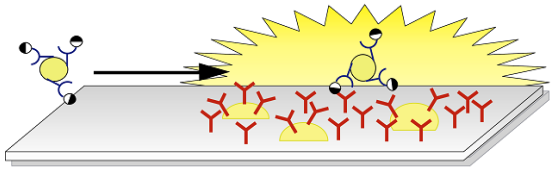
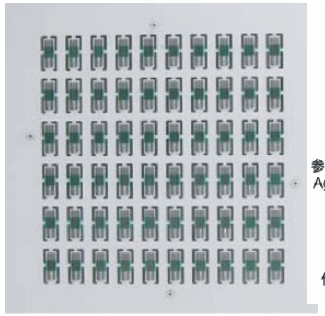
BioDevice Technology, Ltd.

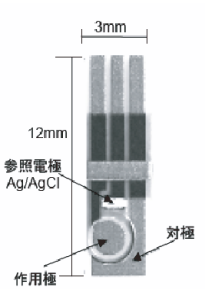
R&D of Biosensors

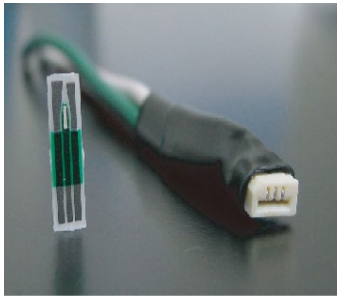
- High Sensitive Immunochromatography (PCT/JP2006/323617)

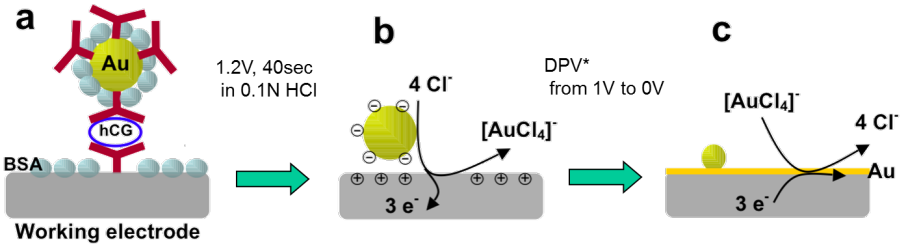


- DEP-Chip Series for Electrochemical Biosensors





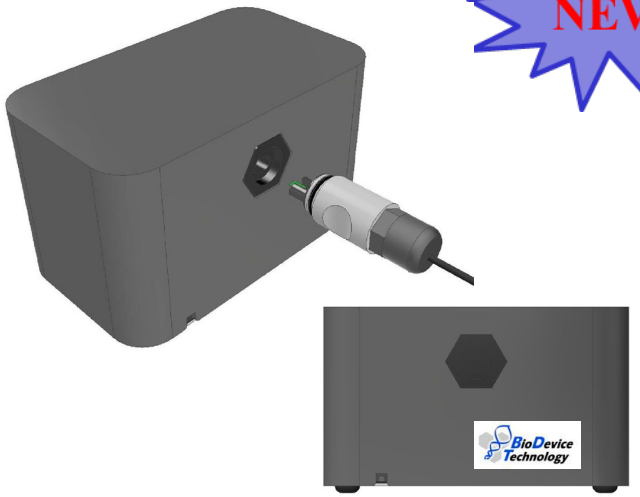




- Compact potentiostat "BDTminiSTAT100"

- Compact electrochemical luminescence device "BDTeCL-XP"

NEW



Gold –Linked Electrochemical Immuno Assay（GLEIA, PCT/JP2007/56992)

BioDevice Technology

Products and Service List

Item	Name
Printed Electrodes for Biosensors	DEP-Chip series SP-N, SP-P EP-N, EP-P, EP-PP SR-N, SR-P ER-N, ER-P, ER-PP TG-1, TG-3 PCR-P01, PCR-P03
Compact Potentiostat	BDTminiSTAT100 BDTminiSTAT400 (4 channel) BDTminiSTATSR-6 (6 channel) BDTminiSTAT100-BTR(blue tooth connection)
Electrochemical Luminescence Device	BDTeCL-P100
Trial Manufacture of Immunochromatography	
Manufacture of customized printed electrodes on assignment	
Contract research on biosensors	

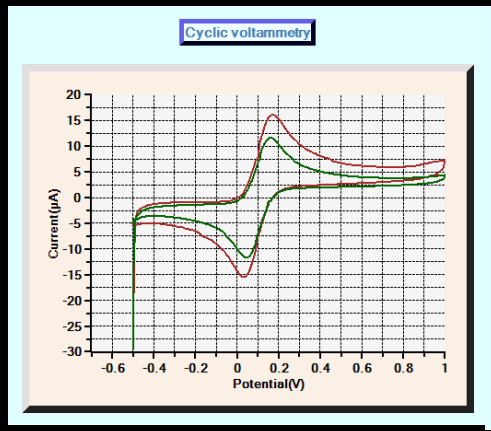
BioDevice Technology

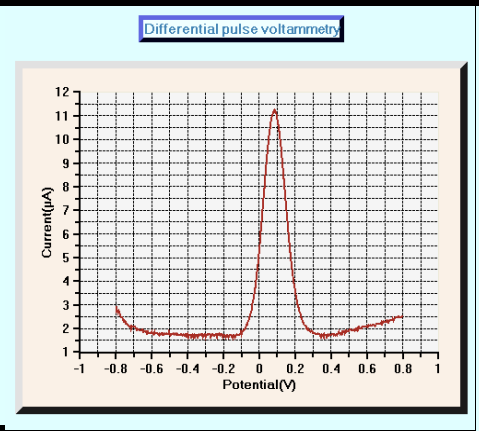
Compact Potentiostat “BDTminiSTAT100”

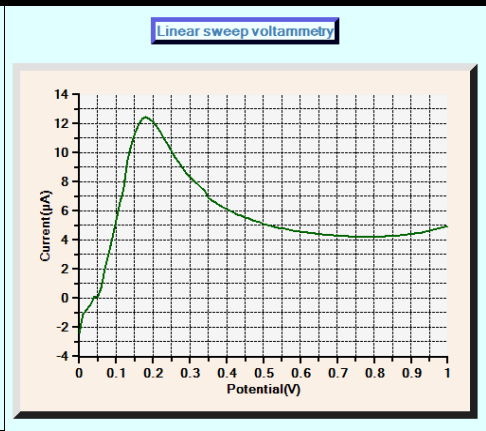
Compact potentiostat BDTminiSTAT100

Light weight, Power supplied with USB connection to PC, Easy to use with a proprietary software.
Use from research to measurement outdoors.

- Five measurement modes of CA, CV, LSV, DPV, SWV
- Compact, Light weight and Easy to carry
- **Power supplied with USB connection to PC**
- **Easy to use with the proprietary software**
- Optional software for Automatic peak detection and determination

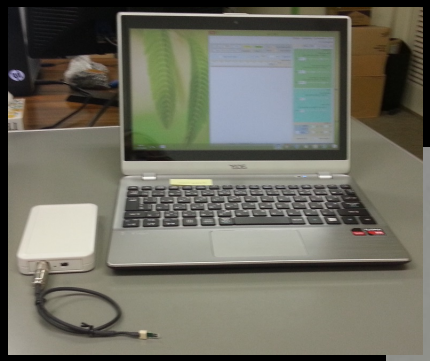






BioDevice Technology

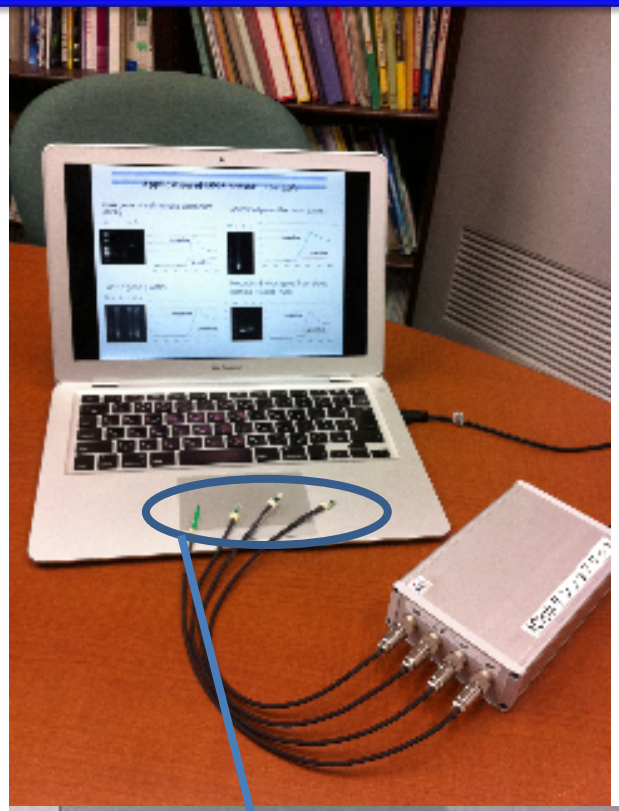
Wireless Potentiostat “BDTminiSTAT100-BTR”

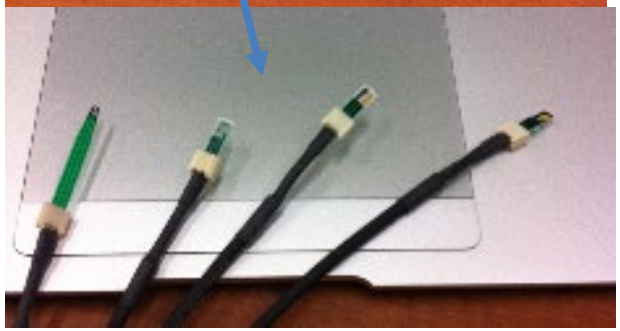


- Five measurement modes of CA, CV, LSV, DPV, SWV
- Compact, Light weight (120 g) and Easy to carry
- **Power supplied by two AAA size batteries**
- **Easy to use with the proprietary software**
- **Wireless connection to computer by Bluetooth**

BioDevice Technology

Compact Multi-channel Potentiostat
BDTminiSTAT400, BDTminiSTATSR-6





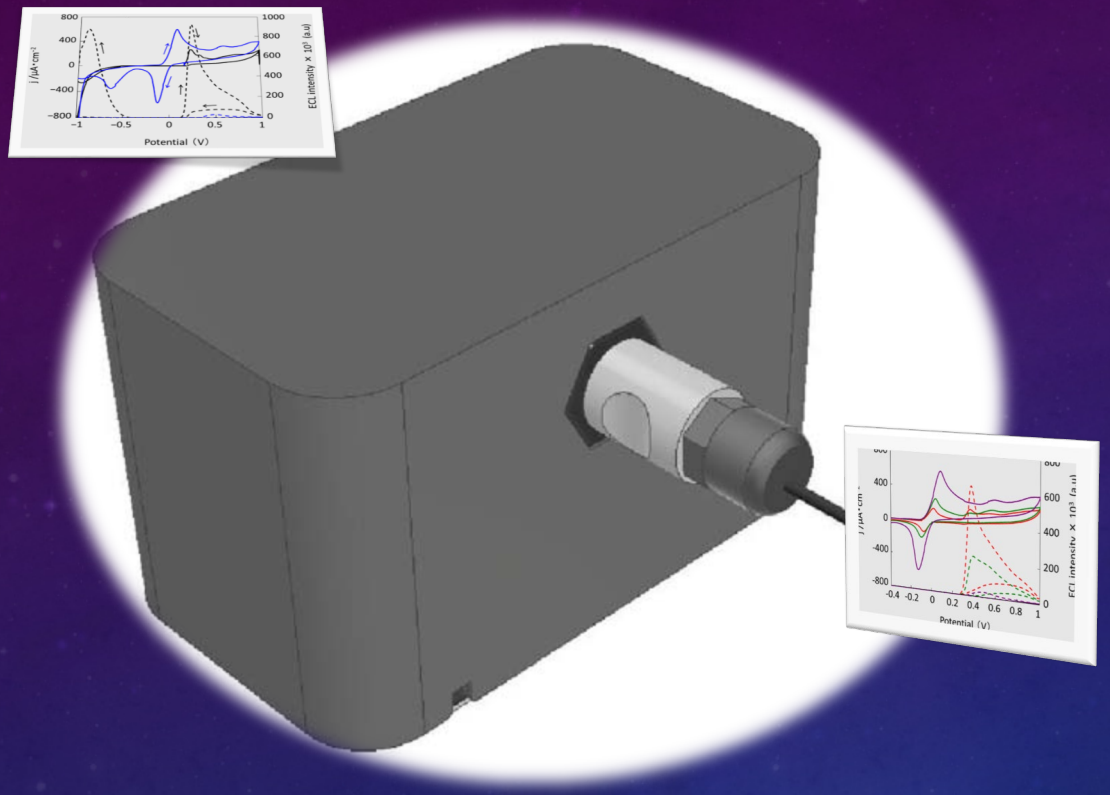
4チャネル同時測定可能な
小型ポテンショスタット

BDTminiSTATSR-6

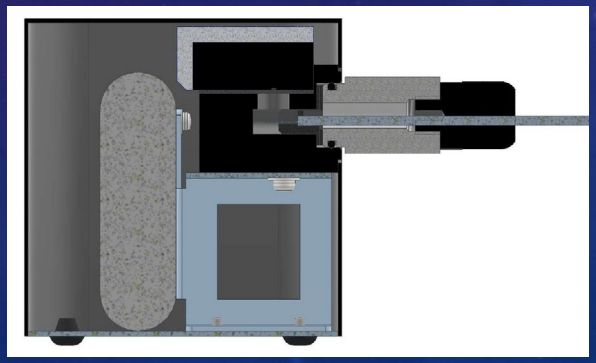
Mail to
postmaster@biodevicetech.com

- 5 measurement modes of CV, LSV, CA, DPV, SWV
- Compact size: 130 x 100 x 40 (mm)　300 g
- The applied electromotive force:　-2.0 ～ +2.0 V, resolution:　2 mV
- The measurement range:　6 range（1 nA ～ 100 μA), resolution: 0.1%
- Easily input measuring conditions (measurement mode, voltage range, time and　scan rate, etc.)
- On-line graphical representation of measurements
- Automatic safe-keeping of measured data (CSV file)

Electrochemical Luminescence Device “BDTeCL-XP”



- Compact ECL device
- Simple and rapid measurement enabled by its dedicated software.
- Highly sensitive and selective measurement enabled



BDTeCL-XP	
PC OS	Windows Vista, 7, 8, 10 (32 bit)
Size (mm)	100(L) x 170(W) x 103(H)
Electrode	DEP-Chip EP, SP, ER, SR

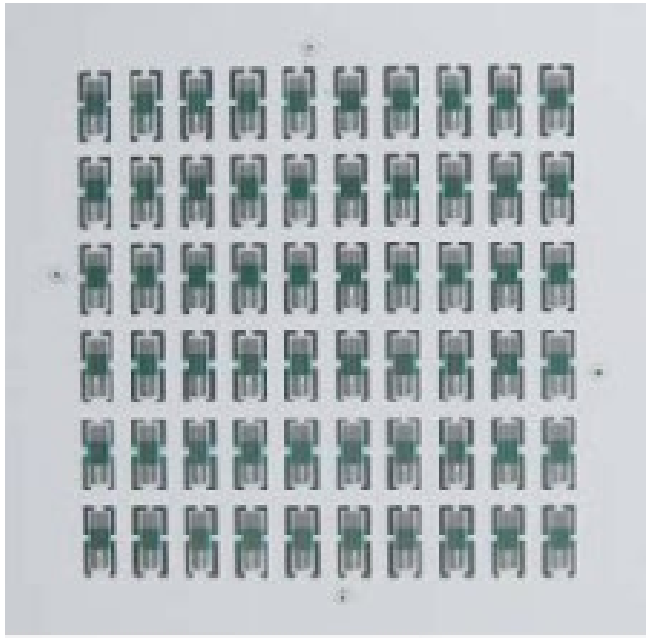
BioDevice Technology

Printed Electrodes “DEP-Chip series”

Square working electrode

SP-N, SP-P
(carbon)

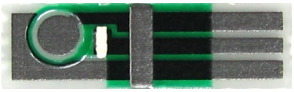
SR-N
(gold)



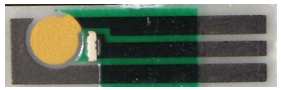
mass production/disposal/low cost
Possible customized fabrication

Round working electrode

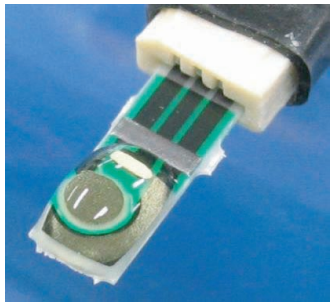
EP-N
(carbon)



EP-PP
(carbon, WE with ring and dam)



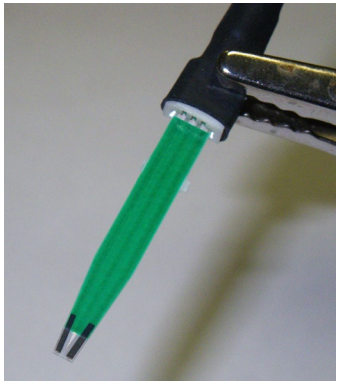
ER-N
(gold)



One drop test

Large size
TG-1 (carbon, WE with ring)

For PCR
PCR-P01
(carbon)
PCR-P03
(gold)

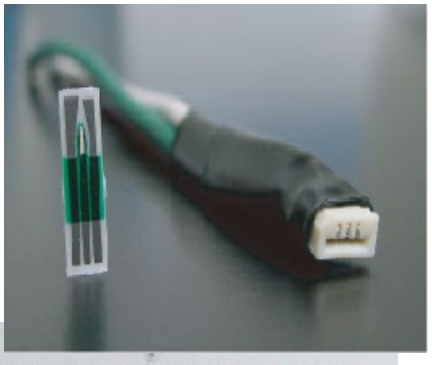


PCR-P01

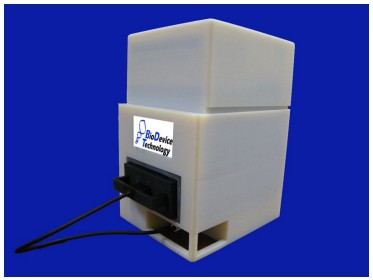
Adapted size
for PCR tube

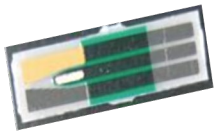
Advantage of DEP-Chips

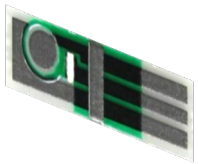
*DEP-Chip series is a trade name of our original printed electrodes
which were developed for fabrication of various biosensors.



- Disposable
- No contamination
- Easy to use
- Mass productive and low cost
- High quality CV < 5%
- Small amount of reagents and samples 1-2 µL
- Various applications for electrochemical determination with BDTminiSTATs and for electrochemical luminescence determination with BDTeCL-P100
  - ➢ Especially suitable for biosensors







BioDevice Technology

Biosensor printed electrodes “DEP-Chip series” are evaluated worldwide

Highlights in Chemical Biology

Chemical biology news from across RSC Publishing.

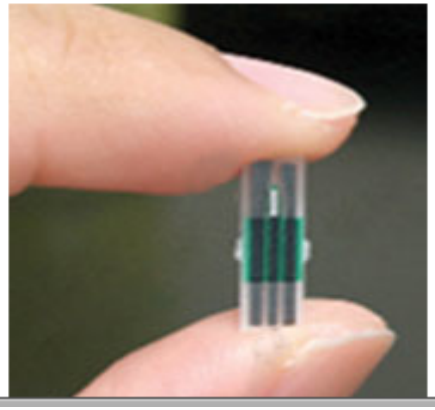
Genetic testing at a snip

12 April 2007

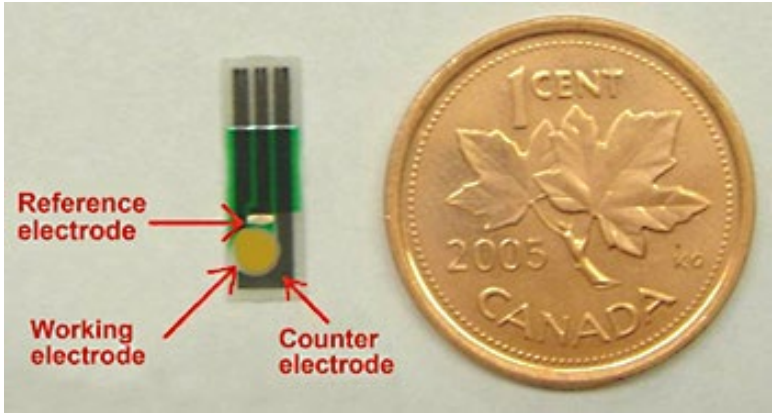
A cheap, rapid and portable point-of-care genetic test could be a step closer thanks to a team of scientists from Japan and Thailand.

Single nucleotide polymorphisms (SNPs, pronounced snips) are genetic variations in a person's DNA sequence. They can indicate a susceptibility to disease and could be useful in predicting a patient's response to therapy. Now Eiichi Tamiya at the Japan Advanced Institute of Science and Technology in Nomi City and his team have developed a chip that can detect SNPs and used it to find the variations in a gene linked to Alzheimer's disease.

"The sensors have the potential to meet the need for inexpensive, rapid and hand-held systems for genetic analysis, diagnosing cancer predisposition, identifying genetically modified organisms, and reducing recent threats of bioterrorism."
- Eiichi Tamiya

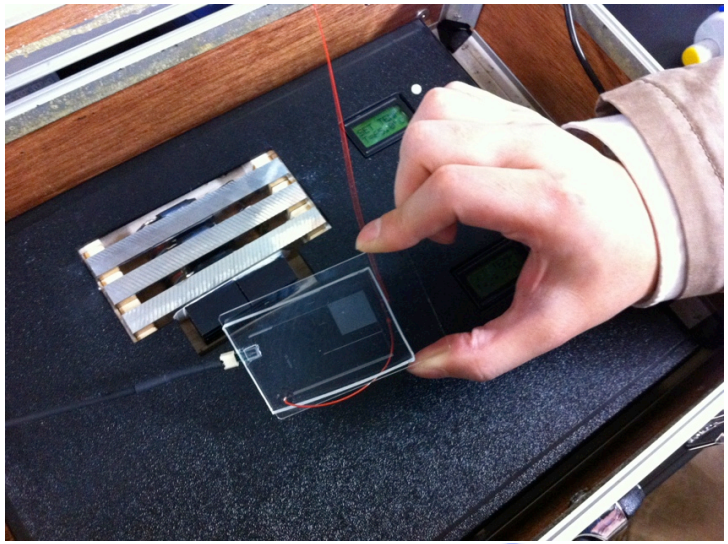


The group used disposable printed chips to analyse DNA from human volunteers. Before analysis, the DNA sample is amplified with a segment of DNA corresponding to the SNP of interest. The DNA is then added to the chip, where it binds to a redox molecule. If the SNP is present, then the amplification step is successful and so a smaller current is measured by voltammetry. Importantly, the method does not require the redox molecule to be immobilised on the sensor. This helps make the chip system simpler and cheaper than existing SNP tests. The group went on to apply the method to detect SNPs linked to



Detection of HIV-1 protease inhibition

K.Kerman,Chem. Commun., 2007, 3829



Printed electrode in RT-PCR flow chip for Flu virus detection

BioDevice Technology

Application examples of BDTminiSTAT100 and DEP-Chips

1. Total viable bacterial sensor
2. DNA sensor
3. Immunochemical sensor
4. Enzyme sensor
5. Heavy metal sensor
6. Residual agricultural chemical sensor

Total viable bacterial sensor

Count of viable bacteria numbers

Respiratory activity (consumption of oxygen)

Determination of dissolved oxygen decrease by the electrochemical method

バイオデバイステクノロジー

食品検査、短時間で

細菌検出、数日から30分に

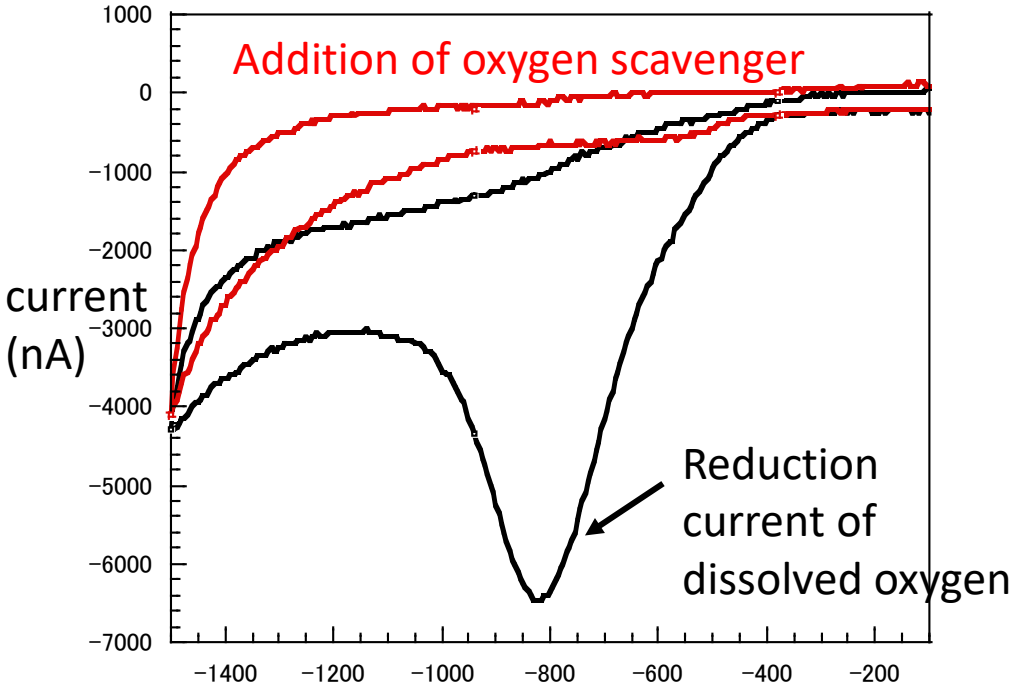
ベンチャー企業のバイオデバイステクノロジー（金沢市）は、食品に含まれる大腸菌などの細菌を短時間で検出する検査機器「写真」を開発した。従来の細菌検査は数日掛かるが、新たに開発した機器を使えば、30分程度で作業が終わるという。

検査機器は名刺サイズで、先端にセンサーが付いている。センサーを食品の表面に当てると、細菌の数を推測できる仕組み。細菌が呼吸する際に増殖し、食品に含まれる酸素の減少量を測定することで検出が可能という。

開発したバイオ社は検査機器メーカーで、民谷栄一大阪大大学院教授が北陸先端科学技術大学院大の教授を務めていた2003年に設立した。石川県産業創出支援機構が運営する能美市内の施設に事業所を置いている。

民谷教授は「小型サイズで導入しやすく、社内で簡単に検査できる。保健所などに検査を依頼するコストが省ける」としている。

北国新聞 2011/9/10

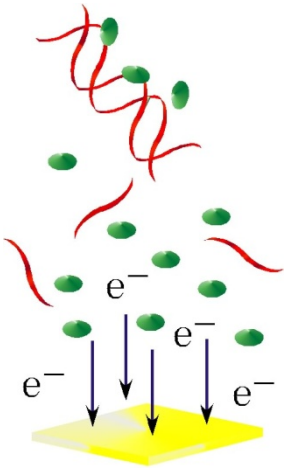


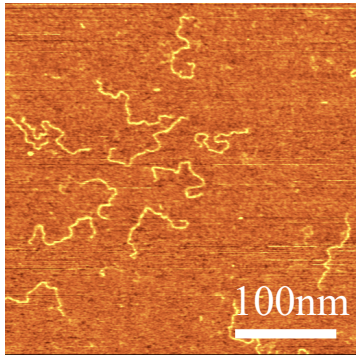
CV（Cyclic Voltammetry） 50mV/sec
Printed carbon electrode （DEP-Chip SP-P）

DEP-Chips: Low cost/Easy to use
miniSTAT100: compact and light weight
The smallest potentiostat in the

Original principle of our DNA sensor
(Japanese patent No. 364257)

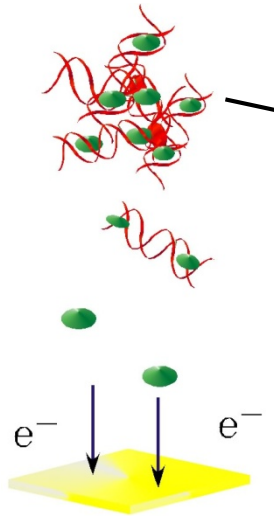
A

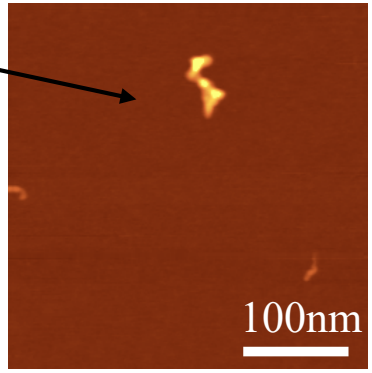




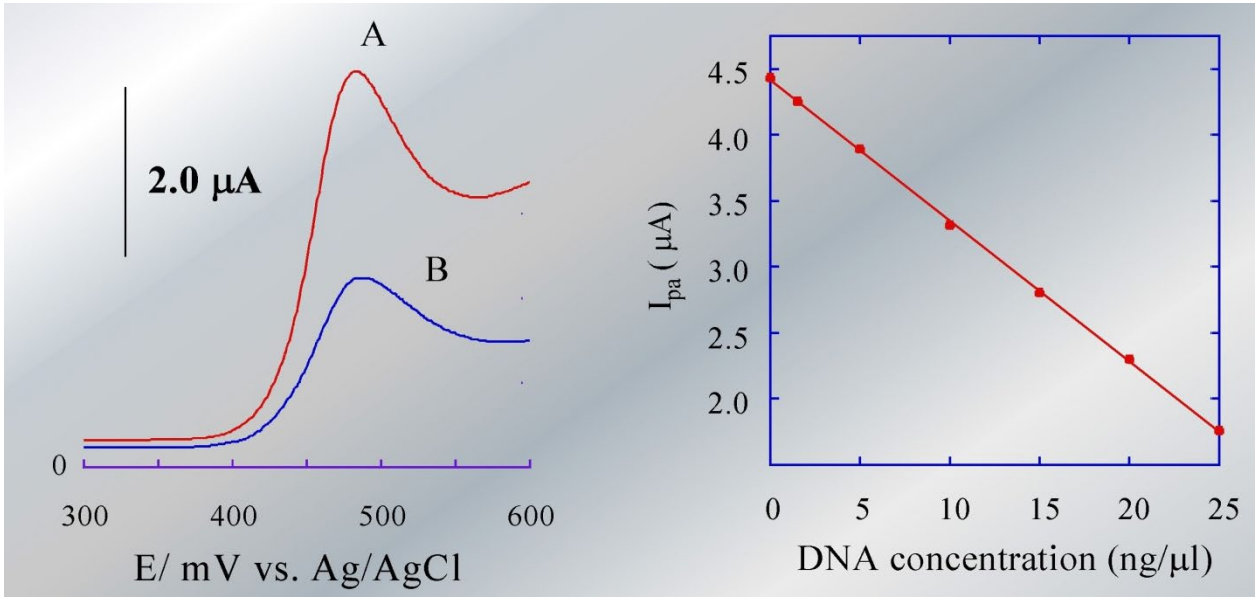
(Low concentration of DNA or Before amplification)

B





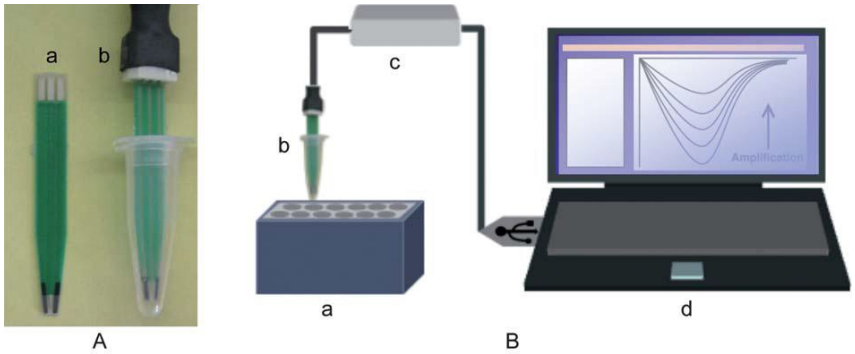
(High concentration of DNA or After amplification)

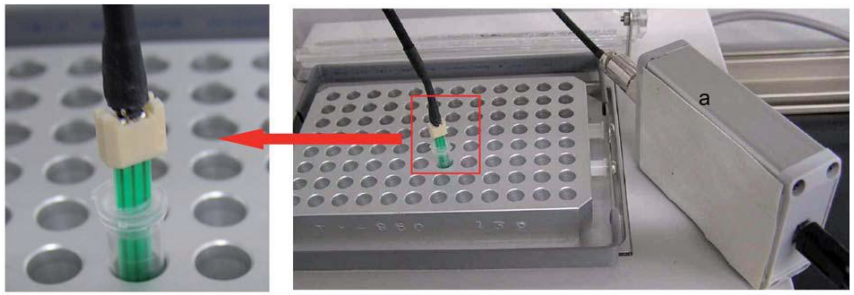


This method is suitable for detection of DNA amplification after PCR or LAMP.

BioDevice Technology

An example of DNA sensor system



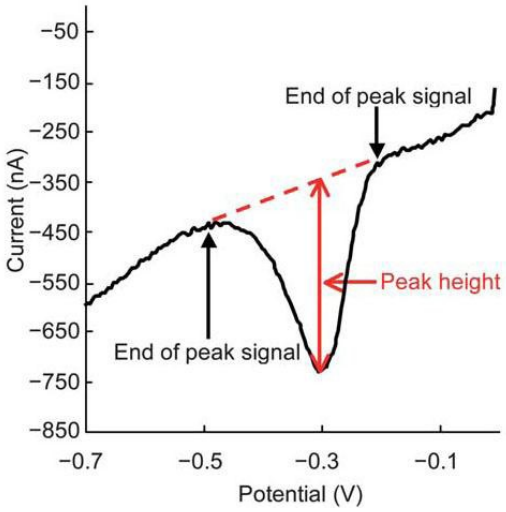


Procedure（RT-LAMP）
Analyst 2011, DOI: 0.1039/c1an15638a

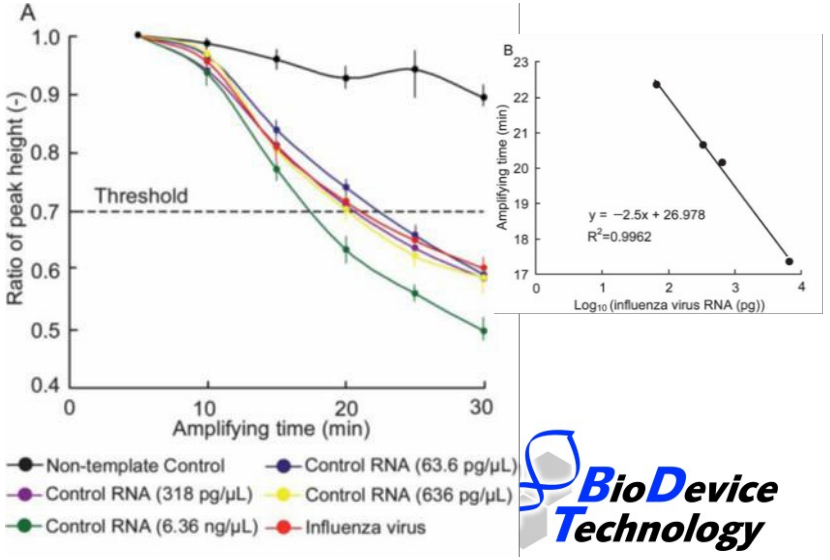
Primer mixture + Metylene Blue
+ influenza virus + dried enzyme + buffer reagents
(Loopamp®) total volume 50 μL

Printed electrode was inserted in the micro tube and the tube was incubated at 63℃for 40 min.

During incubation, electrochemical measurements (SWV) were performed every 5 min.



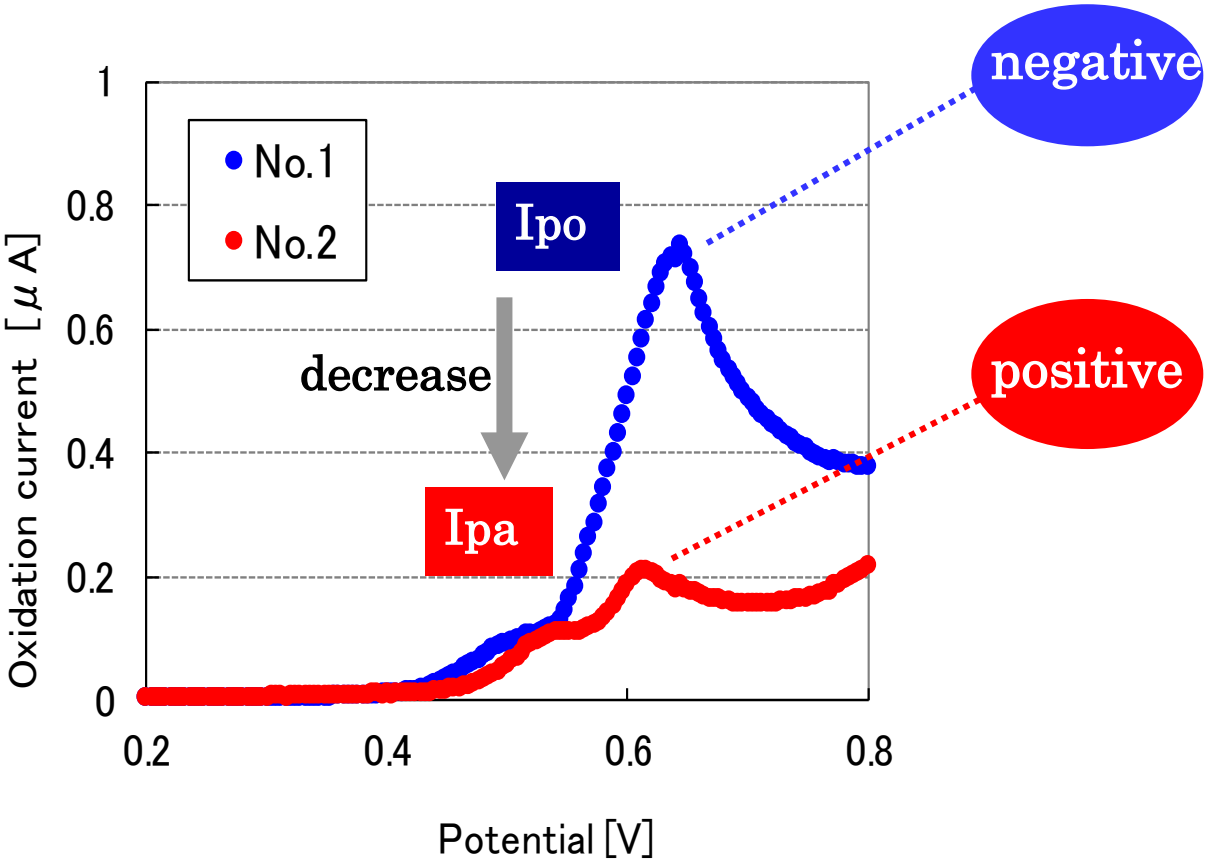
(A) Photograph of the screen-printed electrodes. a: screen-printed electrode, b: screen-printed electrode inserted into the 200 mL micro tube. (B) Illustration of the semi-real time monitoring system using the screen-printed electrode with a USB powered portable potentiostat. a: heat block, b:screen-printed electrode inserted into the micro tube, c: USB powered portable potentiostat, d: laptop computer.
(C) Photographs of the USB powered portable potentiostat and screen-printed electrode inserted into the micro tube with heating unit. a: USB powered portable potentiostat (BDTmini-STAT100, Bio device technology Co., Ltd., Japan).



BioDevice Technology

Example of detection of the food poisoning infectious organism gene

【Electrochemical determination】



negative

Without salmonellas

positive

With salmonellas

BioDevice Technology

Application of DNA sensor

1. Pathogenic microbe

Salmonella, E. coli O-157, MRSA(nosocomial infection),
Periodontal disease bacteria, Anthrax

2. Infectious virus

Influenza, Hepatitis virus B

3. Food

Determination of species of meat(pork, beef, chicken),
genetically modified food (GMO corn, GMO soybean etc.)

4. SNPs

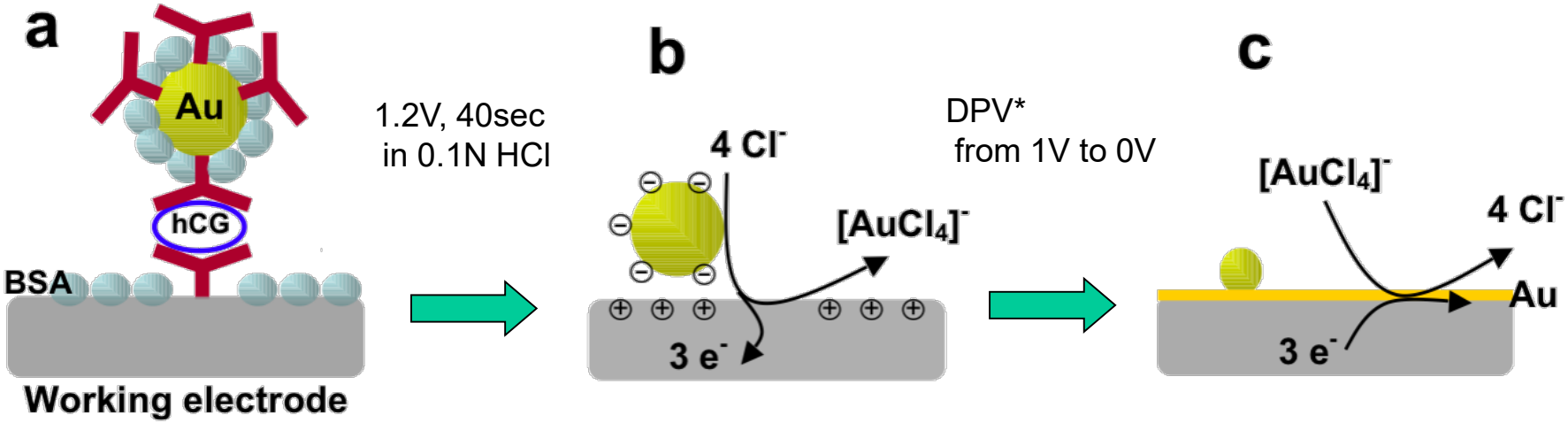
drug resistant gene, Alzheimer's disease-associated gene

BioDevice Technology

Gold-Linked Electrochemical Immuno-Assay
(GLEIA, PCT/JP2007/56992, JP5187759)

Gold nanoparticle redox signal enhancement for detection of antigens

After the recognition reaction between the surface-immobilized primary antibody and hCG, the captured antigen was sandwiched with a secondary antibody that was labeled with gold-nanoparticles. Then the amount of gold nanoparticles was determined by its redox signal.



The primary antibody was Immobilized directly on the working electrode, and a sandwich-type immuno-reaction was performed

A high potential was applied In HCl for the oxidation of gold nanoparticles

The voltammetric measurement was performed.

DPV* : differential pulse voltammetry

Reference:

- Direct fabrication of catalytic metal nanoparticles onto the surface of a screen-printed carbon electrode, ***Electrochemistry Communications*** *8, p1375-1380 (2006)*.
- Gold nanoparticle-based redox signal enhancement for sensitive detection of human chorionic gonadotropin hormone, Koutarou Idegami, Miyuki Chikae, Kagan Kerman, Naoki Nagatani, Teruko Yuhi, Taturo Endo, and Eiichi Tamiya, ***Electroanalysis*** *20, p14-21 (2008)*

BioDevice Technology

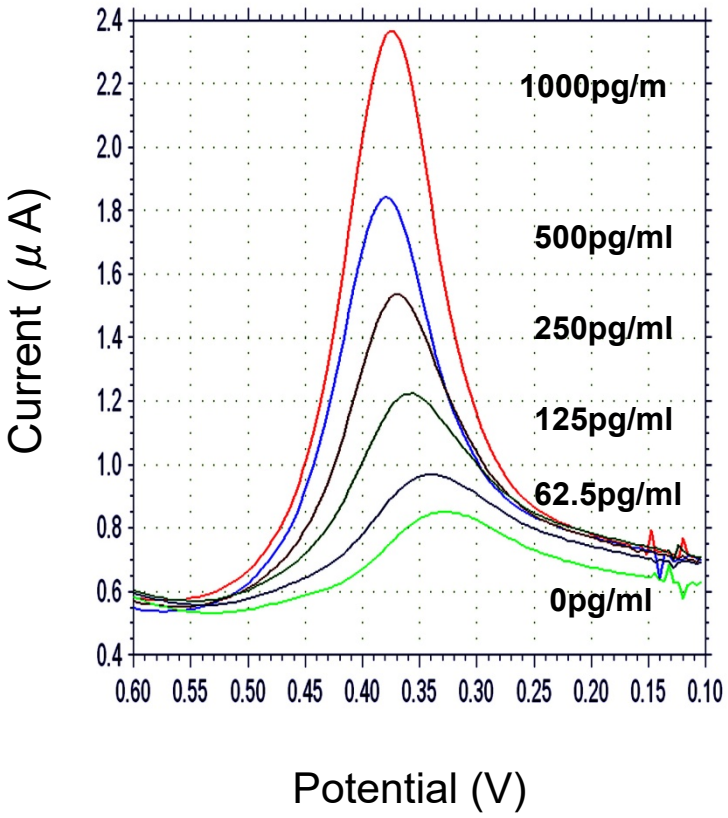
Comparative table of GLEIA and ELISA, CLEIA

	GLEIA	ELISA, CLEIA
Labeling	Gold nanoparticle	Enzyme
Detection method	Electrochemical measurement （reduction current of gold particle）	Optical measurement （coloring or fluorescence by enzyme activity）
Measurement time	Within 60 min (within 15 min by combination with micro flow channels)	2 – 3 hours
threshold	pg/mL ~ ng/mL	pg/mL ~ ng/mL
Sample volume	1 μL	A few tens of μL
cost	Less than 800JPY/test	800～1600JPY/test
device	inexpensive・compact	expensive・large sized
purpose	Medical/foods/environmental （For point of care testing at bed-side, clinic, manufacturing floor)	Medical/foods/environmental （For facilities for medical examination, Laboratories, stationary/batch processing）
Application examined	hCG, insulin in human serum, IgA, hemoglobin, albumin in human urine, DNA detection after PCR with FITC and biotin labeled primer	

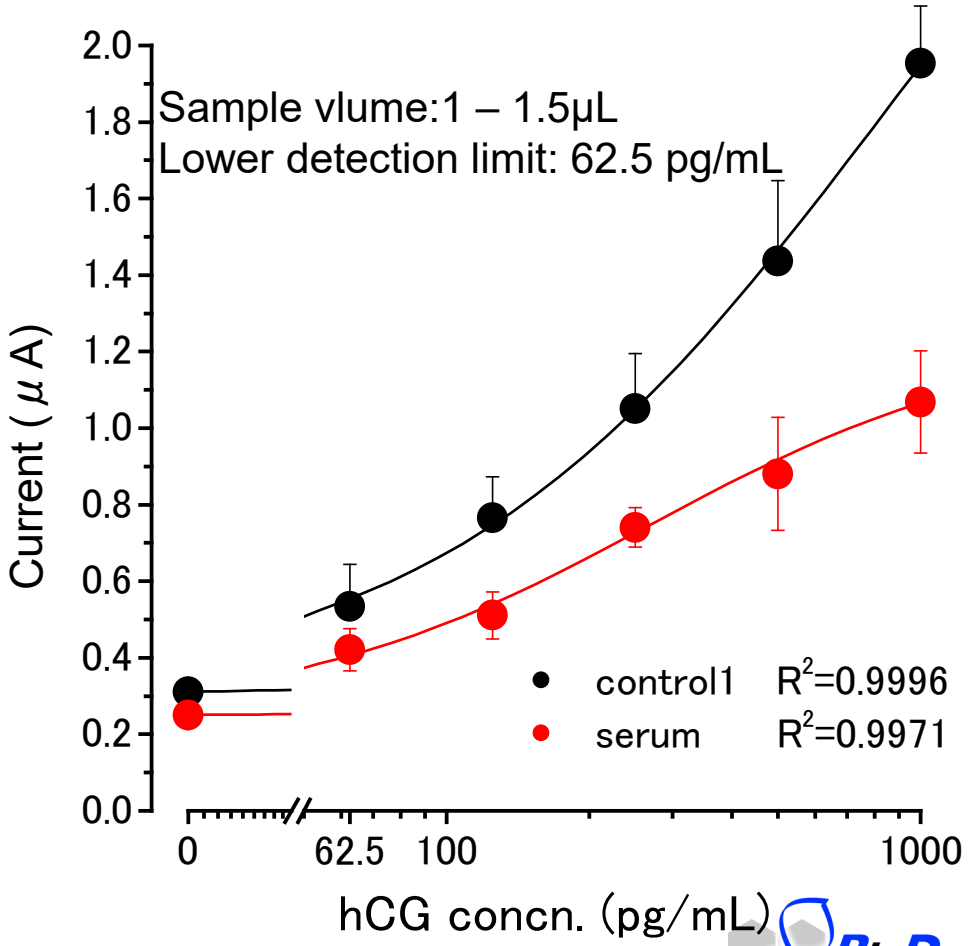
BioDevice Technology

Application of Gold-Linked Electrochemical Immuno-Assay I

Typical differential pulse voltammograms of GLEIA.

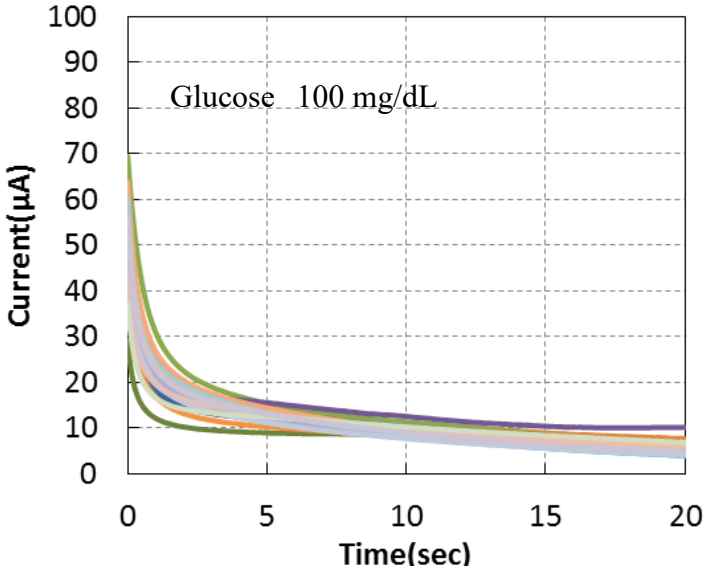


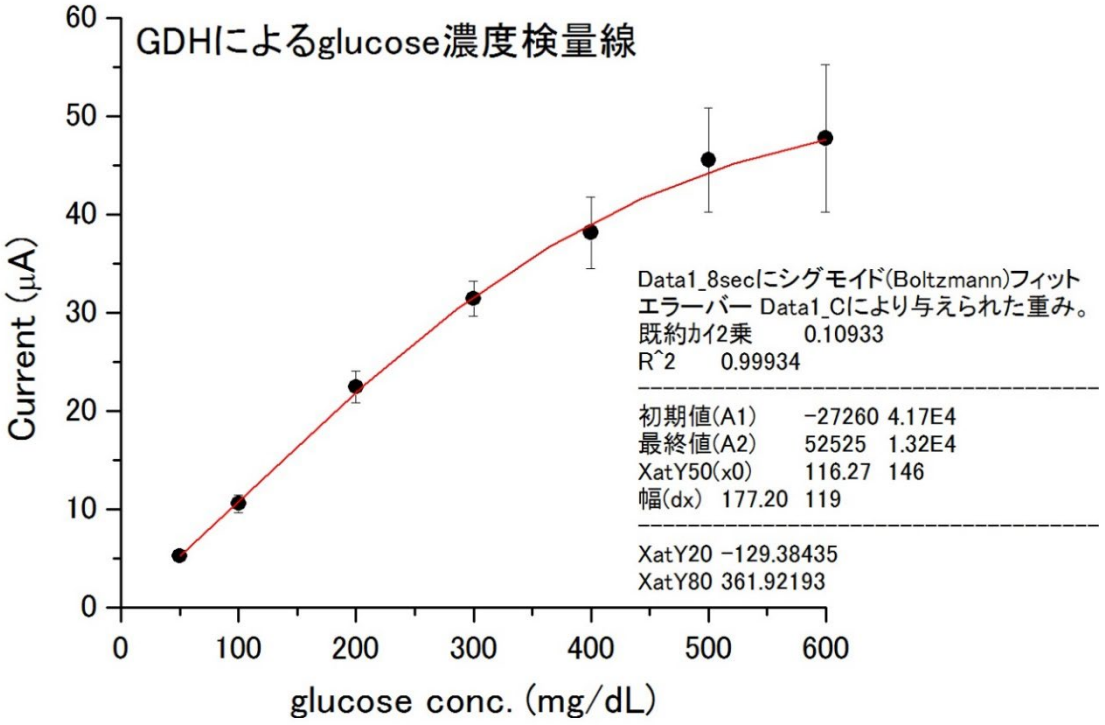
Human Chorionic Gonadotropin Hormone standard curves constructed with buffer (●) and with serum (●)



BioDevice Technology

Glucose sensor with Glucose Dehydrogenase using DEP-Chips (Chrono-amperometry)

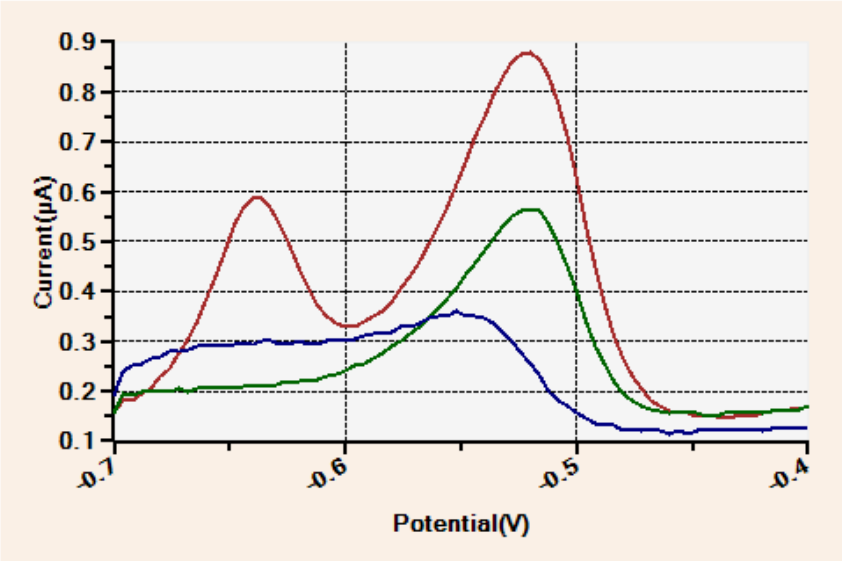




BioDevice Technology

Heavy metal determination（DPV）

Pb

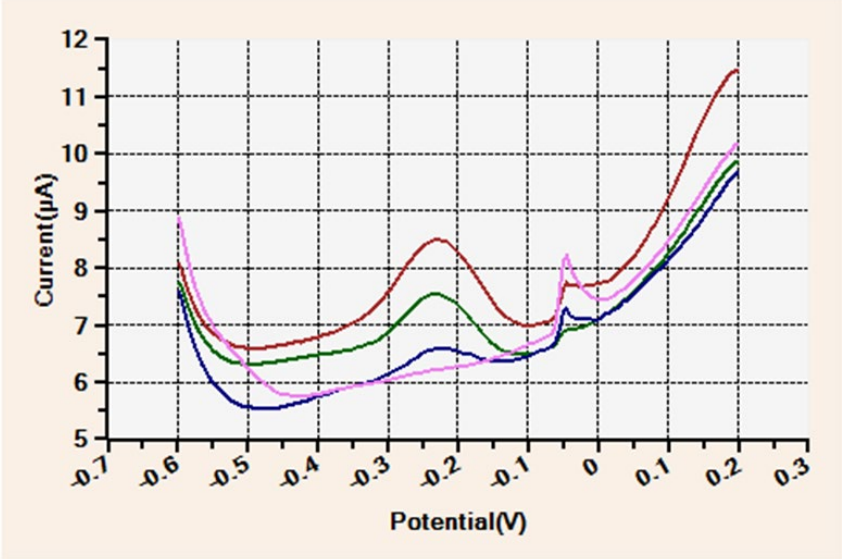


Pb 赤：100、緑：10、青：0 (ppb)

Pb conc (ppb)	Peak Height (μA)
0	0.150
10	0.385
100	0.624

DEP-Chip SP-N SPKI13
Dilution with 0.1N

Cd



Cd 赤：100、緑：50、青：20、桃：0 (ppb)

Cd conc (ppb)	Peak Height (μA)
0	0
20	0.433
50	1.046
100	1.628

DEP-Chip SR-N SRJR10
Dilution with 0.1N

BioDevice Technology

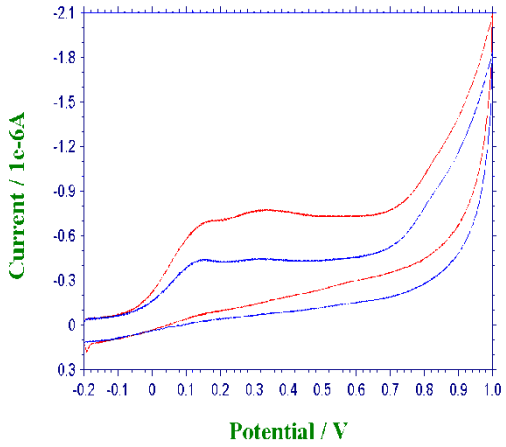
Detection of residual agricultural chemicals (RAC) using inhibition of Acetylcholine esterase activity (Electrochemical method)

Acetylcholine esterase (AChE) mediates the following reaction.
Agricultural chemicals inhibit the activity of AChE and inhibit formation of thiocholine (TCh)

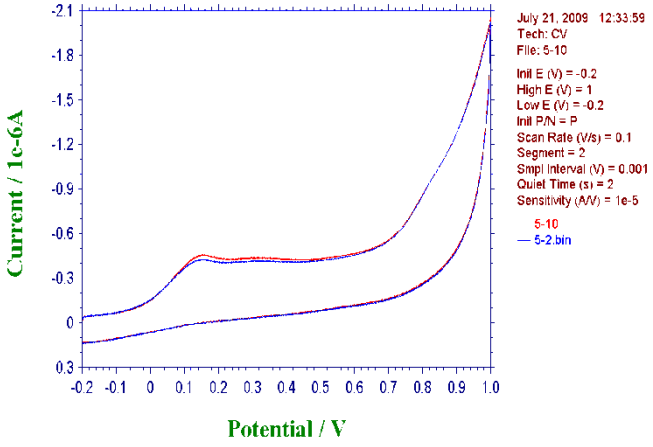
Principle of reaction

$$\underset{\text{ATCh}}{(CH_3)_3\,N^+CH_2CH_2SCOCH_3} + H_2O \xrightarrow{\textbf{AChE}} \underset{\text{TCh}}{(CH_3)_3\,N^+CH_2CH_2SH} + CH_3COOH$$

$$\underset{\text{ATCh}}{(CH_3)_3\,N^+CH_2CH_2SCOCH_3} + H_2O \xrightarrow{\textbf{AChE + RAC}} \times$$



↑without RAC



↑with RAC (chloropyrifos 5 ppm)

AChE converts ATCh to TCh. After 10 min reaction, the current became larger by the increased TCh.
When the activity of AChE was inhibited by RAC, TCh was not formed and the increase of the current was also inhibited.

Blue line: 2 min after ACTh addition, Red line: 10 min after ACTh addition

BioDevice Technology

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BioDevice Technology

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