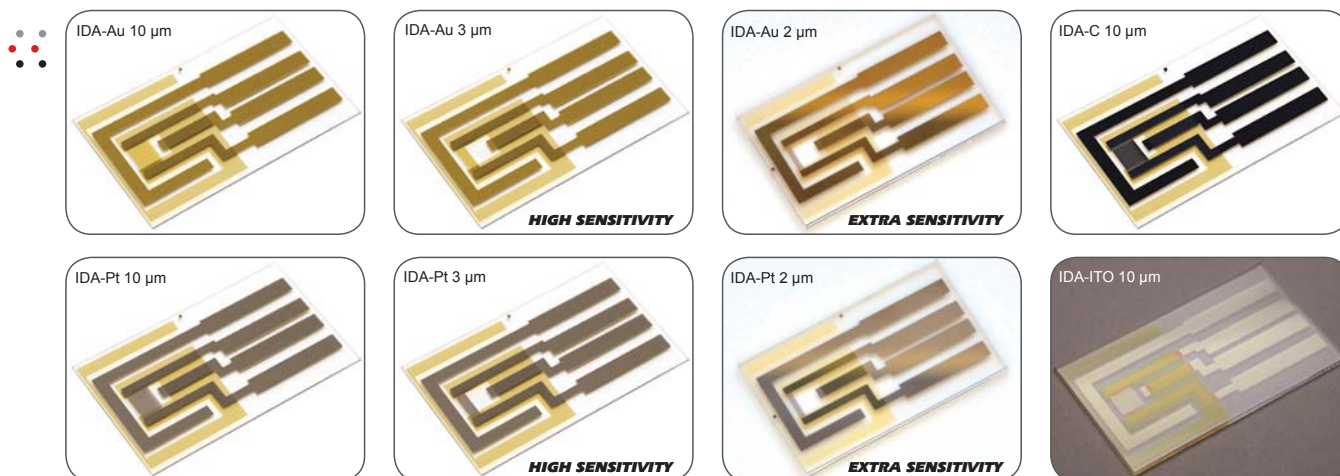
Feature

- High sensitivity CV measurement
- Electrochemical measurements in a small quantity of the sample
- Small integration
- High-speed response

Application

- Electrochemical measurements
- Conductivity measurement
- Biosensor/chemical sensor
- Chemically modified electrode
- Chemical reaction process control

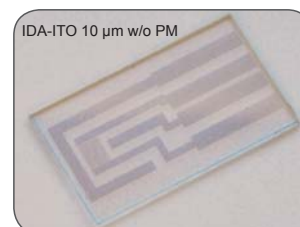
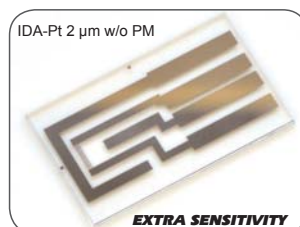
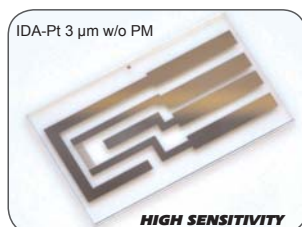
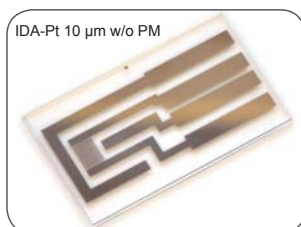
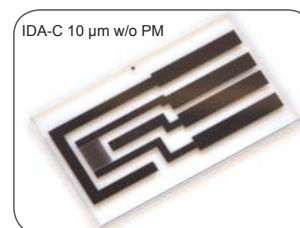
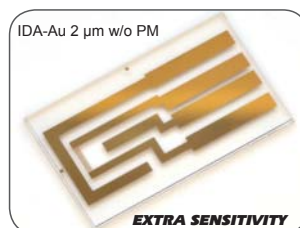
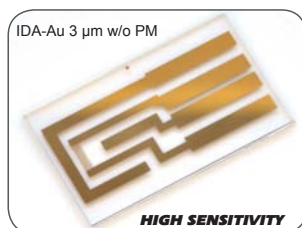
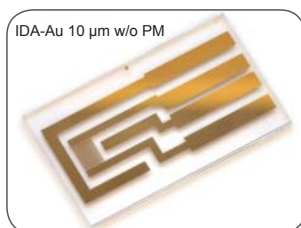
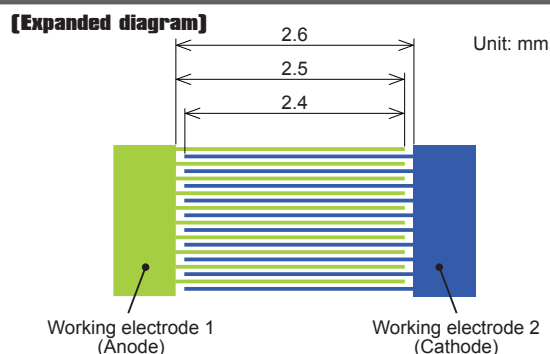
List



Catalog No.	Description	Specification				
		Width (μm)	Interval (μm)	Length (mm)	pairs	Film thickness
012125	IDA electrode (Au)	10	5	2	65	90 nm
012126	IDA electrode (Pt)	10	5	2	65	90 nm
012127	IDA electrode (C)	10	5	2	65	1.2 ± 0.1 μm
012128	IDA electrode (ITO)	10	5	2	65	100 ± 20 nm
012129	IDA electrode (Au)	3	3	2	65	90 nm
012130	IDA electrode (Pt)	3	3	2	65	90 nm
012257	IDA electrode (Au)	2	2	2	65	90 nm
012258	IDA electrode (Pt)	2	2	2	65	90 nm
011066	Cable kit for IDA electrode					
011464	Ag/AgCl Ink for reference electrode (2.0 mL)					

IDA electrode w/o passivation membrane

There is a method for the calculation of the dielectric constant from the capacitance measured from the current intensity by the application of the alternative potential through the IDA electrode. However, for an IDA electrode with a passivation membrane, the capacitance of the membrane is also measured, making impossible to obtain the exact measured value. For this purpose, IDA electrode without passivation membrane was added to the product lineup.



Catalog No.	Description	Specification				
		Width (μm)	Interval (μm)	Length (mm)	pairs	Film thickness
012259	IDA electrode (Au) 10μm without passivation membrane	10	5	2.5	65	90 nm
012262	IDA electrode (Pt) 10μm without passivation membrane	10	5	2.5	65	90 nm
012266	IDA electrode (C) 10μm without passivation membrane	10	5	2.5	65	1.2 ± 0.1 μm
012265	IDA electrode (ITO) 10μm without passivation membrane	10	5	2.5	65	100 ± 20 nm
012260	IDA electrode (Au) 10μm without passivation membrane	3	3	2.5	65	90 nm
012263	IDA electrode (Pt) 10μm without passivation membrane	3	3	2.5	65	90 nm
012261	IDA electrode (Au) 10μm without passivation membrane	2	2	2.5	65	90 nm
012264	IDA electrode (Pt) 10μm without passivation membrane	2	2	2.5	65	90 nm

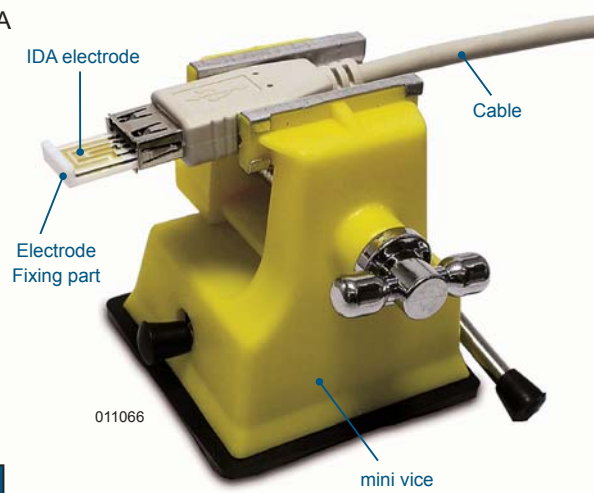
Cable kit for IDA electrode

The Cable kit is the most suitable connector for IDA electrode. Be careful when you are inserting or removing the IDA electrode, it consists of quartz glass and it can break easily.

- 1) Put the IDA electrode into the connector
- 2) Insert the teflon fixer into the connector

Composition

- Connecting cable
- Electrode Fixer (Teflon plate)
- Mini vice



Catalog No.	Description
011066	Cable kit for IDA electrode

Ag/AgCl Ink for Reference electrode



011464

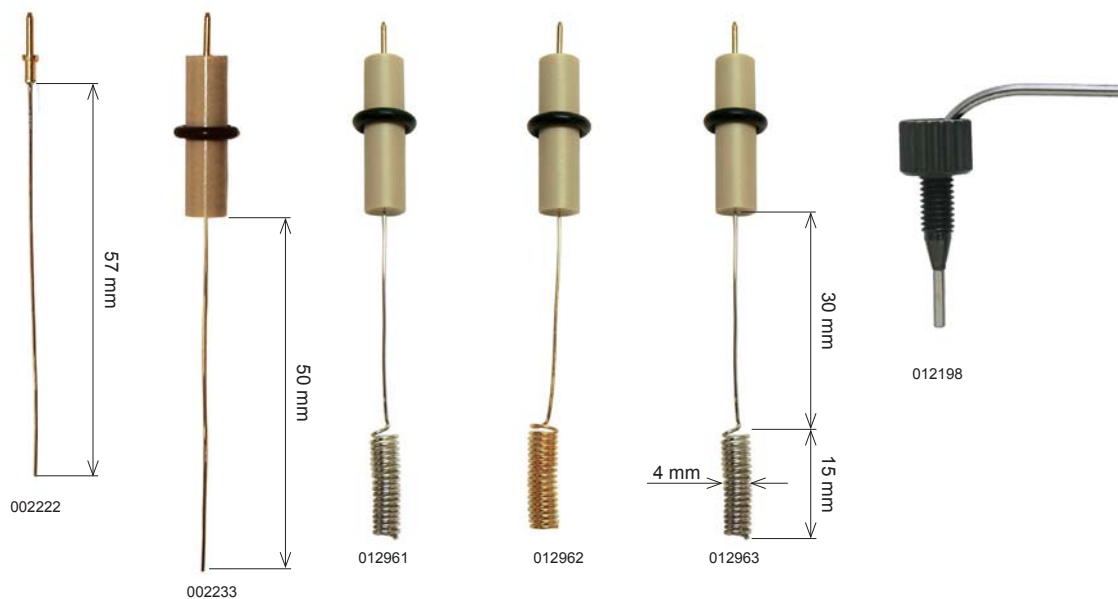
Reference electrodes can be easily prepared by coating Ag/AgCl ink on the metal (Ag, Pt, Au, etc.) surface. The only thing you are required to do is just to deposit the Ag/AgCl ink and wait for dry. The reference electrode prepared by Ag/AgCl ink is quite useful for IDA electrode, micro CV cell measurements and so on.

Catalog No.	Description
011464	Ag/AgCl Ink for reference electrode 2.0 mL
Specification	
Surface resistance	0.2 Ω/sq/25.4 μm
Viscosity	50,000 ±10,000 CP @21.1 deg C
Flash point	82 deg C

4

Counter Electrodes

Four different shapes of the counter electrodes are available. Select the counter electrodes suitable for the experimental conditions. Custom-made counter electrode is also available.



List

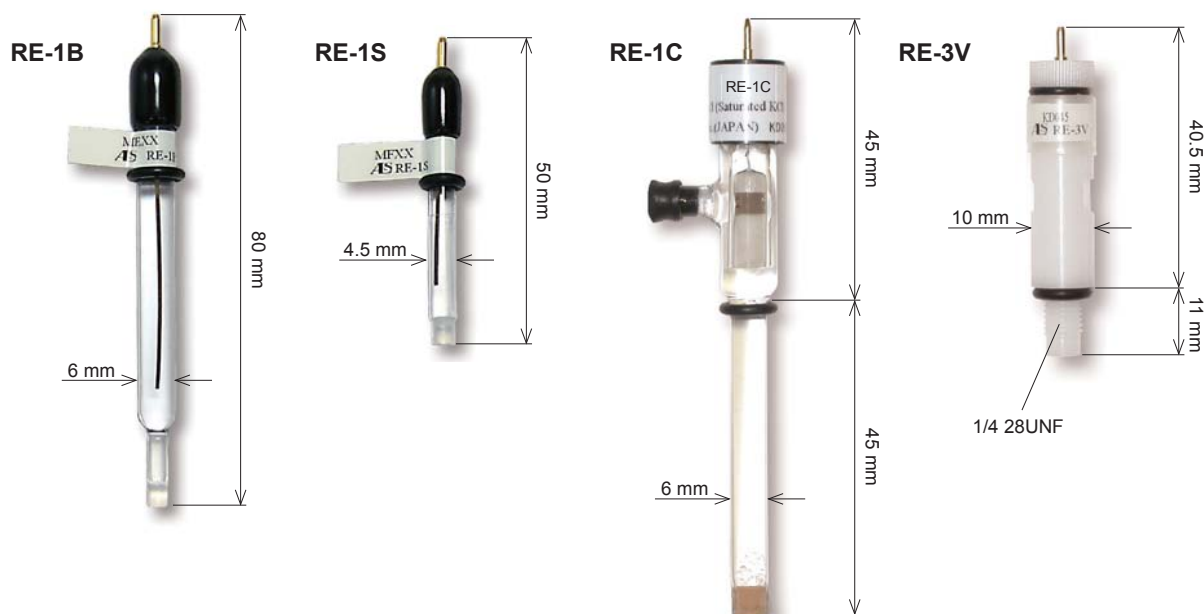
Catalog No.	Description	Length	Wire dia.	Purpose
002222	Pt counter electrode	5.7 cm	0.5 mm	SVC-2, VC-4, Plate Material Evaluating cell
002233	Pt counter electrode	5 cm	0.5 mm	SVC-3
012961	Pt counter electrode NEW	23 cm	0.5 mm	RRDE, Bulk electrolysis, SVC-3
012962	Au counter electrode NEW	23 cm	0.5 mm	RRDE, Bulk electrolysis, SVC-3
012963	Ni counter electrode NEW	23 cm	0.5 mm	RRDE, Bulk electrolysis, SVC-3
012198	Counter electrode for Flow cell	5 cm	1.6 mm	stainless steel, for Flow cell (LC, EQCM, SEC-2F)

5

Reference Electrodes

Reference electrodes are widely used for electrochemical measurements (CV, LSV, DPV, etc.) and electrochemical devices (electrochemical detection for HPLC, electrochemical biosensor, etc.). Various kinds of them such as aqueous, non-aqueous, calomel and own-constructing types are available.

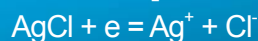
Ag/AgCl type (Aqueous electrodes)



Feature

- For application in an aqueous solution
- Relatively long life time

Reference potential



$$E_0 = 198 \text{ mV vs NHE (25 deg C)}$$

Catalog No.	Description	Junction	Electrolyte	Purpose
012167	RE-1B Ag/AgCl reference electrode	Vycor glass	3 M NaCl	SVC-2, SVC-3, VC-4, Bulk electrolysis, RRDE, EQCM
012168	RE-1S Ag/AgCl reference electrode	Vycor glass	3 M NaCl	SECM
002058	RE-1C Ag/AgCl reference electrode	Ceramics	saturated KCl	SVC-2, SVC-3, VC-4, Bulk electrolysis, RRDE, EQCM
012169	RE-3V Ag/AgCl reference electrode	Vycor glass	3 M NaCl	Polyacetal resin, for Flow cell (LC, EQCM, SEC-2F)
012170	RE-3VP Ag/AgCl reference electrode	Vycor glass	3 M NaCl	PEEK resin, for Flow cell (LC, EQCM, SEC-2F)

Technical note

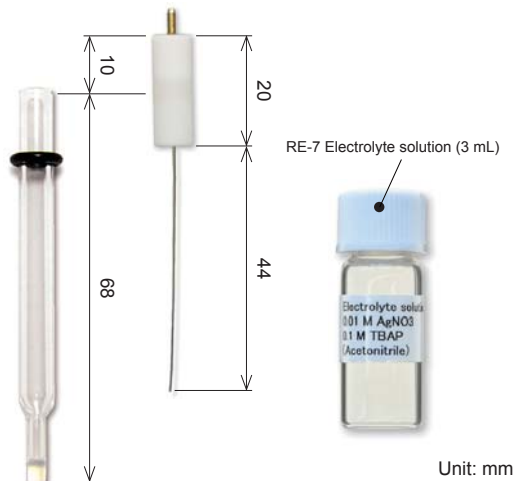
Reference Electrode potentials at 25 deg C (V vs. NHE)

NHE (Normal Hydrogen Electrode)	-----	0 mV
SCE (Potassium Saturated Calomel Electrode)	-----	241 mV
SSCE (Sodium Saturated Calomel Electrode)	-----	236 mV
Ag/AgCl (Saturated KCl)	-----	198 mV
Hg/Hg ₂ SO ₄ (0.5 M H ₂ SO ₄)	-----	682 mV

Encyclopedia of Electrochemistry 5th Ed. (The Electrochemical Society of Japan)

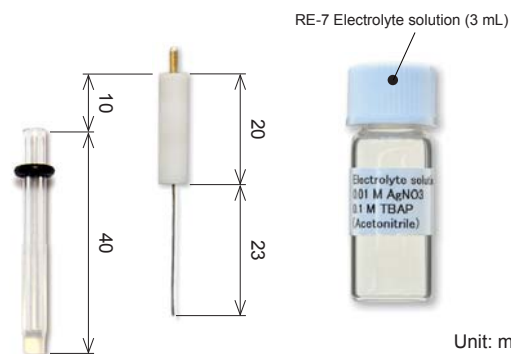
Ag/Ag⁺ type [Non Aqueous electrodes]

RE-7



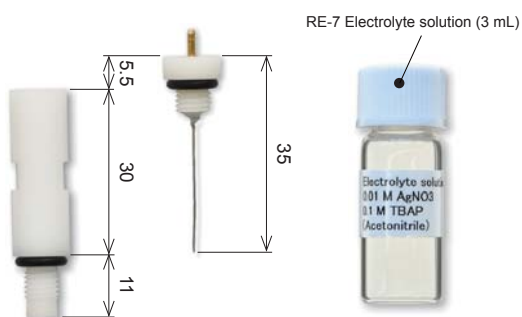
Unit: mm

RE-7S



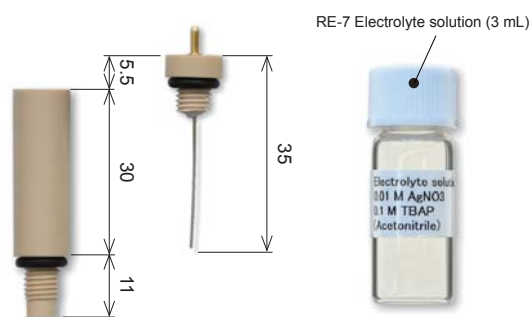
Unit: mm

RE-7V



Unit: mm

RE-7VP



Unit: mm

Catalog No.	Description	Junction	Electrolyte	Purpose
012171	RE-7 Non Aqueous reference electrode (Ag/Ag ⁺)	Vycor glass	ACN/TBAP	SVC-2, SVC-3, VC-4, Bulk electrolysis, RRDE, EQCM
012172	RE-7S Non Aqueous reference electrode (Ag/Ag ⁺)	Vycor glass	ACN/TBAP	SECM
012173	RE-7V Non Aqueous reference electrode (Ag/Ag ⁺)	Vycor glass	ACN/TBAP	Polyacetal resin, for Flow cell (LC, EQCM, SEC-2F)
012174	RE-7VP Non Aqueous reference electrode (Ag/Ag ⁺)	Vycor glass	ACN/TBAP	PEEK resin, for Flow cell (LC, EQCM, SEC-2F)

ACN: acetonitrile
TBAP: tetrabutylammonium perchlorate

Preservative vial



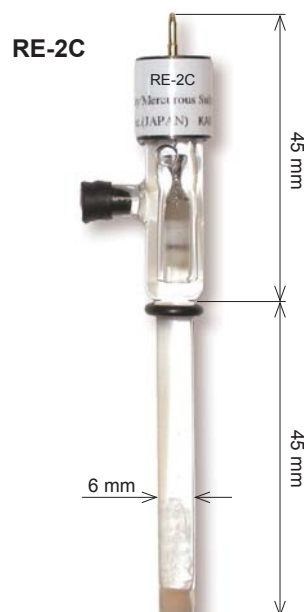
012108

If the purchased or self-prepared reference electrode is left in direct contact with the air, the inside solution will evaporate and dry up gradually. When it is not in use, the recommended way, in order to maintain the reference electrode capability and life time, is to preserve in a sealed preservative bottle with a solution, according to the reference electrode internal solution.

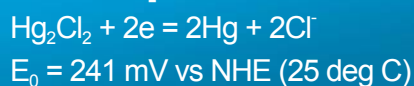
For example: 3 M NaCl for the preservation of the RE-1B Reference electrode.

Catalog No.	Description
012108	RE-PV Preservative vial for Reference electrode, 10 mL
Contents	
011987	Teflon cap for RE-PV
-----	Screw vial 10 mL
Option	
012549	RE-7 Electrolyte solution 10 mL

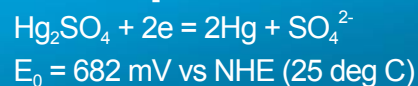
Hg type



Reference potential

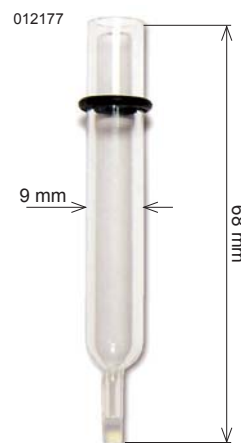
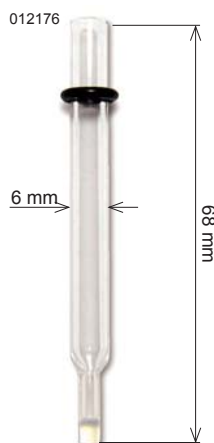


Reference potential



Catalog No.	Description	Junction	Electrolyte	Purpose
002056	RE-2B Calomel reference electrode	Ceramics	saturated KCl	Standard reference electrode
002057	RE-2C reference electrode	Ceramics	saturated K ₂ SO ₄	Reference electrode free from chloride ion

Sample Holder & Accessories



These products enable to take electrochemical measurement by only 200 μL that analyzes with voltammetry cells. A Vycor glass tip is attached to the end of its glass tube, and ions transmit freely. The sample holder is a multi-purpose accessory.

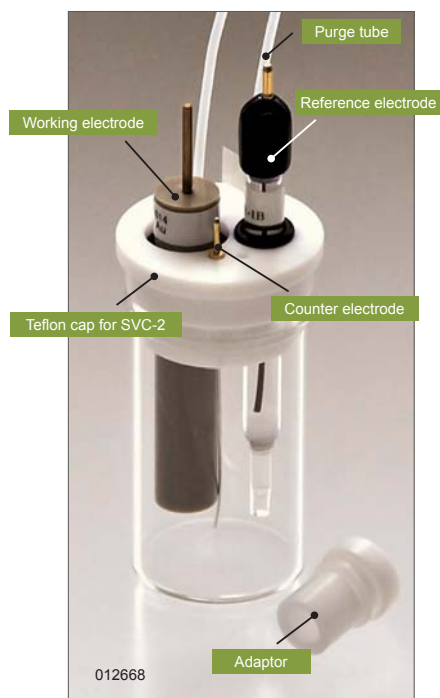
- 6 mm diameter holders can be used for RE-7 series reference electrode
- 9 mm diameter can be used in SVC-2 voltammetry cell (MCA and SVC-3C mode)
- The salt bridge can be used as reference electrode to prevent contamination

Catalog No.	Description	Qty
012176	Sample holder dia 6.0 mm	2
012306	Sample holder dia 6.0 mm	22
012177	Sample holder dia 9.0 mm	2
012307	Sample holder dia 9.0 mm	22

6

Voltammetry Cells

SVC-2 Voltammetry cell

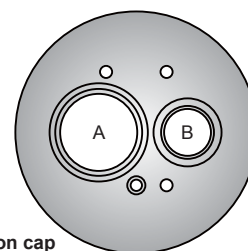


4 ways application

SVC-2 Voltammetry cell can also be used as previous VC-2, VC-5, MCA and SVC-3C Voltammetry cells. Each Voltammetry cell has its specific feature. However, SVC-2, can be used in 4 ways, and you also can apply as an oxygen-free voltammetry cell.

- For various types of electrodes
- Sample volume from 5 to 20 mL
- Easy removal of the dissolved oxygen

Full scale



- A** : for OD 9, 10 mm electrode
- B** : for OD 4, 6 mm electrode
- Adaptor** : for OD 6 mm electrode

Location of the holes in the SVC-2 Teflon cap

Catalog No.	Description	
012668	SVC-2 Voltammetry cell	
Contents		Qty
(001056)	Sample vial (20 mL)	7
002222	Pt counter electrode	1
012670	Teflon cap for SVC-2	1
(010537)	Purge tube (ETFE), 30 cm	1
Option		
012177	Sample holder dia 9.0 mm	2

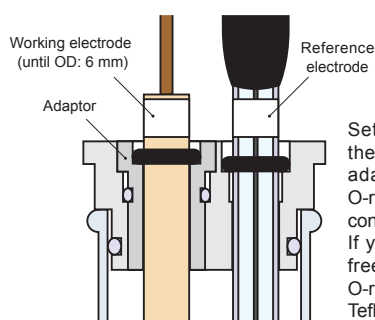
Working electrode and reference electrode are sold separately. Each component could be purchased separately. For acquisition separately, the sample vial of 20 mL is composed for 20 pieces.

Introduction and handling for each mode

: hermetically seal

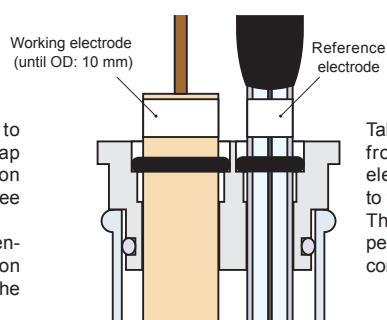
: non-hermetically seal

VC-2 mode



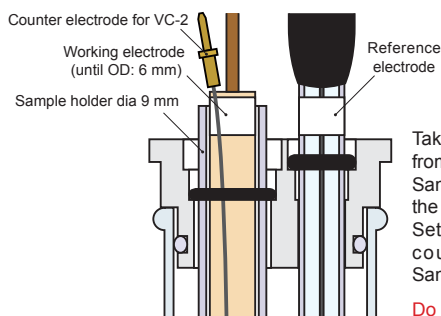
Set the Teflon cap adaptor to the Teflon cap. The Teflon cap adaptor is fixed with a silicon O-ring to work in an oxygen-free condition. If you do not need the oxygen-free condition, then the silicon O-ring can be taken out from the Teflon cap.

VC-5 mode



Take out the Teflon cap adaptor from the Teflon cap. Working electrode can be fitted directly to the Teflon cap. The O-ring will fit perfectly. It permits to have the oxygen-free condition.

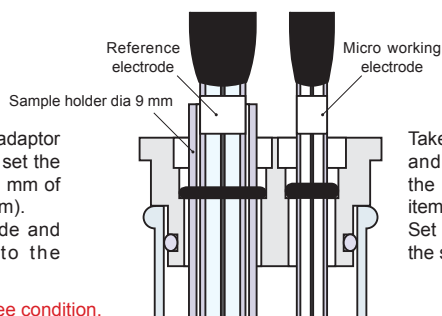
MCA mode



Take out the Teflon cap adaptor from the Teflon cap, and set the Sample holder of the 9.0 mm of the diameter (optional item). Set the working electrode and counter electrode into the Sample holder.

Do not work in oxygen-free condition.

SVC-3C mode

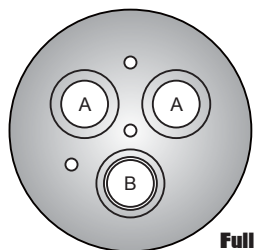


Take out the Teflon cap adaptor, and set the Sample holder of the 9.0 mm diameter (optional item). Set the reference electrode into the sample holder.

SVC-3 Voltammetry cell



- Sample volume from 5 to 10 mL
- For various types of electrode
- Easy removal of the dissolved oxygen



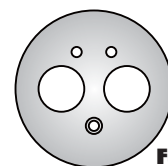
Full scale

Catalog No.	Description
012669	SVC-3 Voltammetry cell
Contents	
(001056)	Sample vial (20 mL)
002233	Pt counter electrode
012671	Teflon cap for SVC-3
(010537)	Purge tube (ETFE), 30 cm
Option	
012961	Pt counter electrode 23 cm
012963	Ni counter electrode 23 cm

VC-4 Voltammetry cell



- Sample volume from 1 to 3 mL
- Including specific cell holder
- Fit the standard type (6 mm)



Full scale

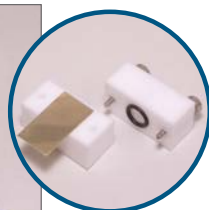
Catalog No.	Description
011224	VC-4 Voltammetry cell
Contents	
(011504)	Sample vial (5 mL)
002222	Pt counter electrode
011226	Teflon cap for VC-4
011227	Cell holder for 5 mL vial
(010537)	Purge tube (ETFE), 30 cm

Plate Material Evaluating cell



011951

Reference electrode is sold separately.



This quite handy cell is developed in order to evaluate a plate material such as metal, semi-conducting plate, etc. In evaluation, a sample plate is sandwiched between cell blocks.

Catalog No.	Description
011951	Plate Material Evaluating Cell
Contents	
	Teflon Cell [Body]
	Teflon Cell [Base]
	Teflon cap
	O-ring (Viton)
	Screw 20 mm
002222	Pt counter electrode
(010537)	Purge tube (ETFE), 30 cm

Bulk Electrolysis cell



001197

Reference electrode is sold separately.

This product is utilized for complete electrolysis. Carbon working electrode is a reticulated form that provides with sufficient surface area to gain the rate in electrolysis. Water-jacketed cell and platinum mesh electrode are also available as optional items.

Catalog No.	Description
001197	Bulk Electrolysis Cell
Contents	
012632	Sample vial (100 mL)
012961	Pt counter electrode 23 cm
012551	Teflon Cap (for bulk)
010530	Porous carbon electrode
001198	Lid for counter electrode
001196	Chamber for counter electrode
001236	O-ring for counter electrode
009131	Port plug
000178	Stirrer bar
(010537)	Purge tube (ETFE), 30 cm
Option	
012652	Water-Jacketed Glass cell (100 mL)

Cell Vials

Spectroelectrochemistry

Instrumentation

Working Electrodes

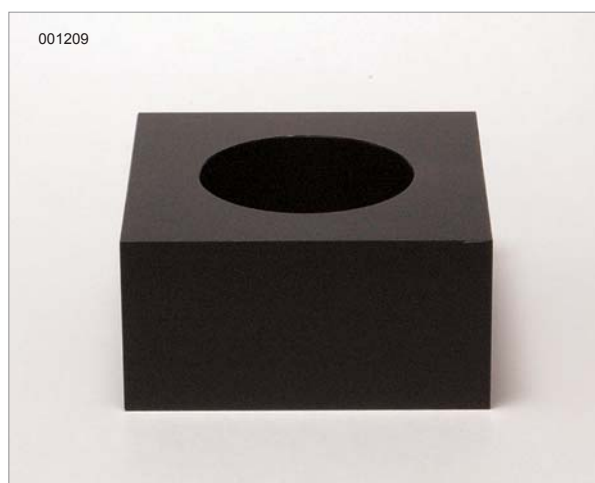
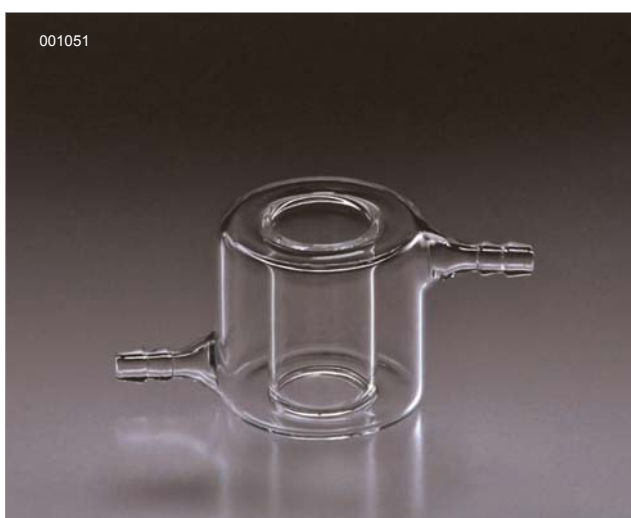
Counter Electrodes

Reference Electrodes

Voltammetry Cells

Flow Cells

Others



Catalog No.	Description	Vol. (mL)	OD (mm)	ID (mm)	Height (mm)	Qty	Purpose
011504	Sample vial	5	18	15.6	30	10	VC-4
001056	Sample vial	20	28	25.6	50	10	SVC-2, SVC-3
012632	Sample vial	100	50	46.4	50	1	RRDE-3A, Bulk Electrolysis Cell
012672	Water-Jacketed Glass cell	5	40	15.6	40	1	VC-4
001051	Water-Jacketed Glass cell	20	55	25.6	50	1	SVC-2, SVC-3
012652	Water-Jacketed Glass cell	100	70	46.4	80	1	RRDE-3A, Bulk Electrolysis Cell
001209	Cell holder for 20 mL vial					1	SVC-2, SVC-3

• Tolerance of each dimension is approximately ± 0.5 mm. • The inner diameter (ID) is the size at the top side.

7

Flow Cells

Electrochemical Flow Cells

Our working electrodes for flow cell are mounted in blocks of PEEK. This resin protects the electrodes from external noise and allows researchers to utilize them regardless the content of mobile phase of HPLC because of their hardness and organic solvent-resistance. Glassy carbon is usually chosen for the redox reaction study on liquid chromatography. Platinum, Gold, Carbon paste and Nickel electrodes are utilized for special purposes.

Working electrodes for Flow cell



Feature

- Excellent chemical resistance
- Easy maintenance of the working electrode
- Working electrode can be polished with PK-3 Polishing kit

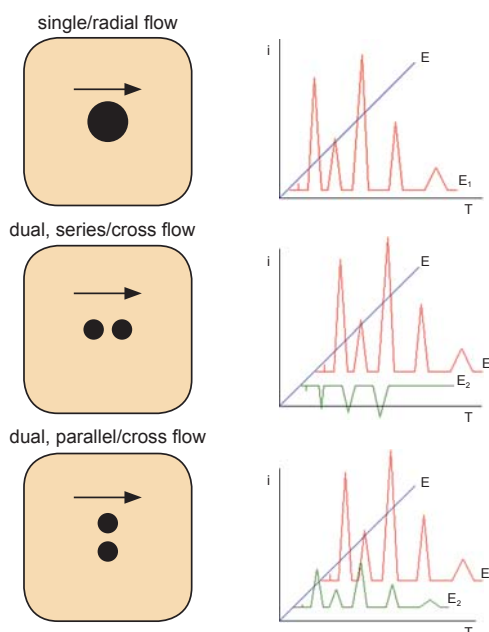
	Catalog No.	Description	Electrode dia.	Size	Purpose
Dual	001000	Glassy Carbon electrode	dia 3 × 2	25 x 25 mm	general redox measurements
	001002	Gold electrode	dia 3 × 2	25 x 25 mm	measurement of thiol-related compounds
	001012	Platinum electrode	dia 3 × 2	25 x 25 mm	measurement of hydrogen peroxide & oxidized substances
	001008	Silver Electrode	dia 3 × 2	25 x 25 mm	measurement of cyano-sulfide
	001009	Nickel Electrode	dia 3 × 2	25 x 25 mm	amino acids measurement by chemically modified electrode
	001004	Carbon Paste electrode	dia 3 × 2	25 x 25 mm	modified electrode measurement using carbon paste
	001006	Glassy Carbon / Gold electrode	dia 3 × 2	25 x 25 mm	others
	012583	Glassy Carbon / Platinum electrode	dia 3 × 2	25 x 25 mm	others
Single	012124	Glassy Carbon electrode	dia 3	25 x 25 mm	general redox measurements
	001016	Glassy Carbon electrode	dia 6	25 x 25 mm	general redox measurements
	000999	PFCE Carbon electrode	dia 3	25 x 25 mm	general redox measurements
	011155	Gold electrode	dia 3	25 x 25 mm	measurement of thiol-related compounds
	009908	Platinum electrode	dia 3	25 x 25 mm	measurement of hydrogen peroxide and oxidized substances
	010251	Carbon Paste electrode	dia 3	25 x 25 mm	modified electrode measurement using carbon paste

Structure of the working electrode

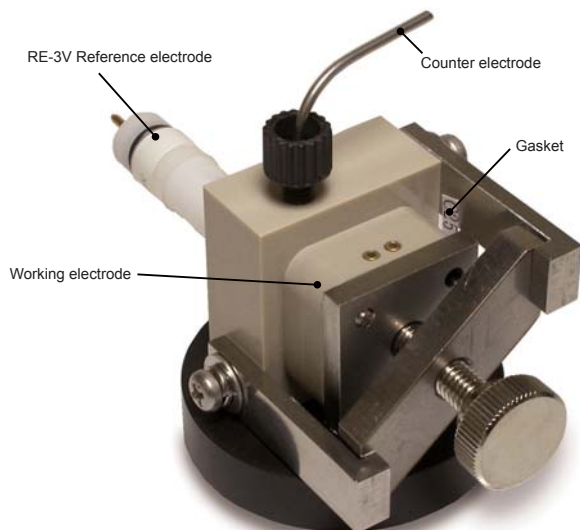
The dual glassy carbon electrode is considered to be a standard working electrode for cross flow cell. It is composed for two glassy carbon electrodes, of 3 mm placed in series. Also it could be rotated 90 degrees and applied as a parallel mode. The selectivity improves with the application of dual series electrode. In the parallel mode, identification of the substance, from the different applied voltage response ratio, is possible. For the dual electrode, the electrode surface area doubles by using the jumper connector, and high sensitivity analysis becomes possible. For the working electrode, the platinum/gold electrode and others are also available.



002245 Jumper connector for dual electrodes



Cross Flow Cell



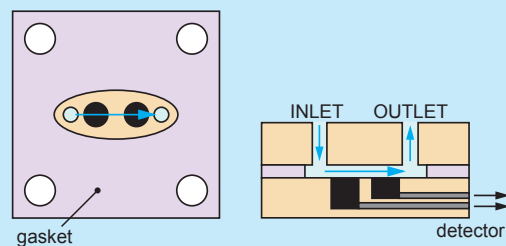
Catalog No.	Description
012798	Cross Flow cell

Cross Flow Cell is capable of quantitation up to the level of 10^{-15} mol by the flow rate : 1 mL/min - 100 μ L/min.

Feature

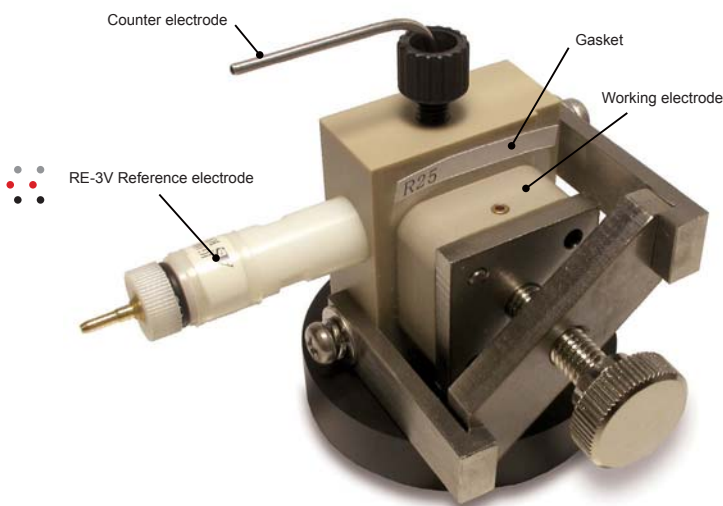
- Detection electrode for HPLC
- for Flow injection analysis
- for bio-sensor development

Schematic diagram of Cross flow cell



* Working electrode, Reference and Gasket are sold separately.

Radial Flow Cell



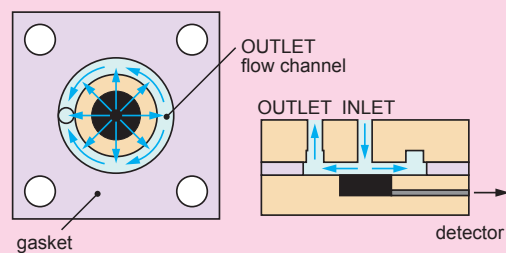
Catalog No.	Description
012799	Radial Flow cell

* Working electrode, Reference and Gasket are sold separately.

Radial Flow Cell is developed for microbore chromatography. Its detecting efficiency will improve when flow rate is 10 μ L/min or lower. This flow cell consists of thin layer electrode and symmetric design.

The wall jet of the sample, after hit in to the electrode's surface, spreads in three dimensions. After hitting the sample on a thin layer electrode directly, it flows to the perimeter from the center of the radiated electrode, improving the sensitivity.

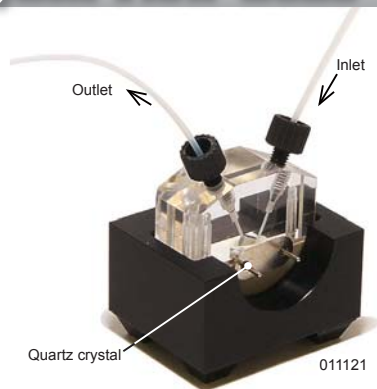
Schematic diagram of Radial flow cell



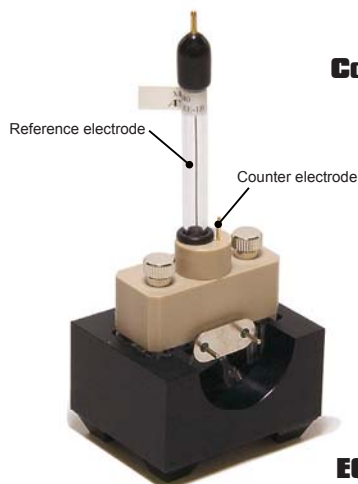
Radial Flow Cell

Catalog No.	Description	Qty
012169	RE-3V Reference electrode Screw type (Ag/AgCl)	1
012173	RE-7V Non Aqueous reference electrode(Ag/Ag ⁺) Screw type	1
001046	TG-2M Teflon Gasket (Cross Flow cell) / 12 μ m	4
001047	TG-5M Teflon Gasket (Cross Flow cell) / 25 μ m	4
001048	TG-6M Teflon Gasket (Cross Flow cell) / 50 μ m	4
012801	TG-8M Teflon Gasket (Cross Flow cell) / 100 μ m	4
001146	TG-2MR Teflon Gasket (Radial Flow cell) / 12 μ m	4
001147	TG-5MR Teflon Gasket (Radial Flow cell) / 25 μ m	4
001148	TG-6MR Teflon Gasket (Radial Flow cell) / 50 μ m	4
012802	TG-8MR Teflon Gasket (Radial Flow cell) / 100 μ m	4

QCM Flow Cells



QCM Flow cell mode



Configuration for QCM Flow cell

Acrylic flow cell; PEEK cell; PEEK cap; Flow cell holder; Pt counter electrode; Dynaseal PEEK; Fixing screw; Silicon O-ring; Teflon tube

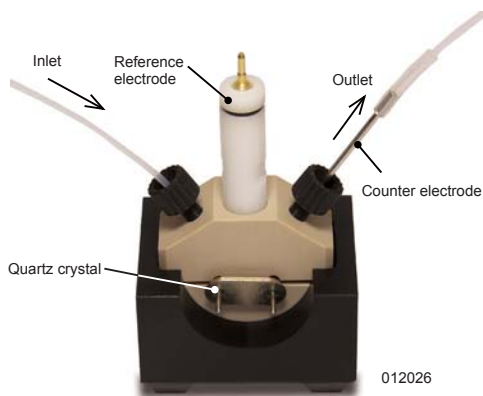
The quartz crystal microbalance (QCM) technique under electrochemical frequency is very useful to determine many compounds such as metal proteins, metal ions and thiol-conjugated oligonucleotides. The Resonance frequency of quartz changes when material attaches to the electrode's surface. This product is capable of super-micro quantitative analysis by using this unique behavior.

QCM Flow cell is reversible. With an inverted position of the blocks, it is possible to change from static to flow measurements

Catalog No.	Description
011121	QCM Flow cell kit
Option	
010226	Quartz crystal Au (5 pcs)
012167	RE-1B Ag/AgCl reference electrode
012171	RE-7 Non Aqueous reference electrode

EQCM Flow Cells

Combination of QCM and electrochemical measurement in a unique flow cell.



Configuration for EQCM Flow cell

PEEK flow cell; PEEK cell; PEEK cap; Pt counter electrode; Stainless tube (Counter electrode for flow cell); Dynaseal PEEK; Fixing screw; Silicon O-ring; Teflon tube

The two blocks of the EQCM Flow cell are constructed using PEEK. It gives a high resistivity for chemical compounds.

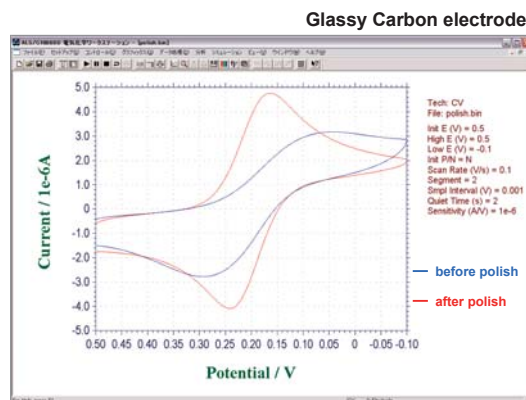
As well as QCM, this cell is reversible. With an inverted position of the blocks, it is possible to change from flow to static measurements.

Catalog No.	Description
012026	EQCM Flow cell kit
Option	
010226	Quartz crystal Au (5 pcs)
012169	RE-3V Ag/AgCl reference electrode
012170	RE-3VP Ag/AgCl reference electrode
012173	RE-7V Non Aqueous reference electrode
012174	RE-7VP Non Aqueous reference electrode

PK-3 Electrode Polishing kit

Polishing refreshes working electrode response

The purpose of the polish is to remove redox reaction products accumulated on the working electrode surface. The polishing maintains a good condition of working electrode for CV/Flow cell.



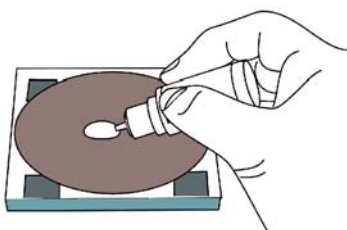
With repeated electrochemical redox reaction experiments, the adhesion of the experimental products on to the electrode surface, and the electron transfer rate is attenuated gradually. If the electron transfer speed becomes slow, the difference between peak potentials for oxidation and reduction will broaden.



Refreshing the electrode surface by polishing, the electron transfer rate will increase again. Consequently, the peak potential difference becomes narrow and returns to an ideal CV.

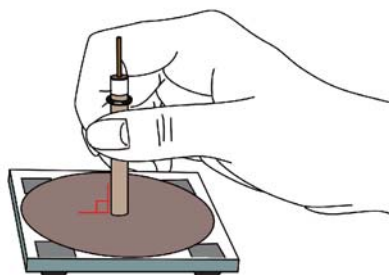
Instructions to polish the working electrode surface with PK-3

STEP 1



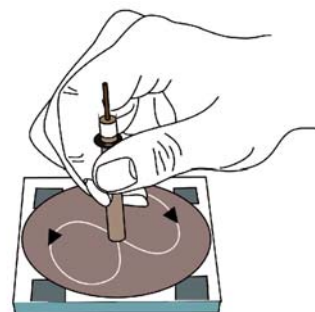
Prepare the glass plate, and put a few drops of polishing diamond on diamond polishing pad.

STEP 2



Hold the CV electrode at right angle to the pad.

STEP 3



Polish in a circular motion, for 30 seconds to 2 minutes. Rinse the electrode surface with distilled water.

Catalog No.	Description		
011975	PK-3 Electrode Polishing kit		
	Contents	Qty	Purpose
012620	0.05 μm polishing alumina (20 mL)	1	for final polishing
012621	1 μm polishing diamond (10 mL)	1	for intermediate polishing
	Alumina polishing pad	10	for final polishing
	Diamond polishing pad	10	for intermediate polishing
002249	Replacement glass plate for PK-3	1	glass plate to stick the polish pad
	Option		
002053	6 μm polishing diamond (10 mL)	1	for rough polishing
012600	Alumina polishing pad	20	for final polishing
012601	Diamond polishing pad	20	for intermediate polishing
012610	Coarse polishing Pad	20	for rough polishing
012611	Emery paper UF800	20	for PG and PFCE electrode polishing

* For polishing using the emery paper, use it only with distilled water. Polishing alumina and diamond cannot be used in Pyrolytic graphite electrode (PGE) and Plastic formed carbon electrode (PFCE).

Glassy Carbon



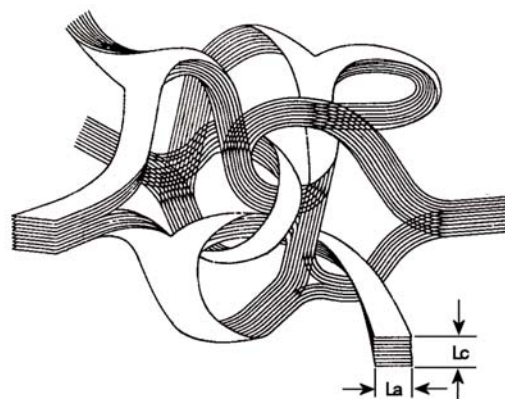
Feature

- High-purity
- Excellent Stability as high as at 3,000 deg C in vacuum / at 500 deg C in the air
- Well Inert against Chemical erosion
- impermeability to gas and solution
- Significant hardness / strength
- Brings fine surface condition after polishing
- Favorable electric conducting property
- Dielectric characteristics in high-frequency
- High resistance against inorganic and organic salts
- Good bio-compatibility
- Isotropic physical/chemical properties

We are dealing with various kinds of Glassy Carbon products. Customer's special processing order such as pipe, pot shape etc. or custom sizing order is also available.

Characteristics of Glassy carbon

Glassy Carbon has a quite unique structure. This material contains random combination of basal plane and edge plane. The figure, at the right, shows the model illustration introduced by G. M. Jenkins and K. Kawamura. It becomes an outstanding material, which can be used for the electrode in an analytical chemistry domain as electrochemical measurements, detection of high-speed liquid chromatography, biosensor and others.



La: Intraplanar Microcrystalline Size, Lc: Interplanar Microcrystalline Size
G.M. Jenkins and K. Kawamura: Nature 231,175 (1971).

List

Catalog No.	Description	Size/Volume
Rod type		
010761	R-1 Glassy Carbon rod	dia 1 x 100 mm
010762	R-2 Glassy Carbon rod	dia 2 x 100 mm
010763	R-3 Glassy Carbon rod	dia 3 x 100 mm
Plate type		
012086	P-1 Glassy Carbon plate	25 x 25 x 1 mmt
012087	P-2 Glassy Carbon plate	25 x 25 x 2 mmt
012088	P-3 Glassy Carbon plate	25 x 25 x 3 mmt
Film type		
012089	F-100 Glassy Carbon film	25 x 25 x 0.1 mmt
Powder type (Spherical)		
012090	S-12 Glassy Carbon powder	0.4 - 12 μm , 10 g
012091	S-20 Glassy Carbon powder	10 - 20 μm , 10 g

Size range available for customized product

Rod type: diameter, from 1 to 10 mm; length until 800 mm

Plate type: within 300 x 300 mm; thickness of 0.3, 0.5, and 1 to 6 mm

Film type: within 100 x 100 mm; thickness of 60, 100, 140 and 180 μm
Furthermore, drilling, cutting and mirror polishing are also possible.

Physical property

Density	1.42 g/cm ³
Ash content	< 100 ppm
Upper Temperature Limit in vacuum	3000 deg C
Porosity	0 %
Gas Transmission Rate	10 ⁻⁹ cm ² /s
Hardness	230 HV1
Bending Strength	260 N/mm ²
Compressive Strength	480 N/mm ²
Young's Modulus	35 kN/mm ²
Thermal Expansion Coefficient (20 - 200 deg C)	2.6×10 ⁻⁶ 1/K
Heat Conducting (30 deg C)	6.3 W/(m•K)
Electrical resistivity	45 $\mu\Omega\cdot\text{m}$



AS

BAS

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