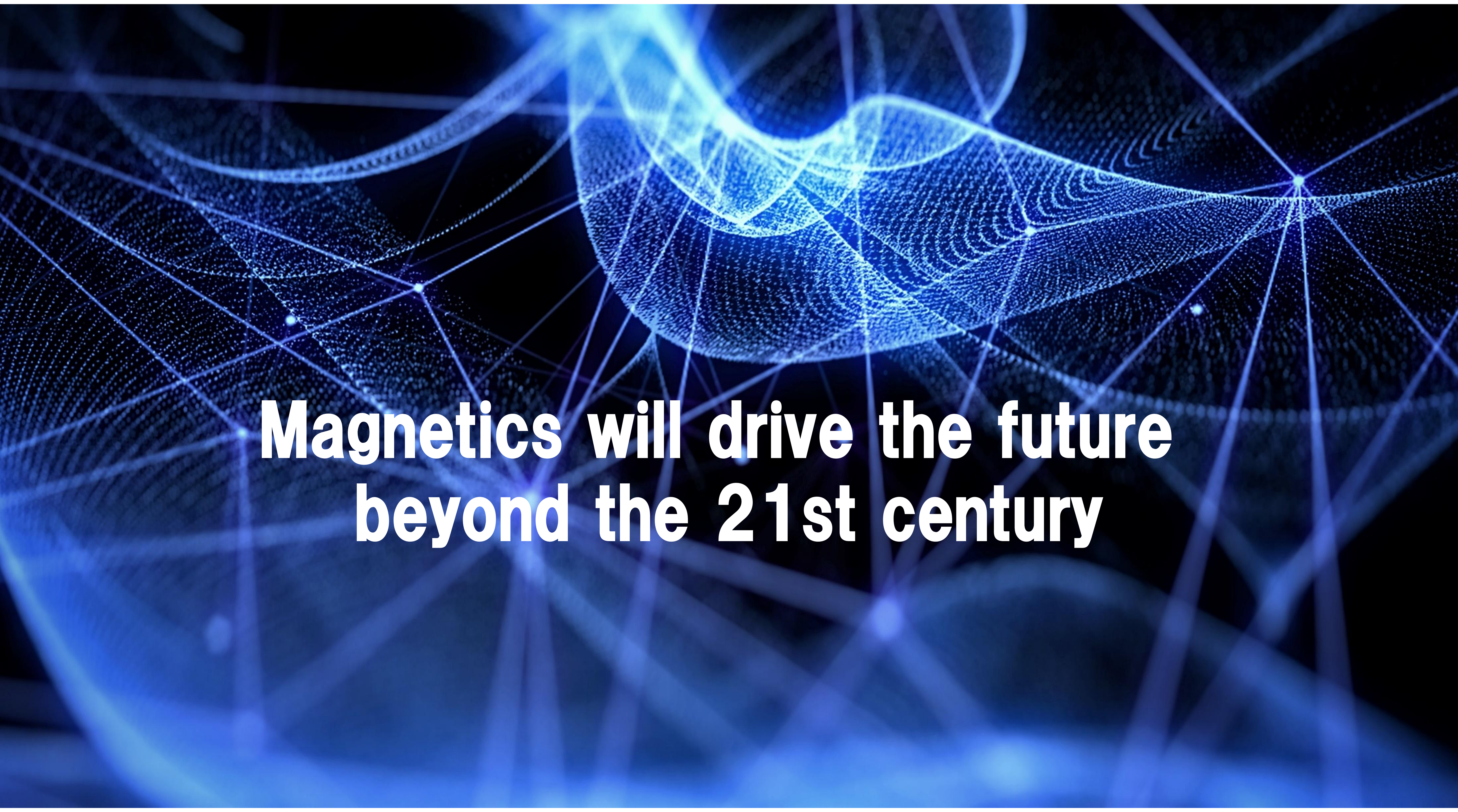


MagneDesign
Company profile
March 2026

Company Profile

Company Profile
History・Career
Laboratory
GSR Sensor
GSR Sensor application
Motor
Dental Magnet
Outlook

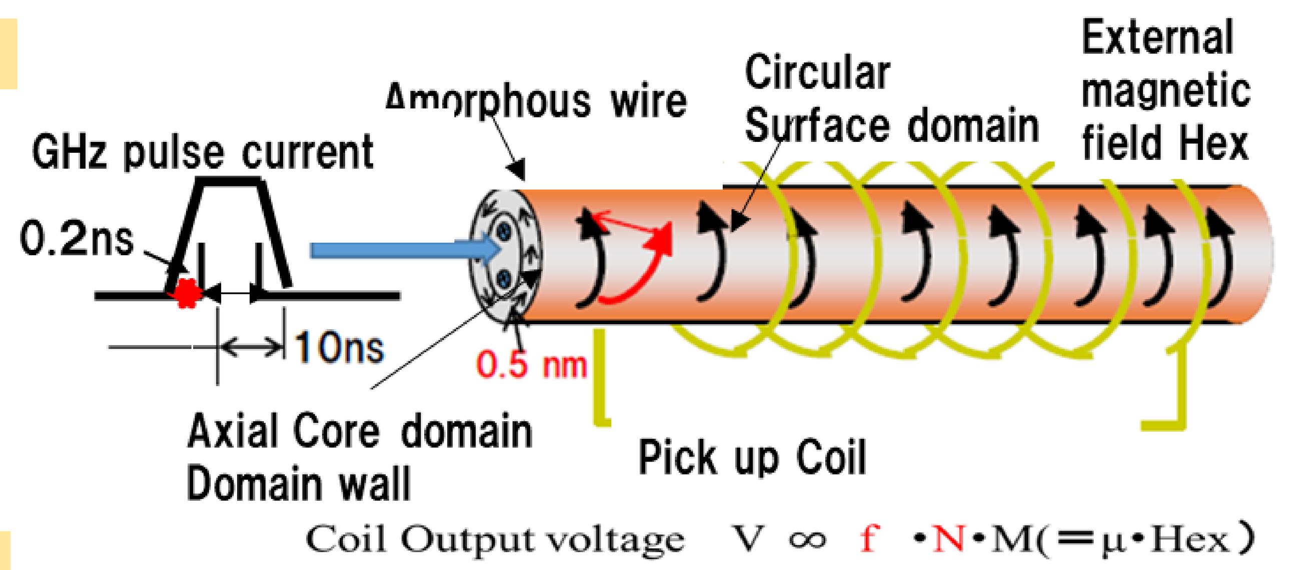
Head Office	Kitahirai2-4,Toyooka,Mihama-cho,Chita-gun,Aichi-ken,470-2414,Japan
Contact details	TEL：＋81-569-47-7631(main number)
Establishment	September 21, 2012
Capital	30 million yen
Board member	CEO：Yoshinobu Honkura Director：Eiki Kikuchi, Shinpei Honkura, Rei Uemura Auditor：Akinori Maeda
Number of employees	23 people(As of May 1, 2025)
Business content	・Research and development of magnetic sensors, motors, magnets, and their application software
Main Bank	The Bank of Nagoya(Tokai Branch), The Aichi Bank(Nawa Branch)
Land	3,836.76㎡
Building	1,279.51㎡

Our product technology

Introduction to the GSR sensor principle

The principle of the GSR sensor involves detecting the phenomenon of simultaneous ultra-high-speed rotation of surface spins induced by GHz pulses using a microcoil. Detection capability increases in proportion to the square root of the pulse frequency and the number of coil turns. The developed GSR sensor can achieve sensitivity performance 100 times greater than that of MI sensors.

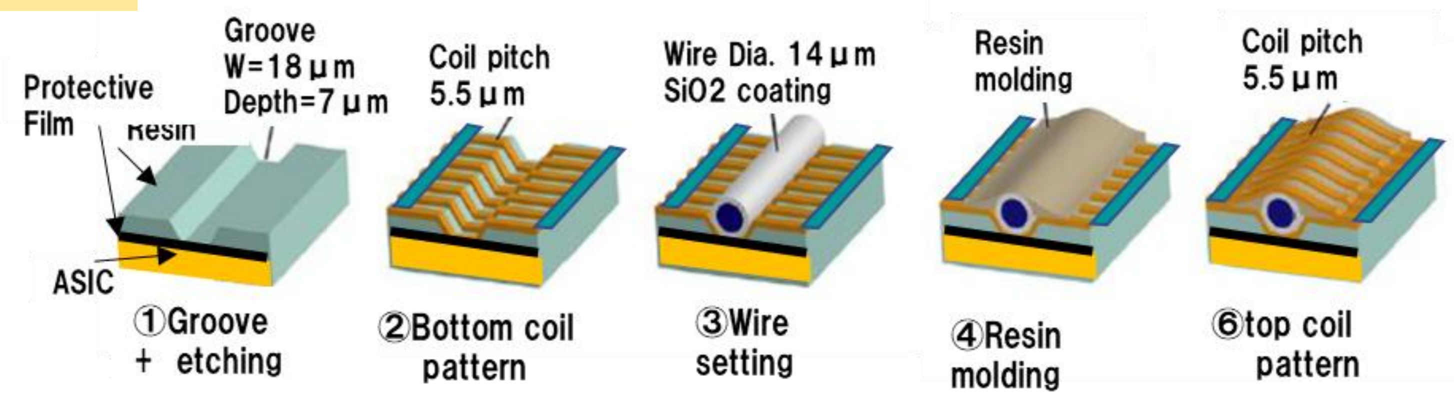
Figure 1



Introduction to 3D Photolithography

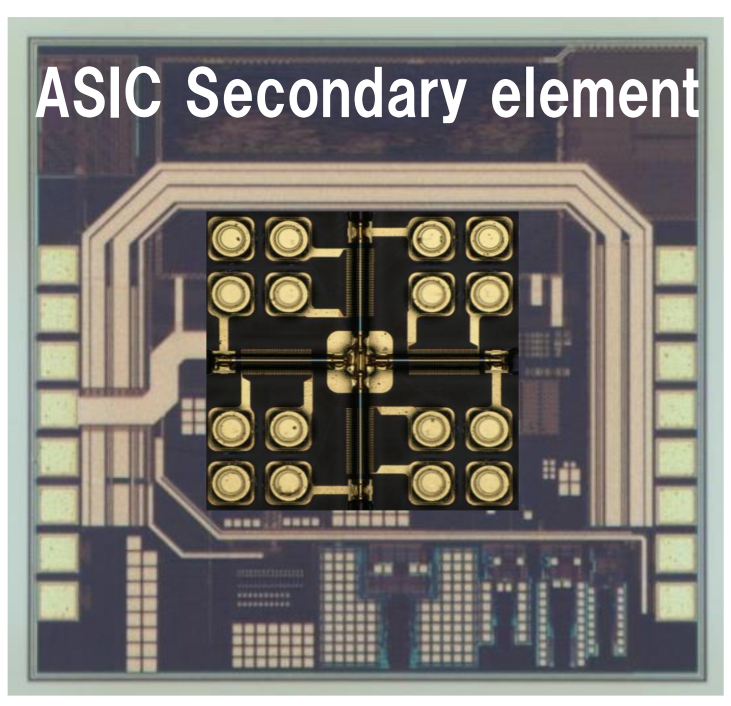
The principle diagram of the GSR sensor is shown in Figure 1.
The GSR element is fabricated using a 3D photolithography process. Notable new technologies include the technique for the fine patterning on uneven surfaces and the technique for aligning 10 μm diameter amorphous wires in 7 μm deep grooves.（Figure 2)

Figure 2



Introduction to GSR Element Products and Samples

The performance of the GSR element currently under trial production is controlled by varying the element length from 0.1 mm to 2 mm, based on a coil pitch of 3 μm, to achieve a measurement range from 6 G to 100 G sensitivity is adjustable from 6 mV/G to 500 mV/G.



Coil pitch
3μm

Company History

Our company was established in September 2012 by Yoshinobu Honkura, following his retirement as Managing Director of Aichi Steel Corporation, with the aim of researching and developing Magnetics technology and disseminating its results. In August 2013, we started joint research with Nagoya University. In January 2015, we discovered the GSR principle enabling ultra-high-sensitivity micro-magnetic sensors, which was widely featured in NHK news reports and attracted significant attention. In April 2016, we established a prototype centre as our development base and successfully developed production technology for GSR sensor elements. In 2020, papers on ASIC-specification GSR sensors were published in the international academic journals Sensors and JMMM. In April 2023, we relocated our head office to Mihama Town, Aichi Prefecture, and simultaneously established the Mihama Research Laboratory. Currently, based on the GSR principle, the company is developing magnetic gyro compasses for wearable computers, pT (pico-tesla) sensors for biomagnetic detection, and GSR sensors for automotive magnetic sensors. Furthermore, it has successfully developed dental magnets and launched in Indonesia.

September 2012	Established company by Dr. Honkura
August 2013	Sign joint research agreement with Nagoya University, open the office at university
October 2014	METI subsidy project (Electronic Compass: 40 million yen over 2 years)
April 2015	Aichi Prefecture subsidy project (pT Sensor: 16 million yen)
May-November 2015	Discovered GSR principle, presented at international conference in July,
	Obtained GSR sensor patent in November
October 2015	Reported GSR sensor on NHK news programme
December 2015	NEDO subsidy project (pT sensor commercialisation: 70 million yen)
April 2016	Relocated to Navi Shirogane (Nagoya City), constructed our own prototype centre
April 2020	Executed a contract with Asahi Intec
July 2020	Executed a license agreement with Asahi Intec
July 2020	Paper on ASIC-specification GSR sensor published in JMMM
April 2023	Head office relocated to Mihama in Aichi ; established Mihama Research Institute
May 2023	Launched magnetic attachment Magteeth700/900
August 2023	Aichi Prefecture subsidy project (thin-type magnetic attachment: 30 million yen)
January 2024	Held Commemorative lecture to mark acquisition of 50 patents
May 2024	Aichi Prefecture subsidy project (magnetic microscope: 60 million yen)
June 2024	NEDO subsidy project (50% lighter motor: 430 million yen)
September 2024	Honkura attended honorary member commendation ceremony of the Magnetics Society of Japan (MSJ)
September 2024	Commenced sales of nT meter and first product exhibition at Sensor Expo Japan 2024

Executive Profile

CEO：Yoshinobu Honkura

・Majored in magnetic physics at Nagoya University and engaged in development within the field of magnetic engineering
・Obtained a Doctor of Engineering degree as an expert in magnetic materials and magnetic circuit design
・Served as Vice President of the Magnetics Society of Japan (2013–2017)

<Awards>

1995: Received **the Chunichi Industrial Technology Award**
2005: Received **the Achievement Award** from the Magnetics Society of Japan
2012: Received **the Minister of Education, Culture, Sports, Science and Technology Award**
2012: Received **the Yamazaki-Teiichi Prize** by Materials Science and Technology Foundation of Japan (MST)
2018: Received **the Six Major Achievements Award for utilization of FY2016** by MEXT (Nanotechnology Platform)
2024: Elected as **an Honorary Member of the Magnetics Society of Japan**

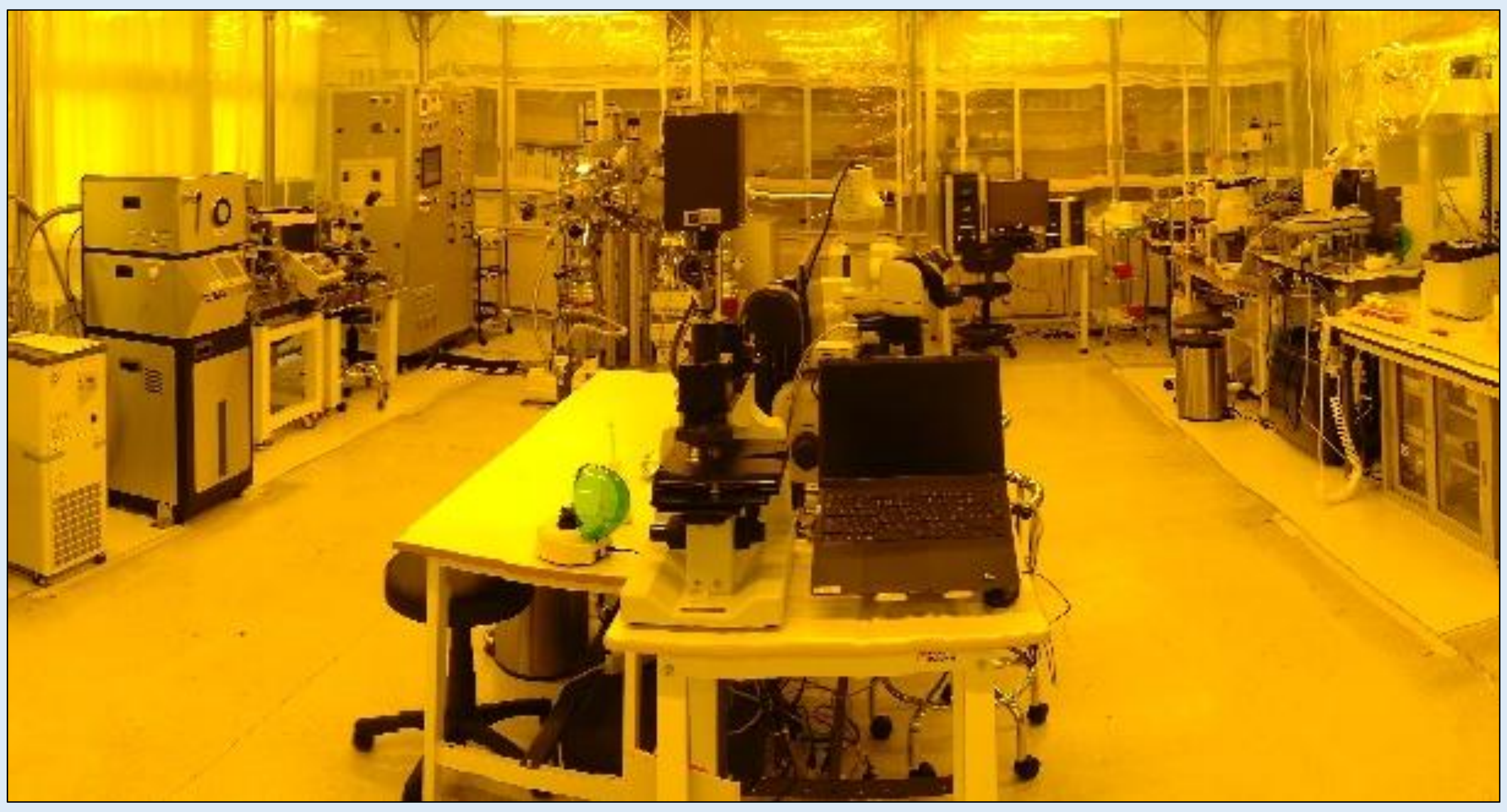
Facility Overview

elementary technology

Laboratory 1

Development of 3D Photolithography Technology

- Ternary evaporation system
- RIE・Exposure equipment
- Etching・Pure water system
- Plating equipment・Polishing equipment
- SEM・Resistance measurement
- Profilometer・3D microscope
- Wire alignment equipment



Laboratory 2

New Alloy Development

- Melting furnace・ICP・Vacuum furnace
- X-ray analysis・VSM・Tensile testing machine
- Magnetising device・Cutting machine
- Swaging machine

Laboratory 3

Amorphous Development

- Precision cutting machine
- Multi-wire cutting machine
- Amorphous wire prototyping equipment
- Wire dimensional measurement equipment
- Precision polishing equipment
- Sweeping machine・Wire rewinding equipment
- Wire heat treatment equipment
- Wire BH measurement equipment

Applied Technology

Laboratory 4
Magnetic Sensor Development

・GHz pulse generator・GHz oscilloscope
・Impedance analyser・Wire bonding
・Shield box・Microscope (stereoscopic/metallurgical)
・3D printer, etc.

Laboratory 5
Dental Magnet Development

・Magnetic modification equipment・Micro laser welding
・Magnetisation equipment・Grinding equipment
・Assembly presses and other production/prototyping equipment
・Automatic assembly welding machines
・Automatic grinding equipment
・Automatic magnetization
・Inspection equipment・Laser marking systems

Laboratory 6
Motor Development

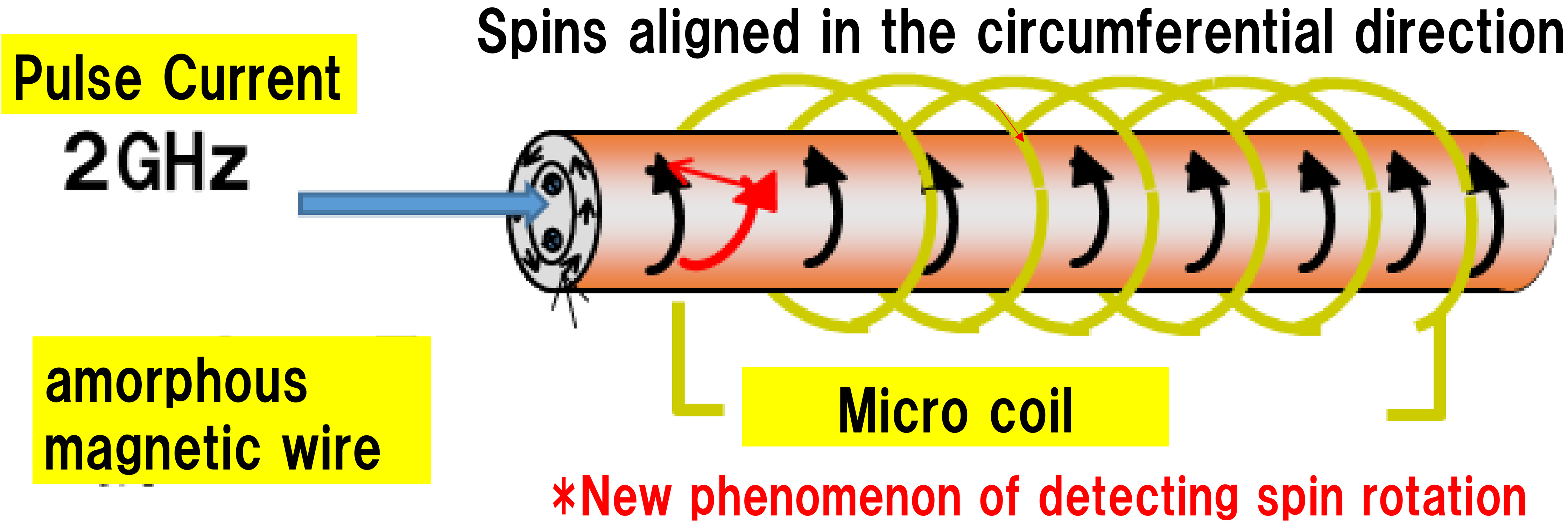
Evaluation Bench
・High-speed rotation test apparatus
・Magnetic field distribution measuring apparatus

GSR Magnetic Sensor for Spintronics Applications

Selected for the 2015 New Aichi Creative Research and Development Grant

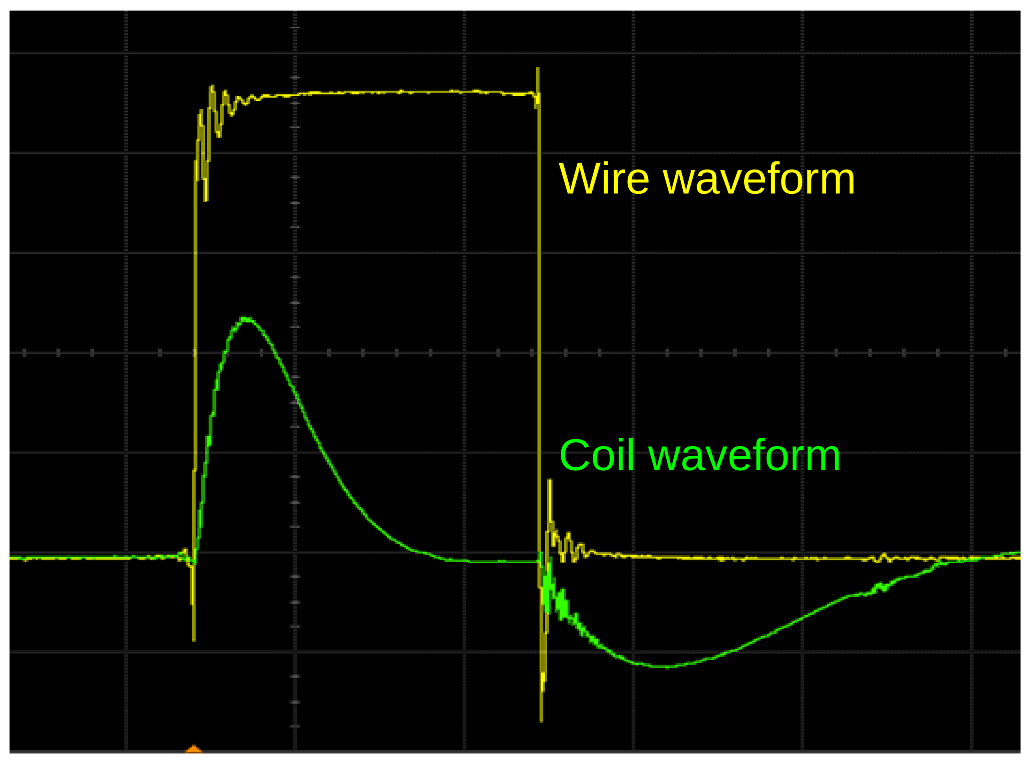
【Principle】

A magnetic sensor enabling measurement of minute magnetic fields（1 nT）by applying a 2 GHz pulse current to an amorphous magnetic wire to rotate spins and detecting the voltage generated in the coil

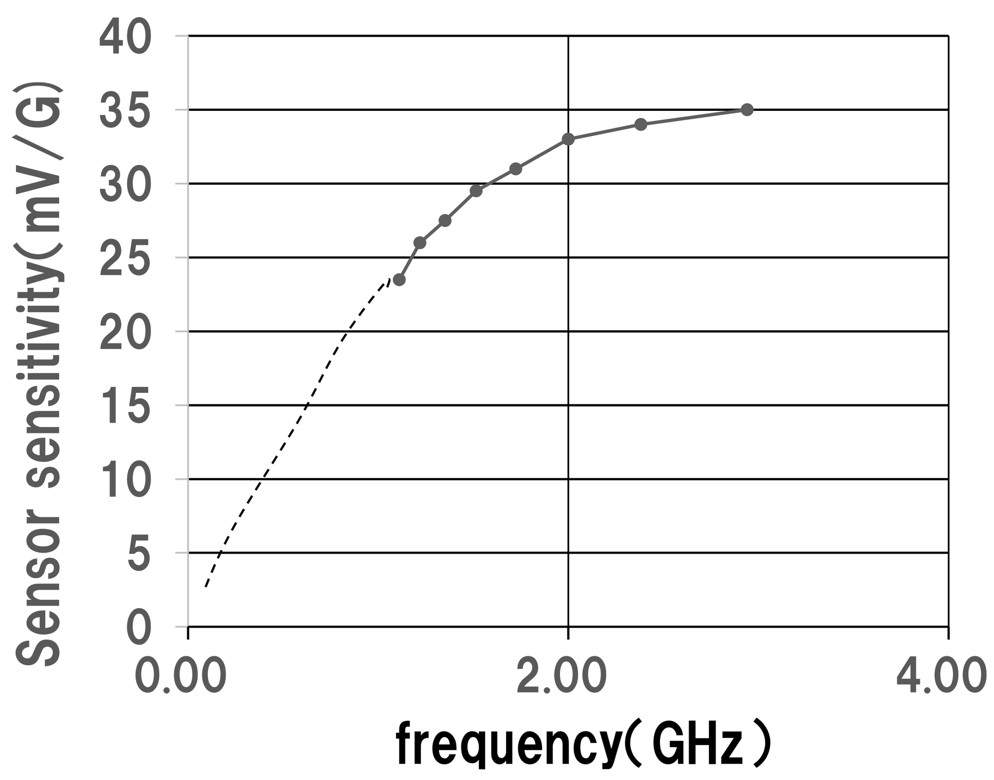


＊New phenomenon of detecting spin rotation
GHz-Spin-Rotation effect

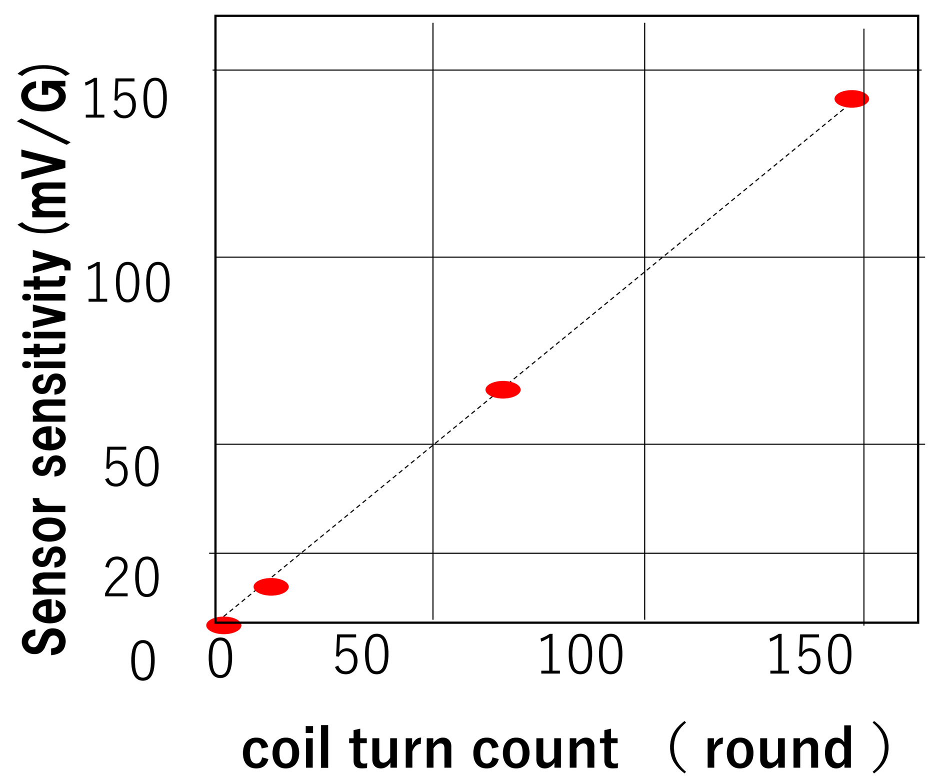
GHz pulse and coil voltage



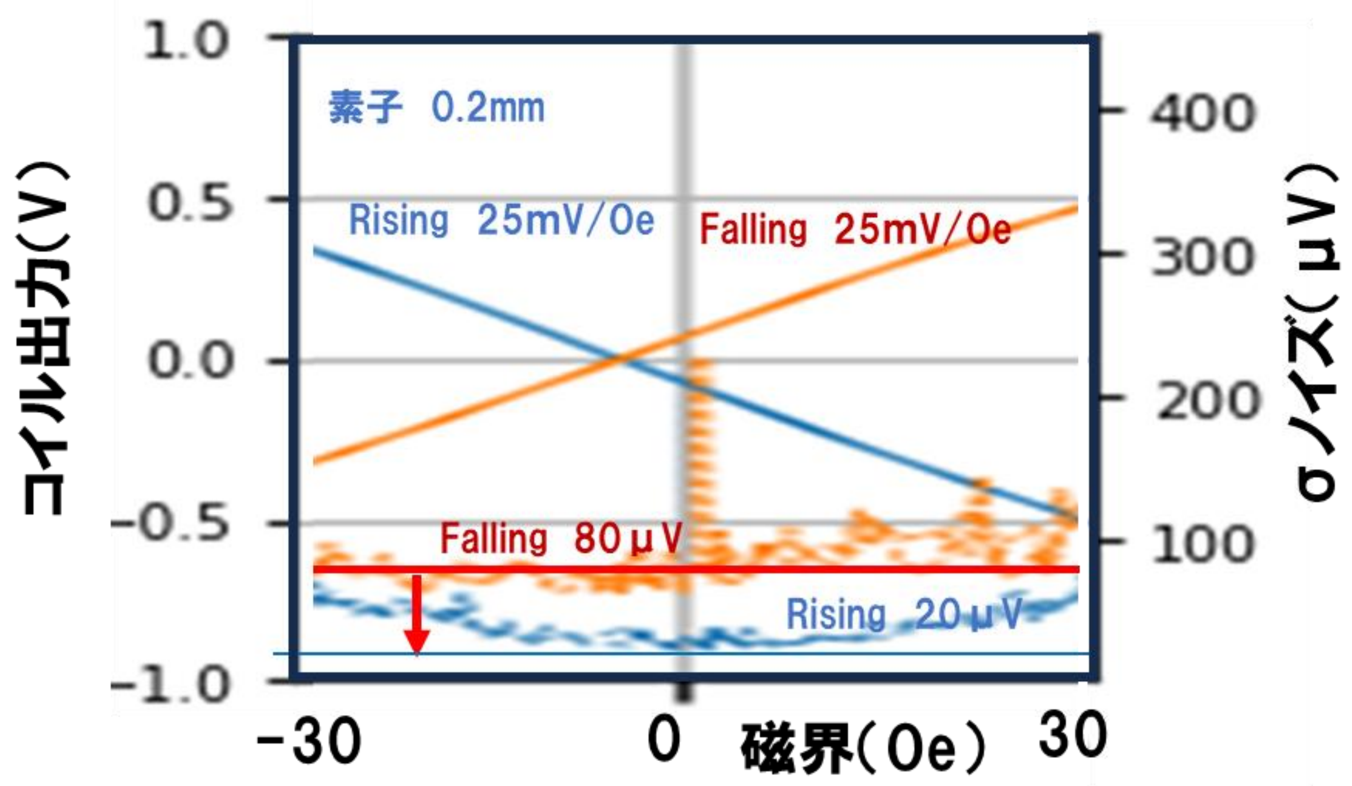
Effect of pulse frequency



Effect of number of coil turns



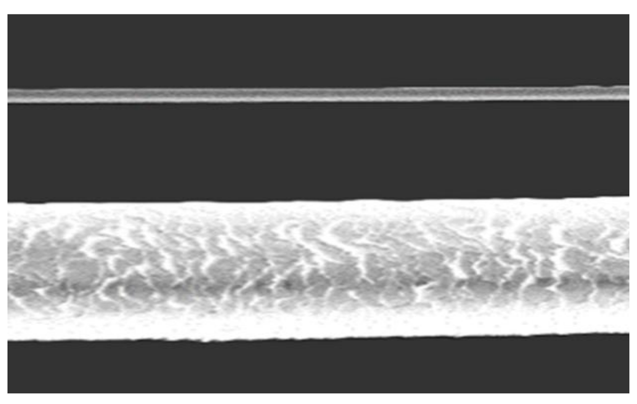
Effect of wire alloy composition
（adopted rising detection）



【GSR core technology】

1） Amorphous Wire Production

Wire diameter:10μm



Amorphous Manufacturing Equipment

2） Three-dimensional photolithography processing

Forming a microcoil on a wire

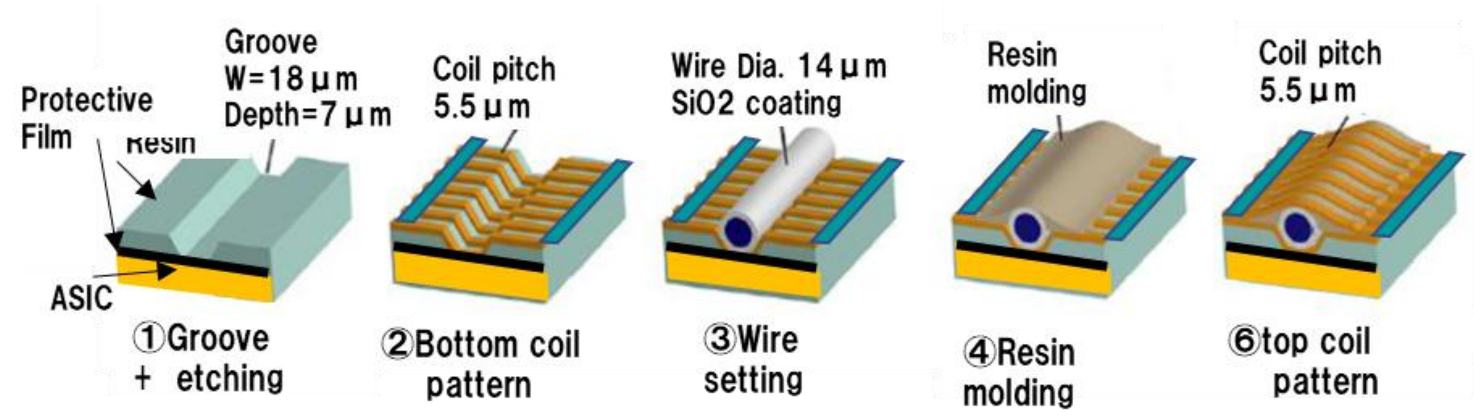
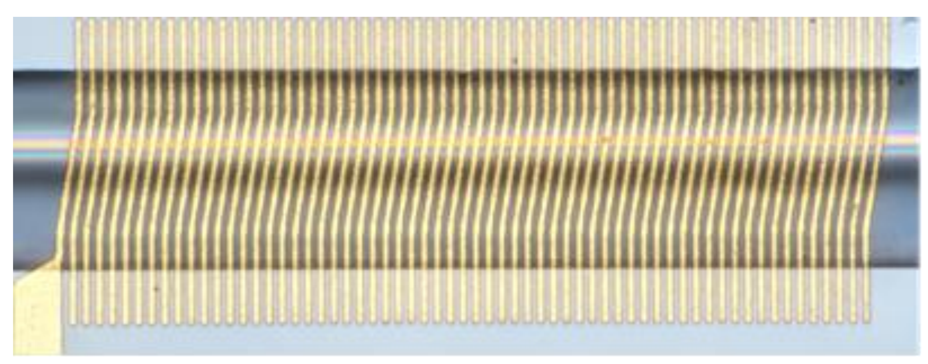


Fig. 15 Production process for a micro coil using 3 dimensional photolithography

GSR element
Coil pitch:3μm



【Applications of GSR Sensors】

1）Industrial applications（below 20 nT）

① Gyrocompass
② Current sensor
③ Rotation angle sensor

2）Medical field（1 nT or below）

① Catheter surgery robot
② Magnetic microscope
③ Bio-magnetic diagnostic device

3）GHz pulse signal processing circuit

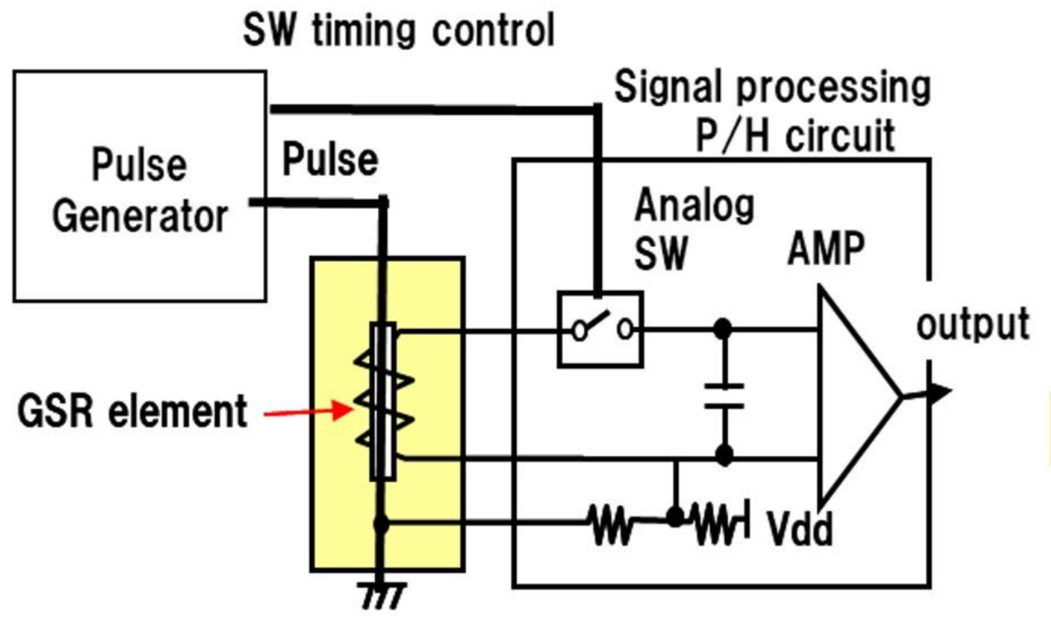
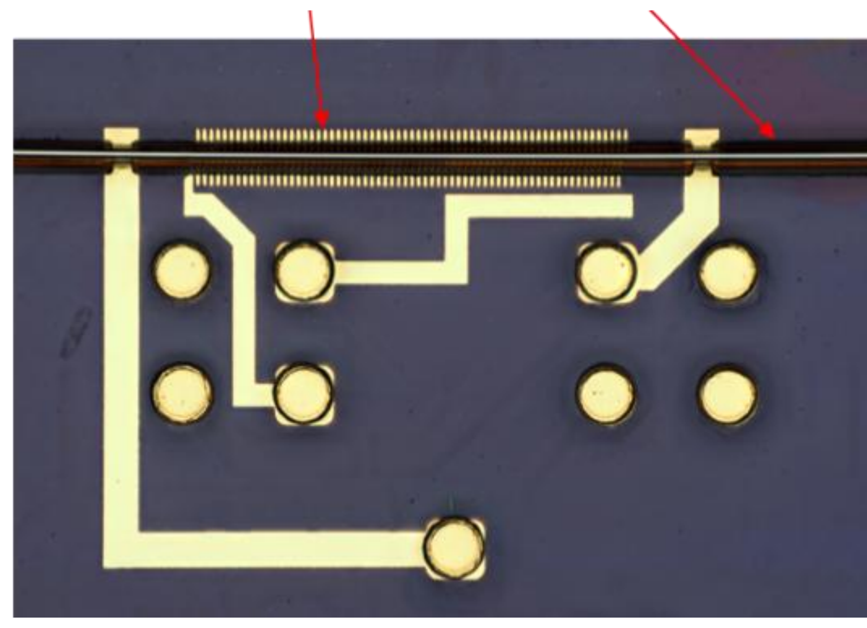


Fig. 24 The brock diagram of GSR Sensor Circuit

Formation of GSR elements on the ASIC substrate surface



Commercialisation of the world's smallest nT meter

Now on sale Magnetic field measurements of magnetic microparticles（diameter 5μm) are also possible.

Company Profile
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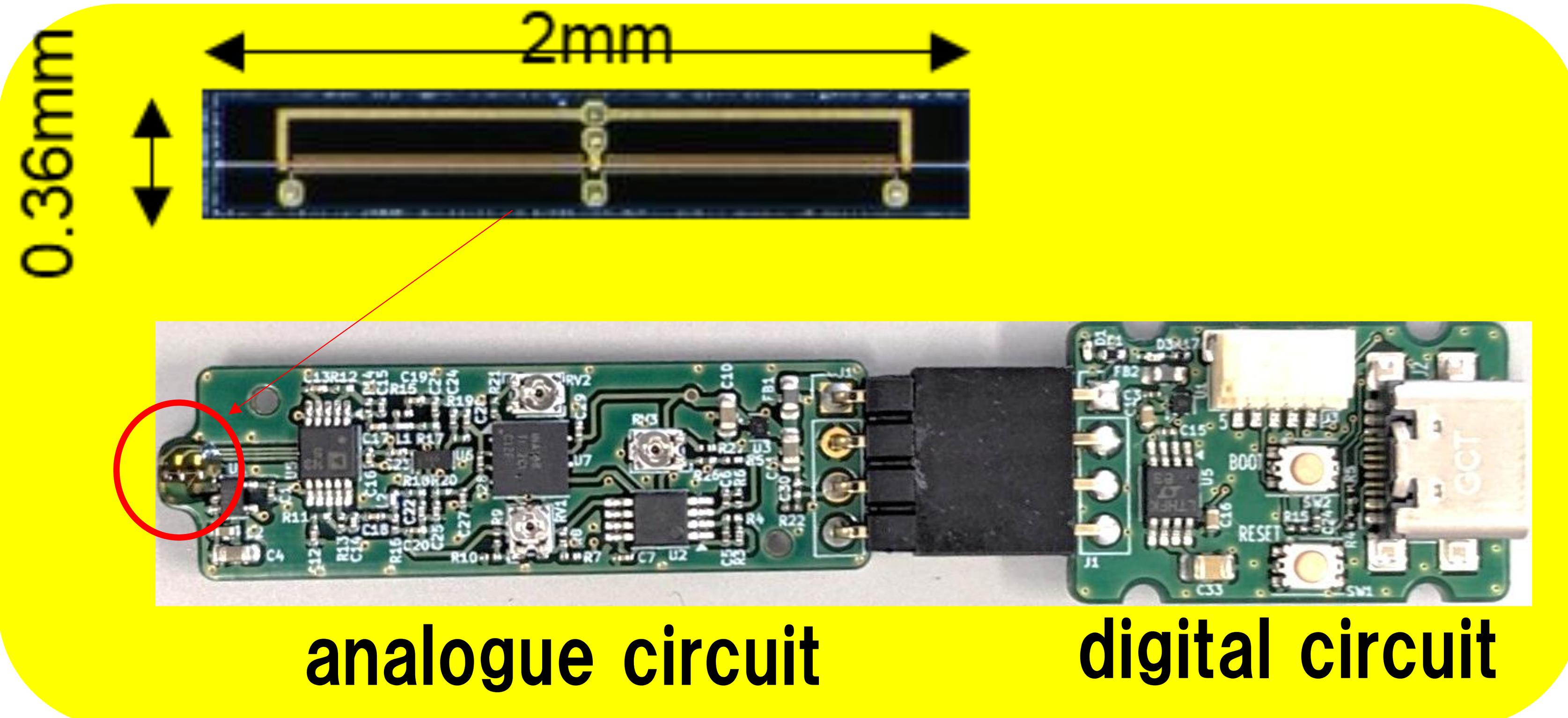
【Features】

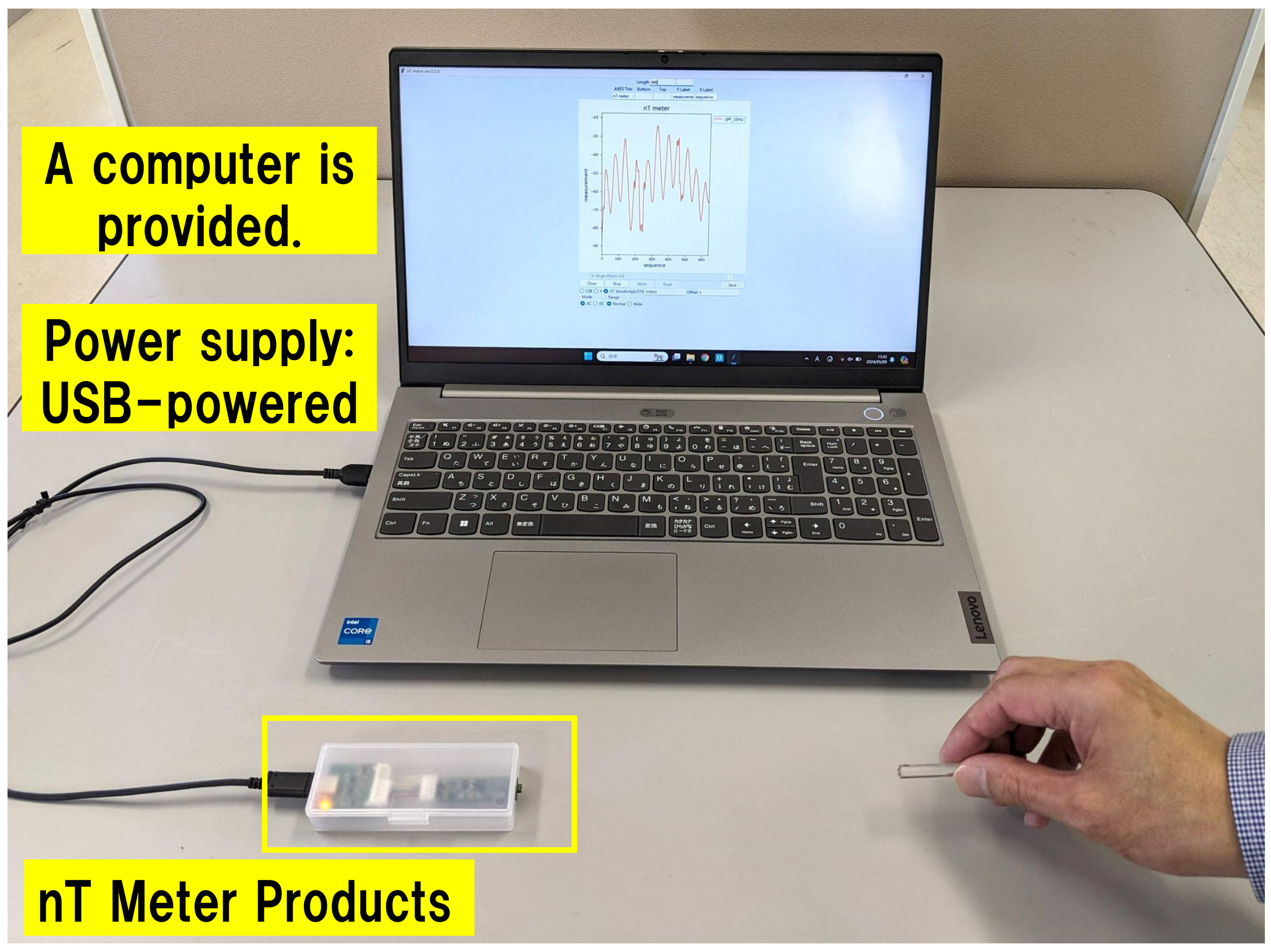
- Detection power :0.3nT@0.1～10Hz
- Element length:2mm, Micro-magnetic fields in miniature spaces
- Sensor size: φ10μm×2mm
- Proximity measurement possible
- Gladiotype requires no magnetic shielding
- Handy type configuration with USB connection between measuring instrument and PC
- PC interface, USB power supply :5V、0.22W

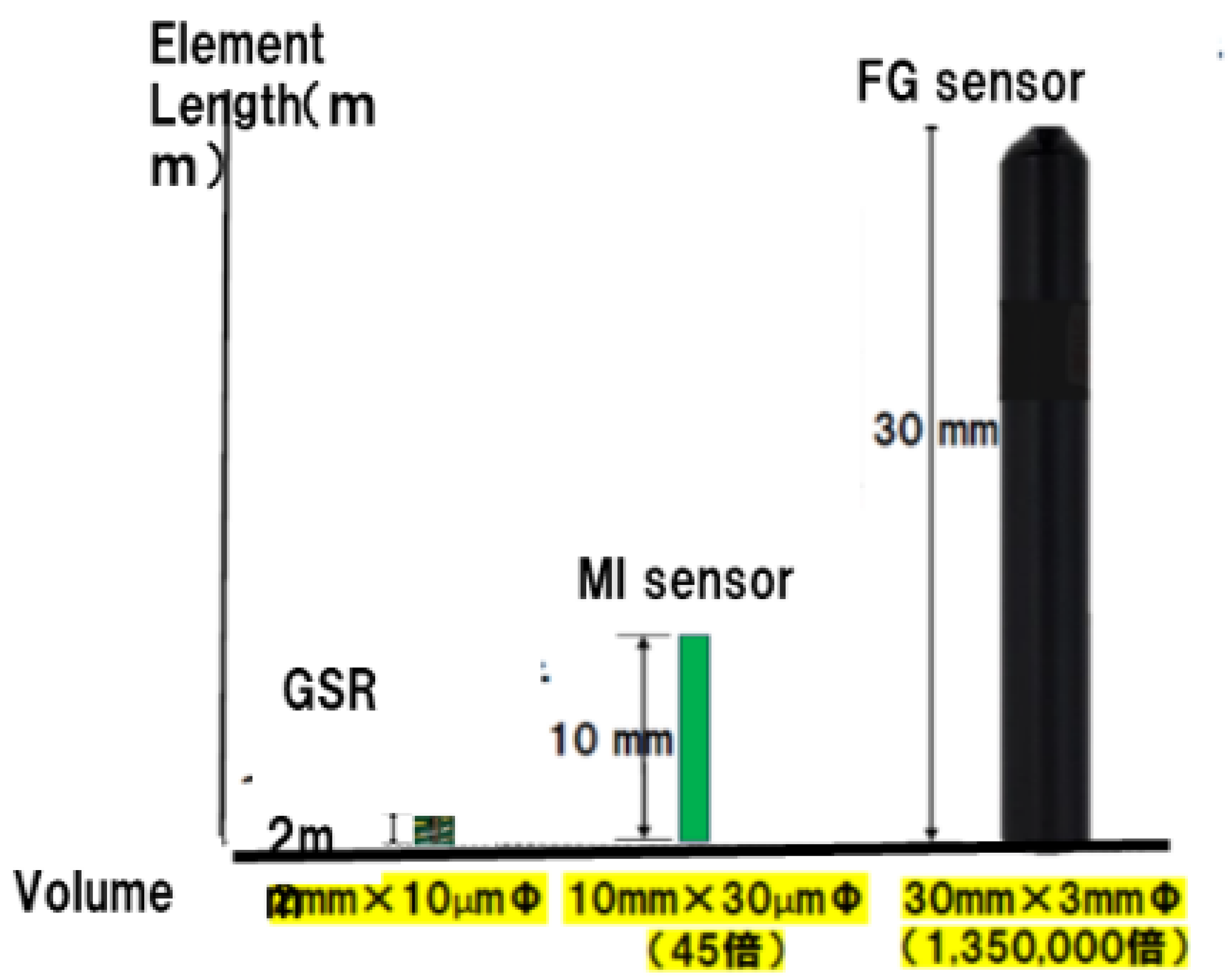


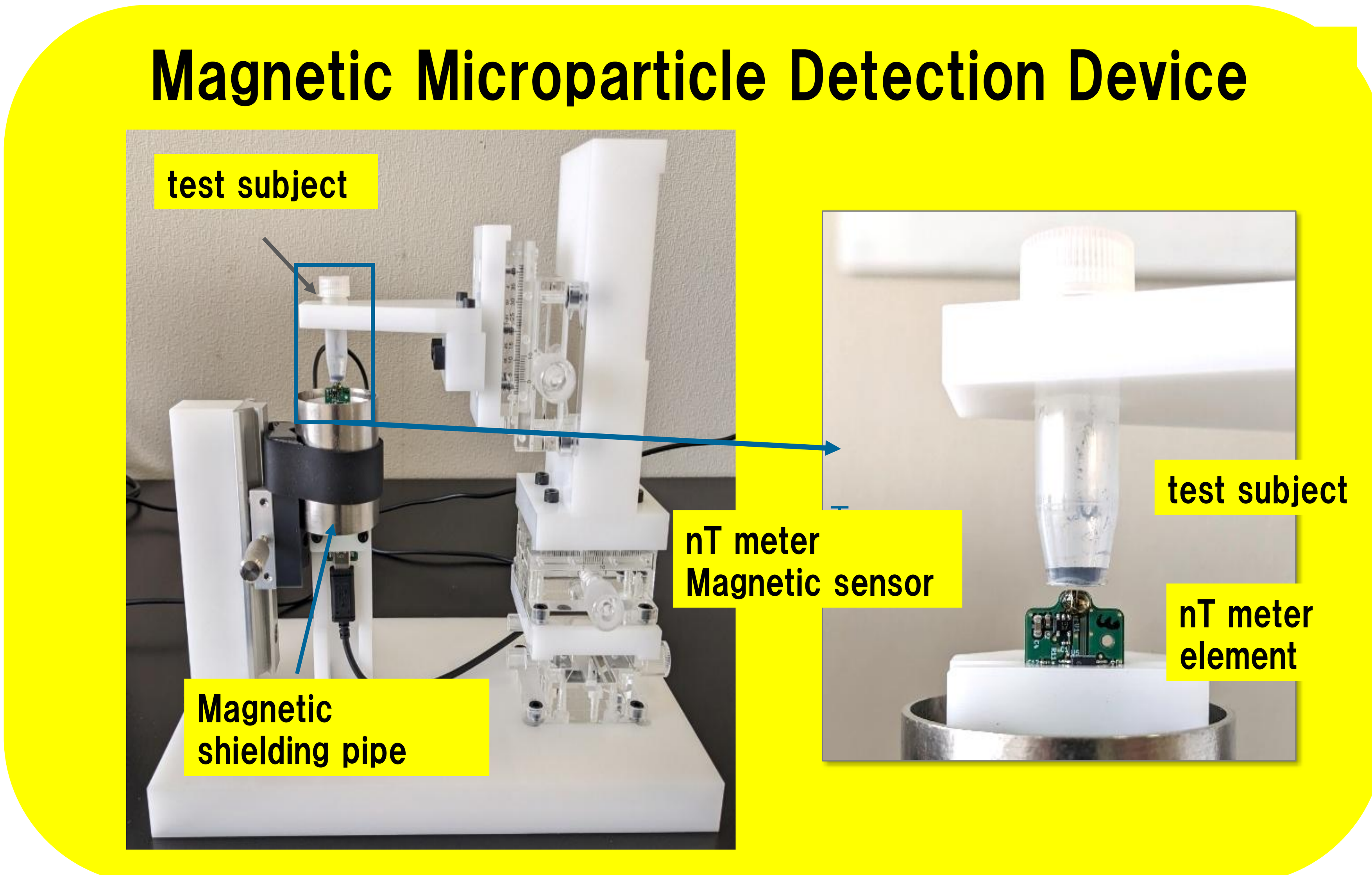
【Specifications】

Sensor main board（Analog spec.)	
Range	±100uT
Linearity	≦2% F.S. (Typ. 1%F.S.)
Bandwidth	DC ～ 1kHz
Sensitivity	25mV/uT
Noise	0.36nT/σ（0.1～10Hz) 0.104nT/√Hz@10Hz
Hysteresis	None
Power Supply	5.5～6V

(Digital spec.)	
ODR	1kSPS
Resolution	0.12nT/LSB
Bit	24bit
Power Supply	USB (5V)



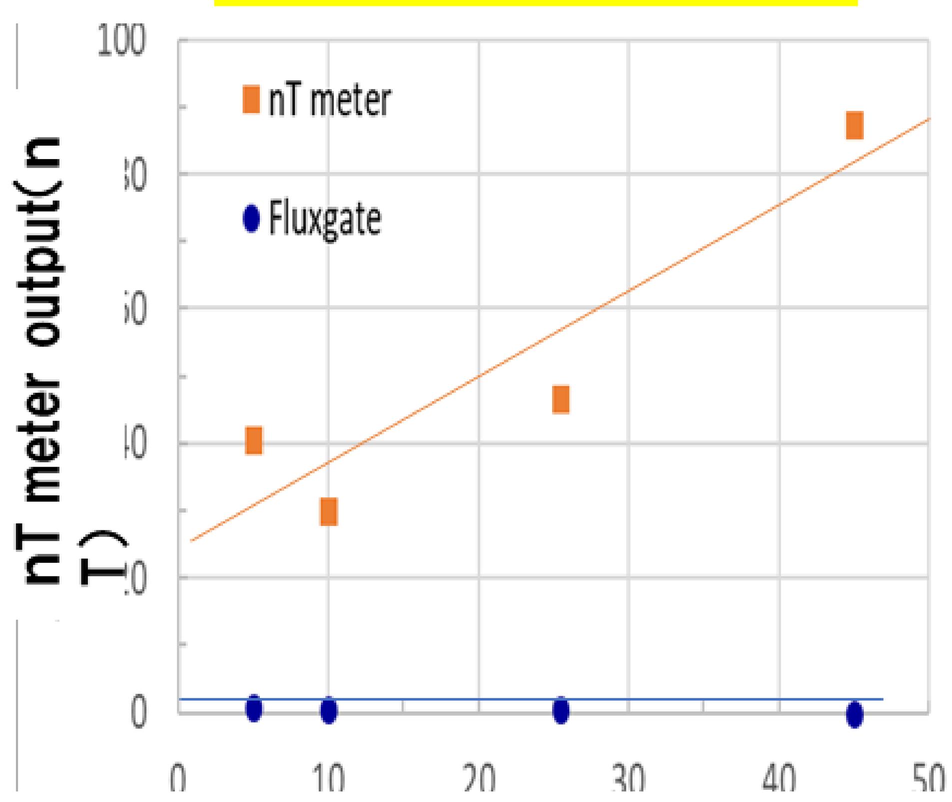




【Application Examples】

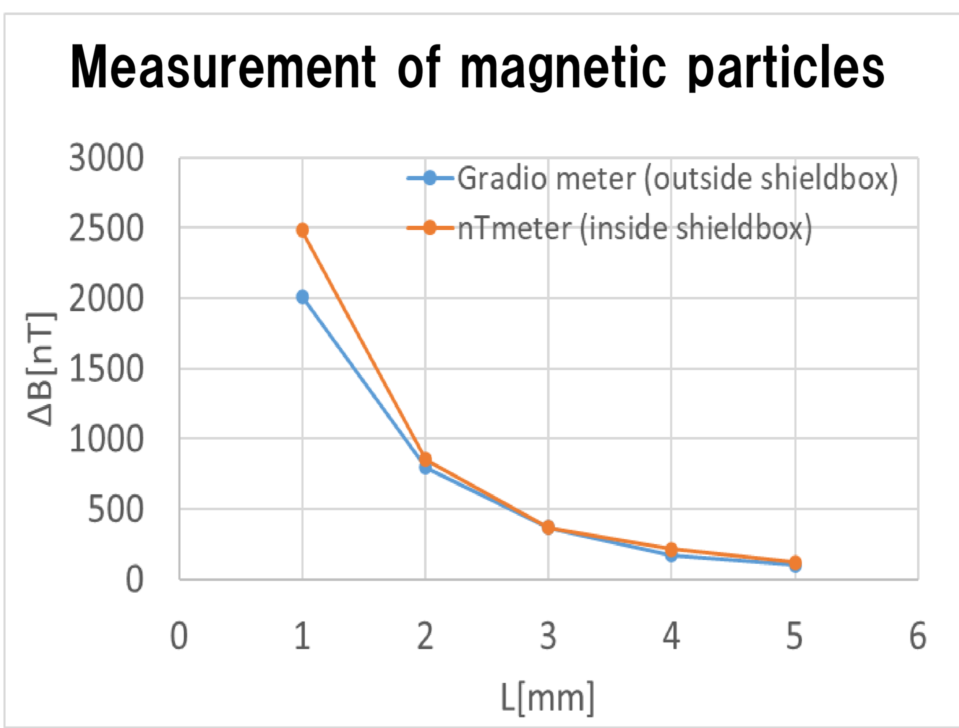
- Ideal for research into magnetic field sources in magnetic microparticles
- Detection apparatus for magnetic nanoparticles within lithium battery materials
- Apparatus for measuring the magnetic moment of micromagnets

Detect 1 micrometre



diameter of magnetic particles（μm）

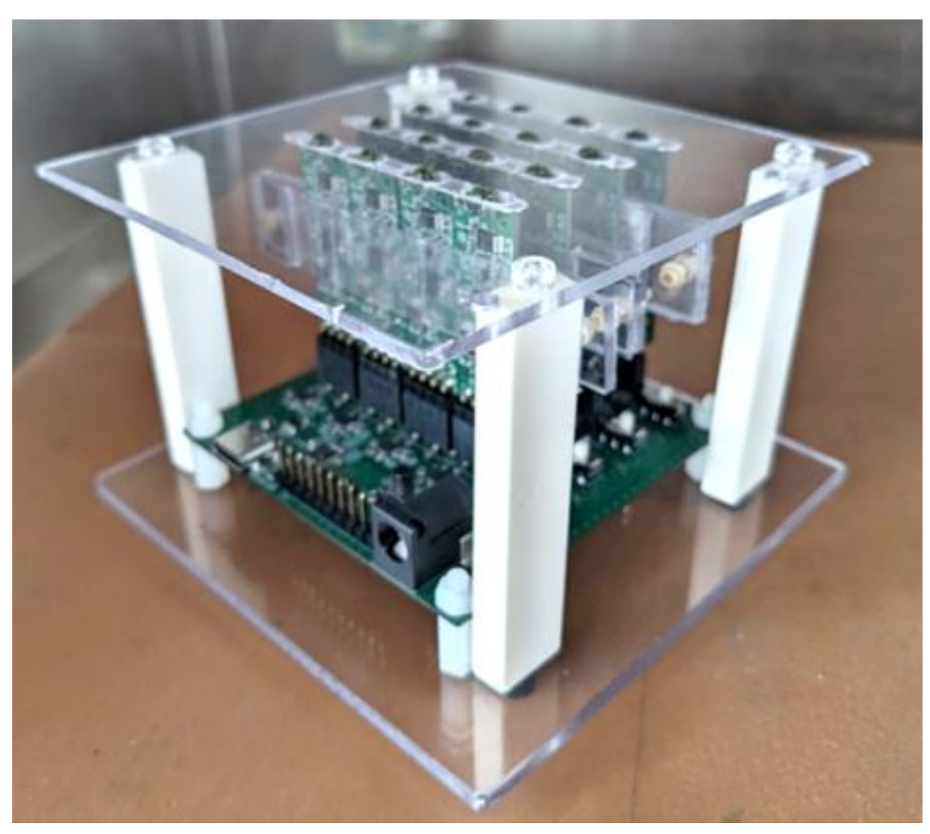
No magnetic shielding



Distance dependence from magnetic particles

3D nT Meter

nT Meter 16-channel grid



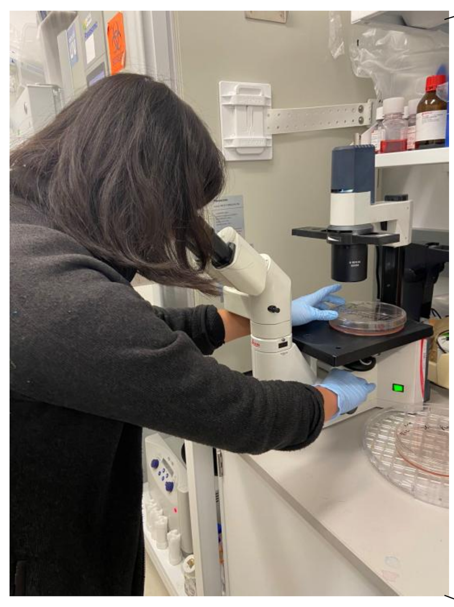
Sensor output (nT)

Development of a magnetic microscope using nT sensors

Selected for Aichi Prefecture subsidy project in 2024

【Aims of developing a magnetic microscope】

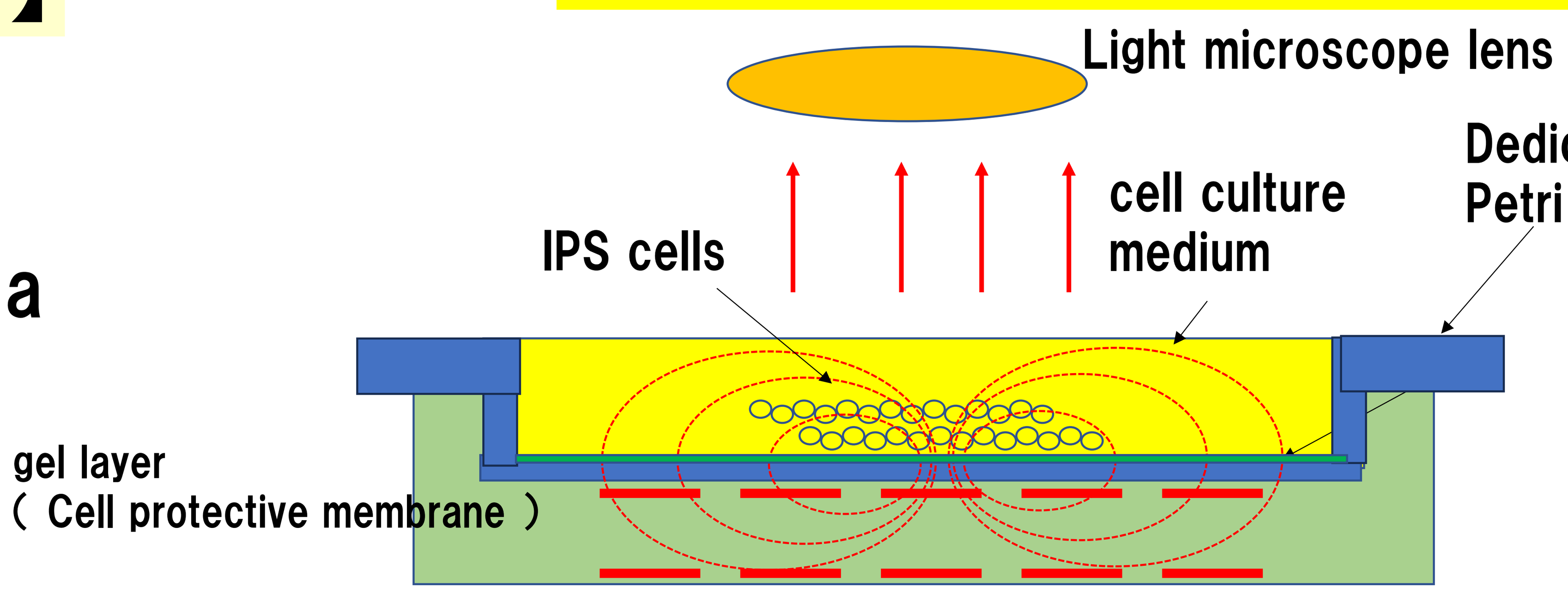
- Development request from Stanford University
- Observing the growth of iPS cells using a microscope and magnetic waveforms
- cell size: 0.02mm, cell body approximately 2 mm
- Aiming for high pixel count
- Aiming for an inexpensive system with non-contact measurement



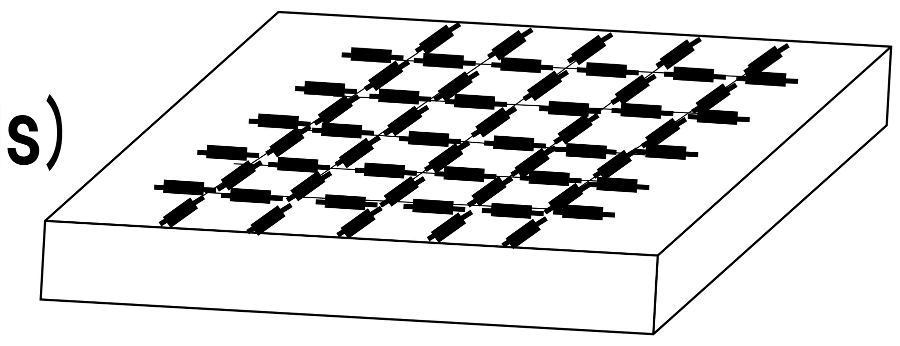
【Magnetic microscope specifications】

- Magnification: 10x High resolution: 0.2mm
- Observation area: 8mm square
- Magnetic sensor grid fixed to the bottom of a special dish
- Selling price: 2 million yen
- Can be fitted to an optical microscope

Image of a magnetic microscope (with integrated magnetic sensor grid)



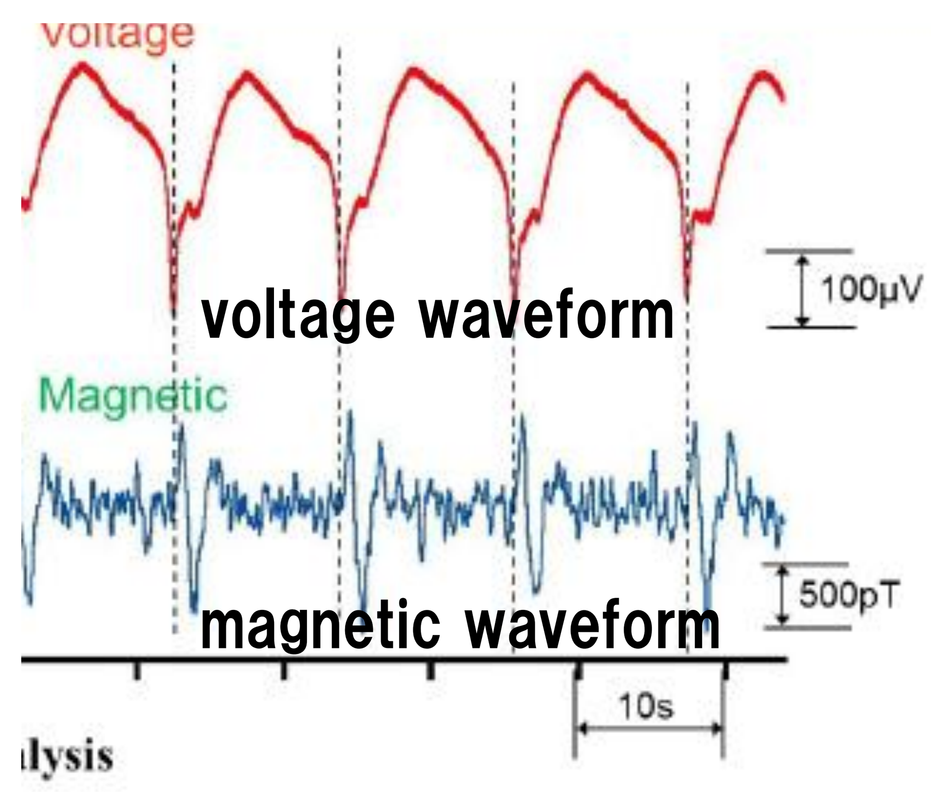
Magnetic microscope (with integrated magnetic sensor grid)



【prior art】

Prof. Uchiyama's Nature paper (on magnetic observation of cells)
<Specifications>
Magnetic sensor detection power: 0.1 nT
Sensor element: 10 mm
Gap between sensor element and cell: 1 mm

Voltage waveform and magnetic waveform



【Development Plan】

<Development Goals>

- Develop a compact, 2mm, high-sensitivity, 0.1nT ASIC-spec sensor
- Co amorphous wire + rising edge detection circuit
- Realize a magnetic microscope (10x magnification) by increasing pixel count with a grid (2mm pixel size)

<Improvements and Outlook from Prior Art>

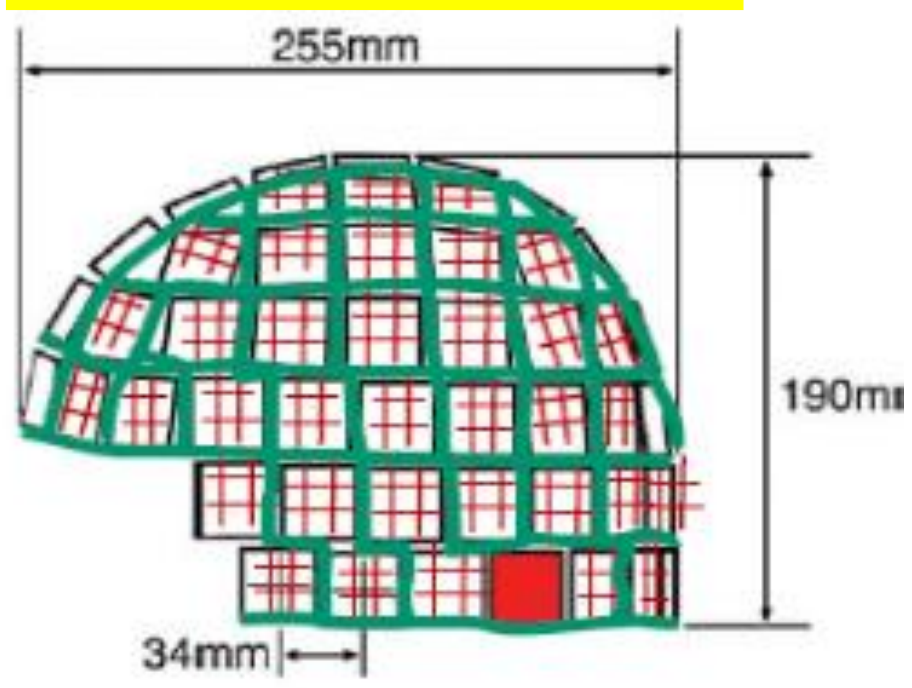
- Miniaturizing the element (from 10mm to 2mm) increases detection power by 5 times
- Closer gap (from 1mm to 0.3mm) increases detection power by 20 times⇒Magnetic microscopes are feasible

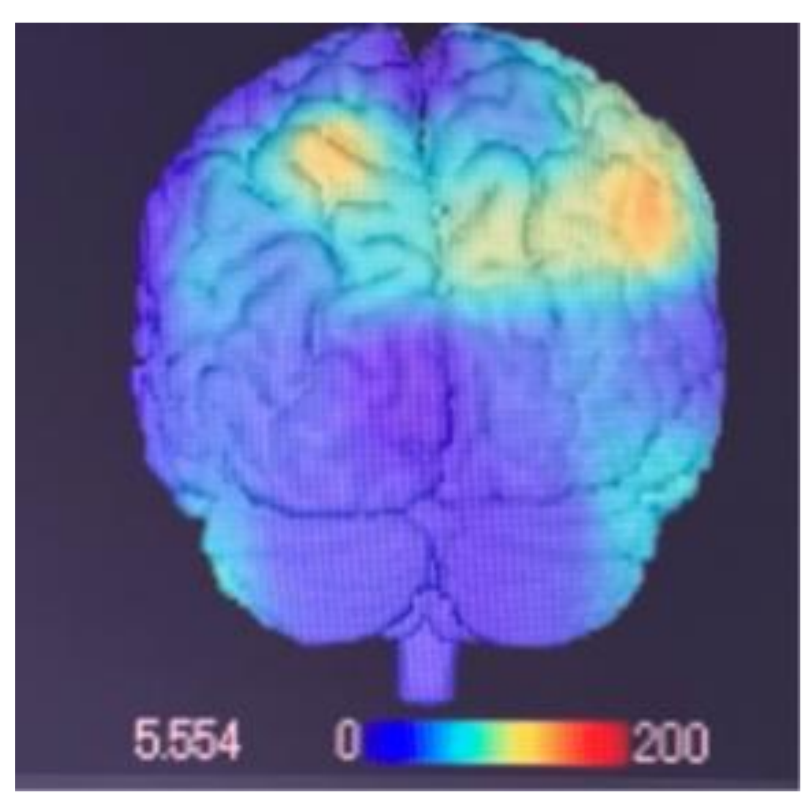
GSR element on-ASIC

【potentiality】

Connecting to biomagnetic detection devices such as magnetoencephalography and magnetocardiography, which serve as alternatives to electroencephalography and electrocardiography

Wearable magnetoencephalography

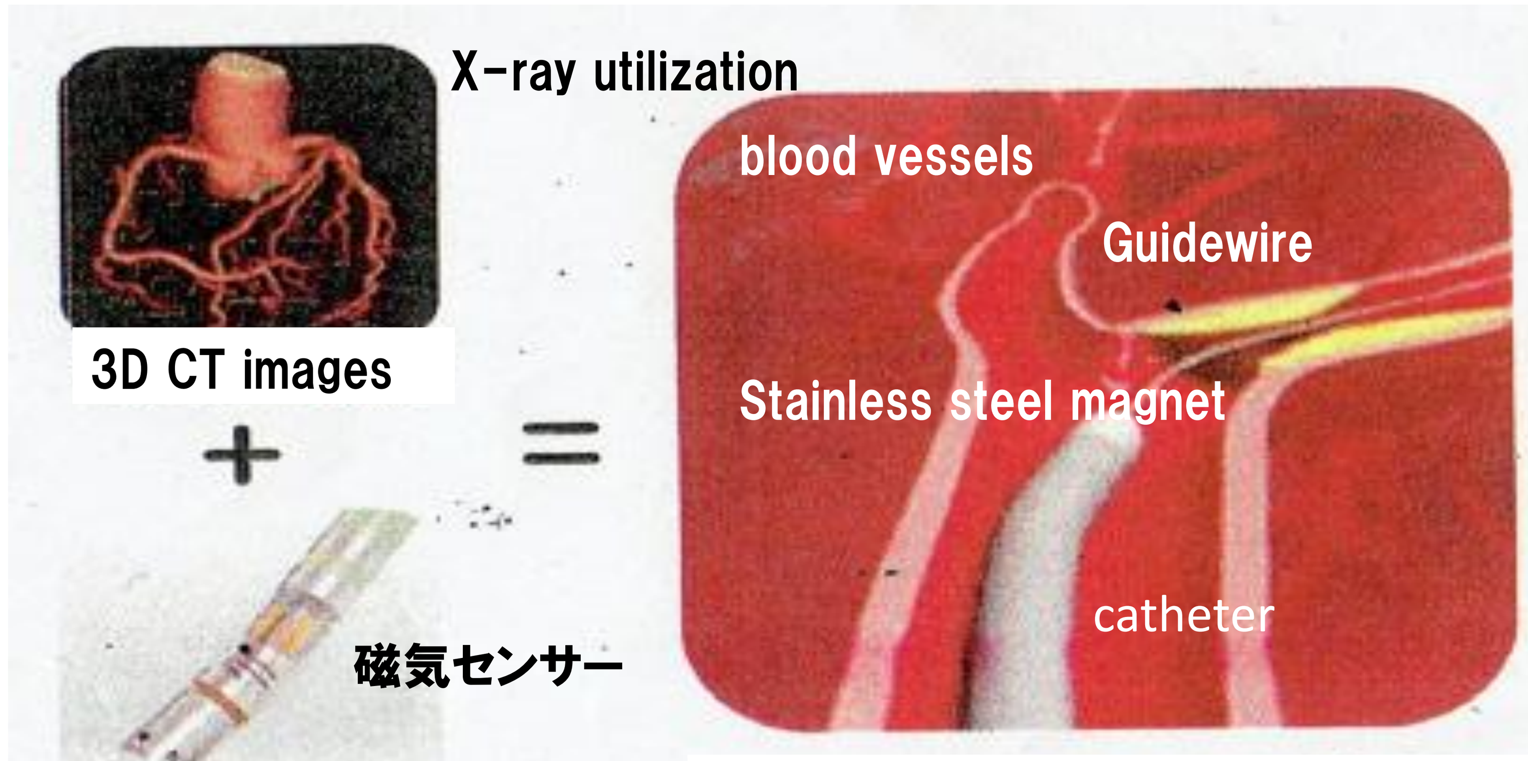




Challenging the development medical device navigation technology

【Aims of developing】

Current systems have poor navigation accuracy (2mm) Guidewires are too small to be developed
⇒Developing guidewires with high accuracy
⇒Application to medical device guidance systems



catheter that can obtain position information

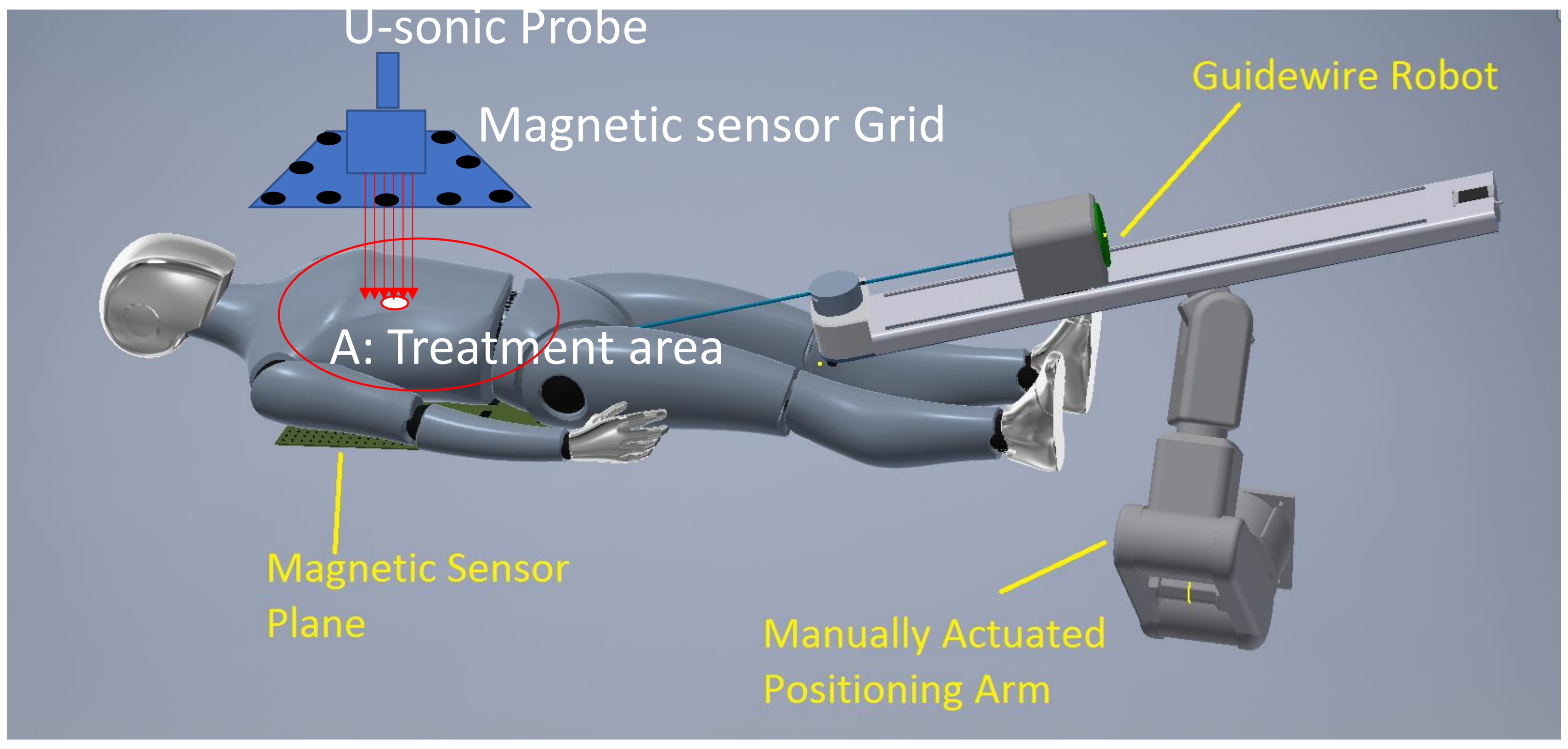
A composite image of 3D position information and CT images using a new method

【Development System Specifications】

New Idea： World's First Built-in Magnet
Goal：High Accuracy (0.2 mm) at a Distance of 10cm
Real-Time (0.05 Seconds)

【Development Strategies】

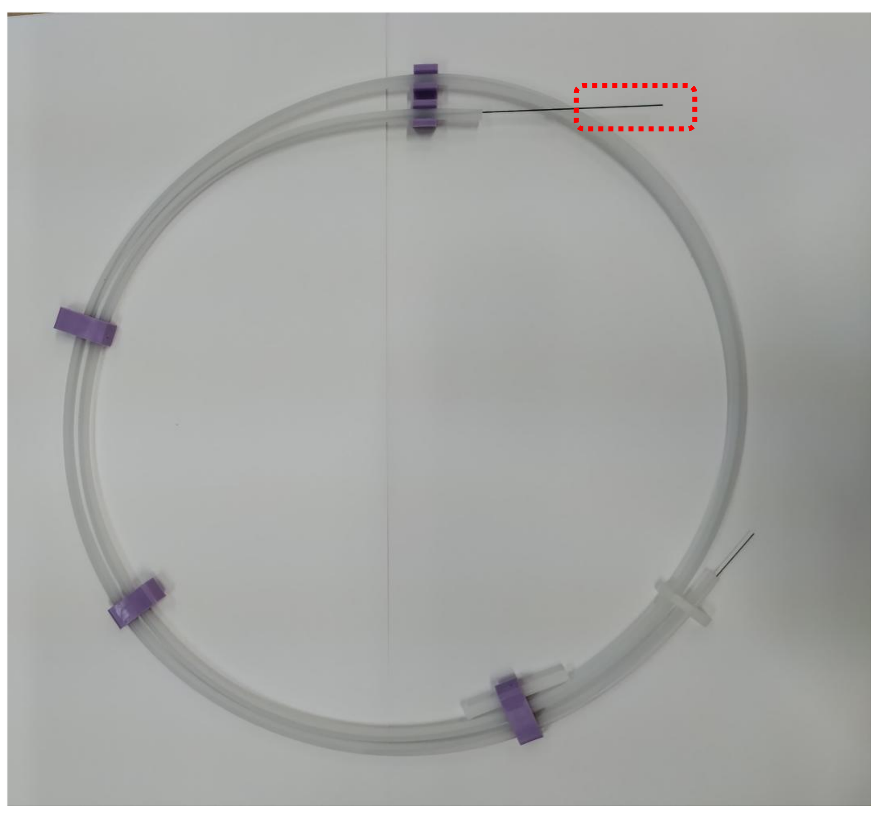
Magnetic moment of tip SUS magnet: 3 nWm
3D magnetic sensor detection power: 0.1 nT
Sensor grid: 13 rows x 13 columns (169 sensors)
Position and orientation calculation program



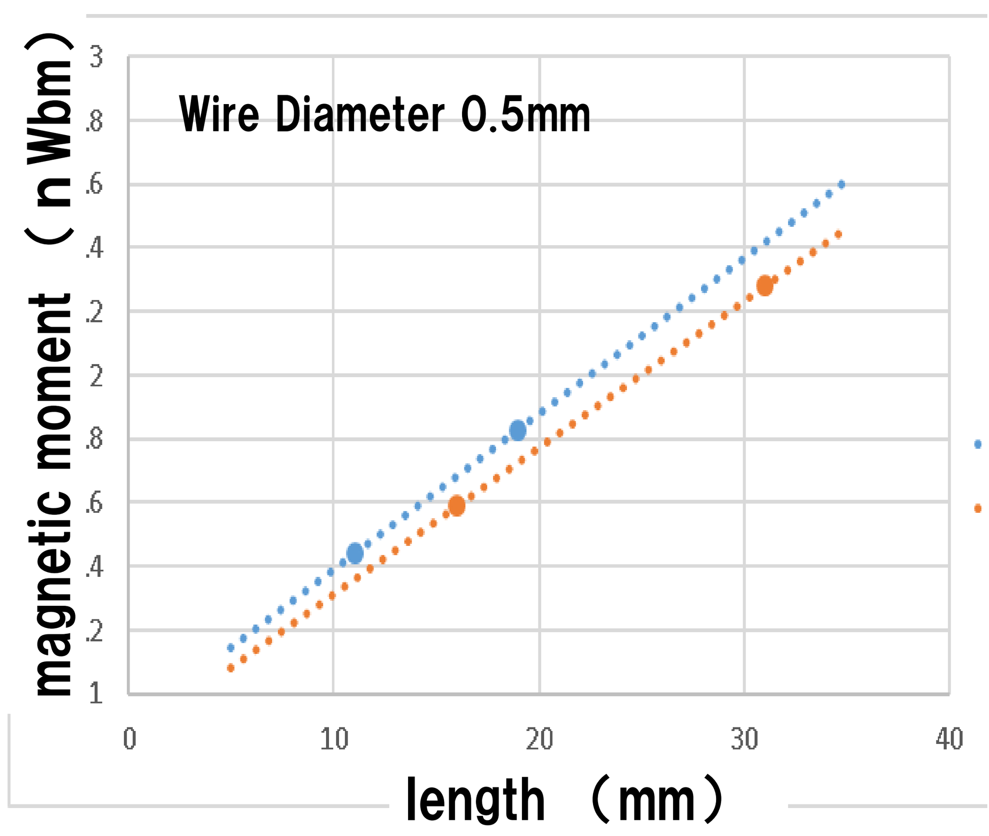
【Current Developments】

①Development of guide wire for tip magnet

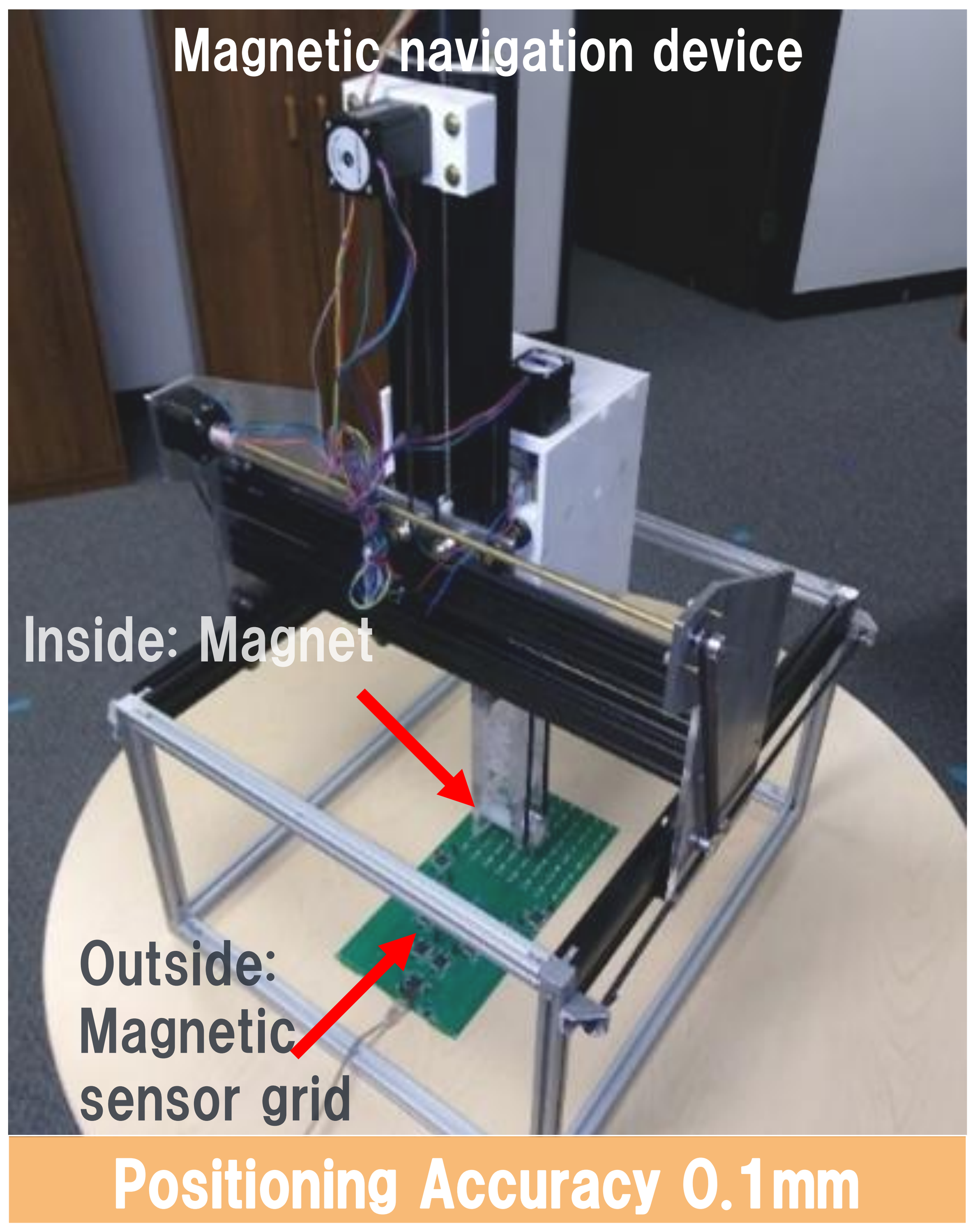
Wire diameter 0.5mm



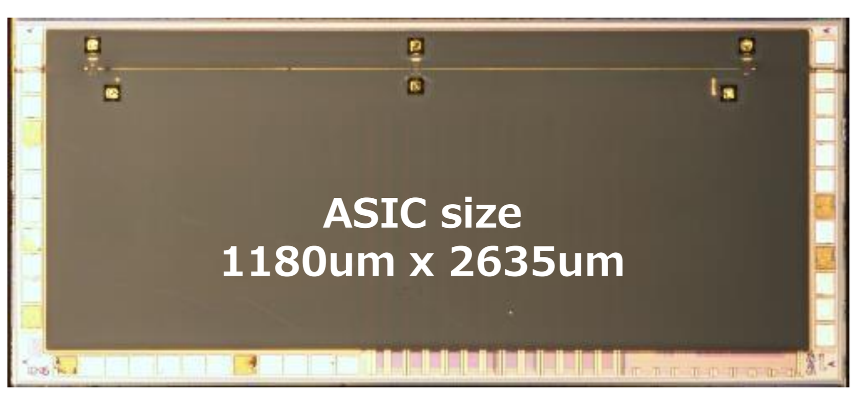
Effect of SUS magnet length on magnetic moment



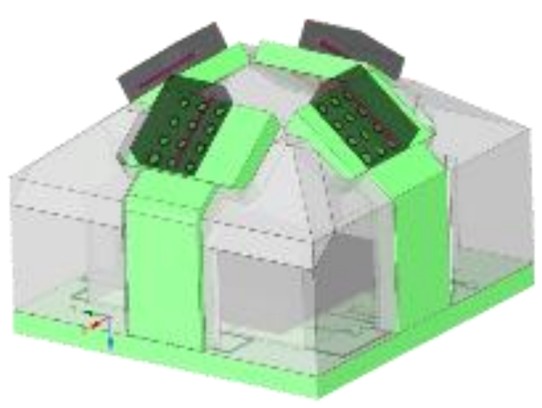
③Wire tip position and orientation Development of calculation program



② Development of a 3D nT sensor



High-performance sensor



3D sensor
(pyramid assembly)

【Outlook】

Position accuracy is proportional to the magnet strength and sensor detection power.
It is proportional to the cube of the distance, so 5 cm is easy to achieve, but 10 cm is challenging.

Development of a Rotary Encoder for Motor Control Using a GSR Sensor Challenge

Company Profile
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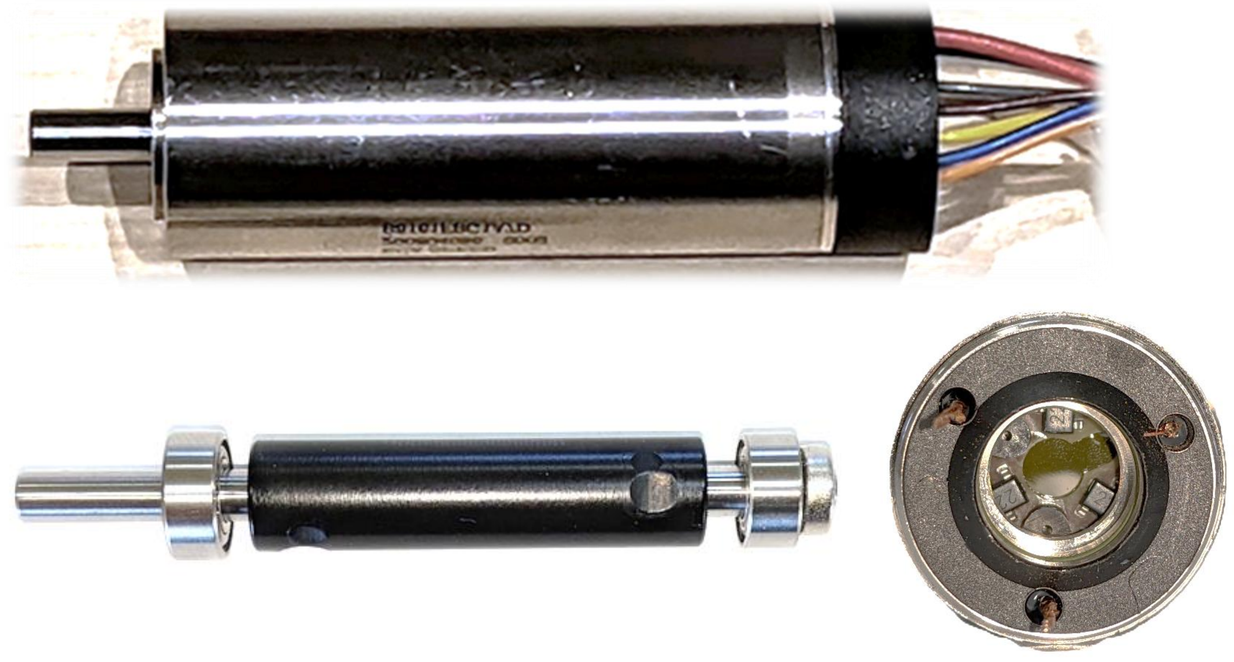
【Current Status and Development Goals of Rotary Encoders】

Control motors require rotation angle and rotation speed sensors
＊Standard type: Magnetic encoder 0.6 degrees
＊High-performance type: Optical encoder 0.01 degrees (expensive)

Objective 1:
Miniaturisation and high-speed rotation capability for magnetic encoders
Objective 2:
Magnetic encoders with accuracy comparable to optical encoders

Current rotary encoders



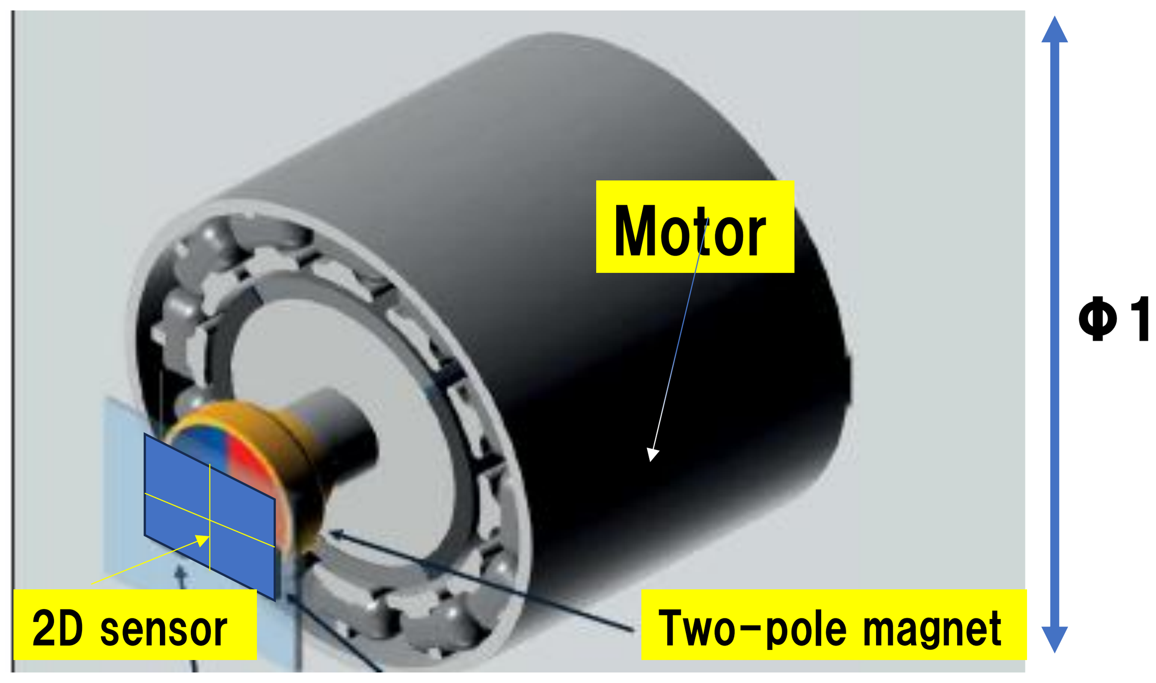
Hall elements (3 locations)

【Measuring principle】

NS magnets are positioned at the rotating shaft end, while two-dimensional magnetic sensors are placed at the stator end to detect rotation direction, angle, and speed.

Compact size: 2D GSR sensor
High speed: 500kHz
Accuracy: 0.1 degree

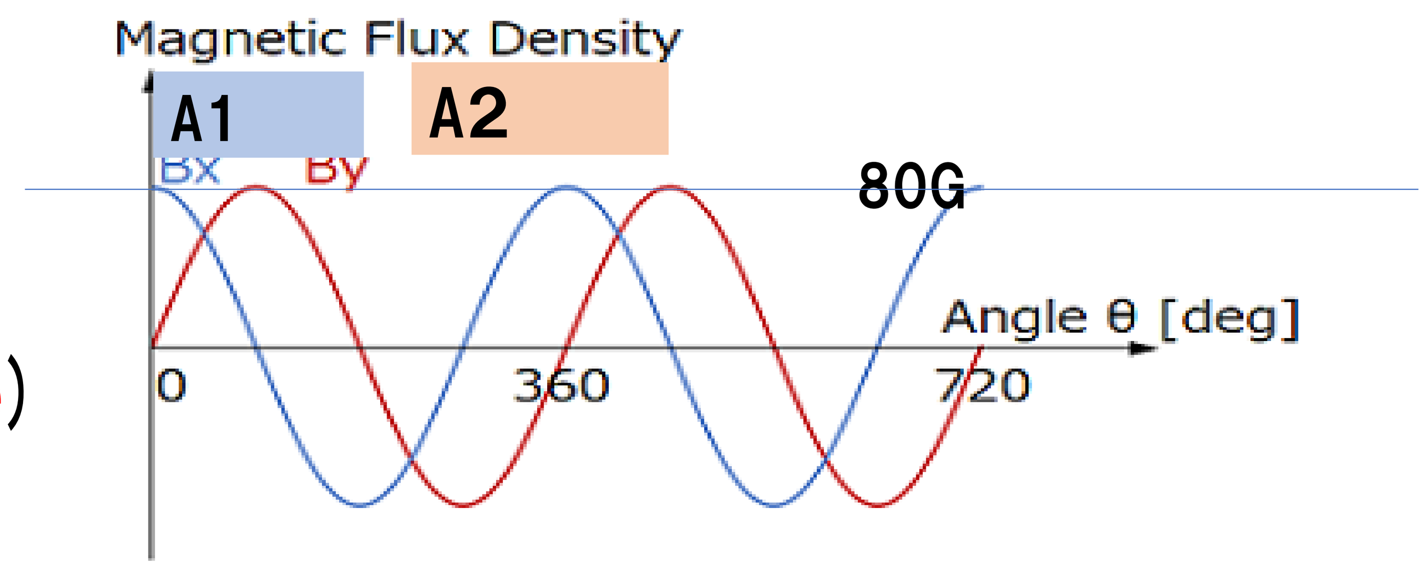
Measuring Principle of Magnetic Rotary Encoders



【Improved accuracy and high-speed response】

- Surface magnet field: Sine function, field strength ±80 G, 2 poles
- What is the field change per 0.1 degree?
  8000000nT×0.0008RAd×0.5(45°)=3200nT
- GSR sensor detection capability: 200nT
  ⇒16 times margin (0.1-degree measurement possible)
- Utilising the sine function interpolation formula enables measurement in increments of 0.01 degrees
- High-speed ASIC development: 500 kHz, 0.1-degree accuracy

$\tan\theta = A2/A1$

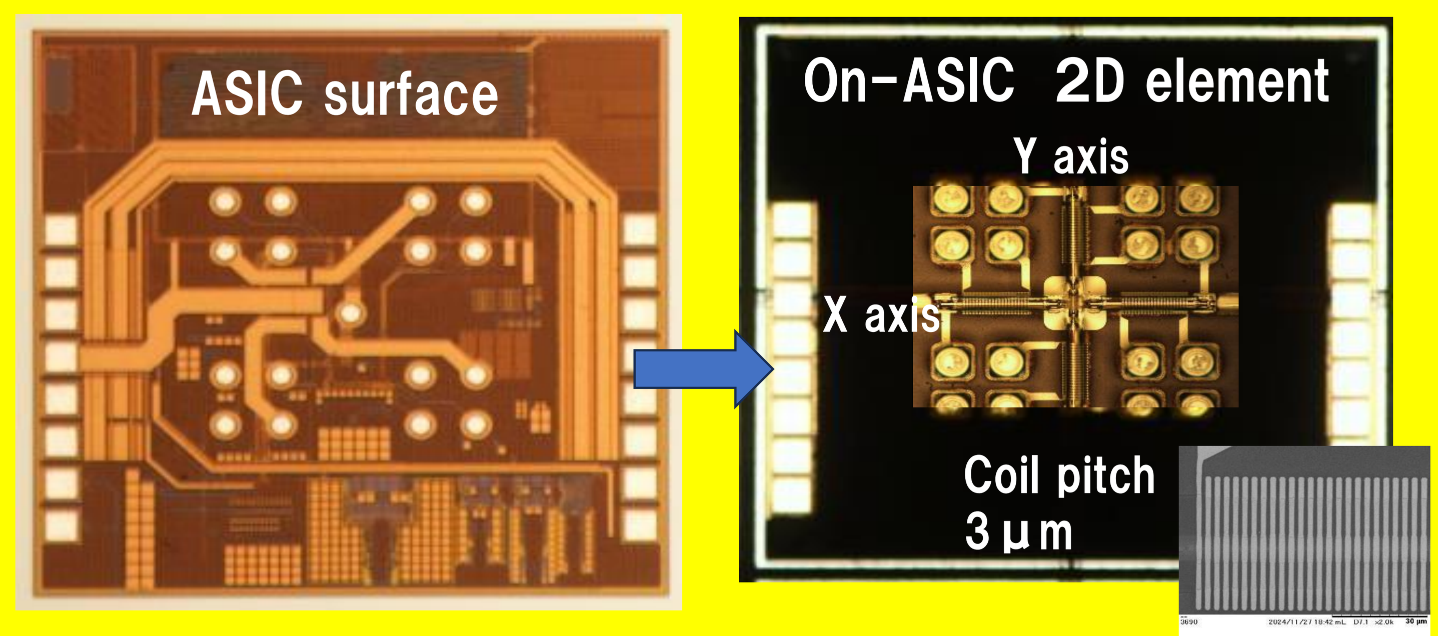


【Principle verification test】

＊Prototyping of a 2D GSR Sensor

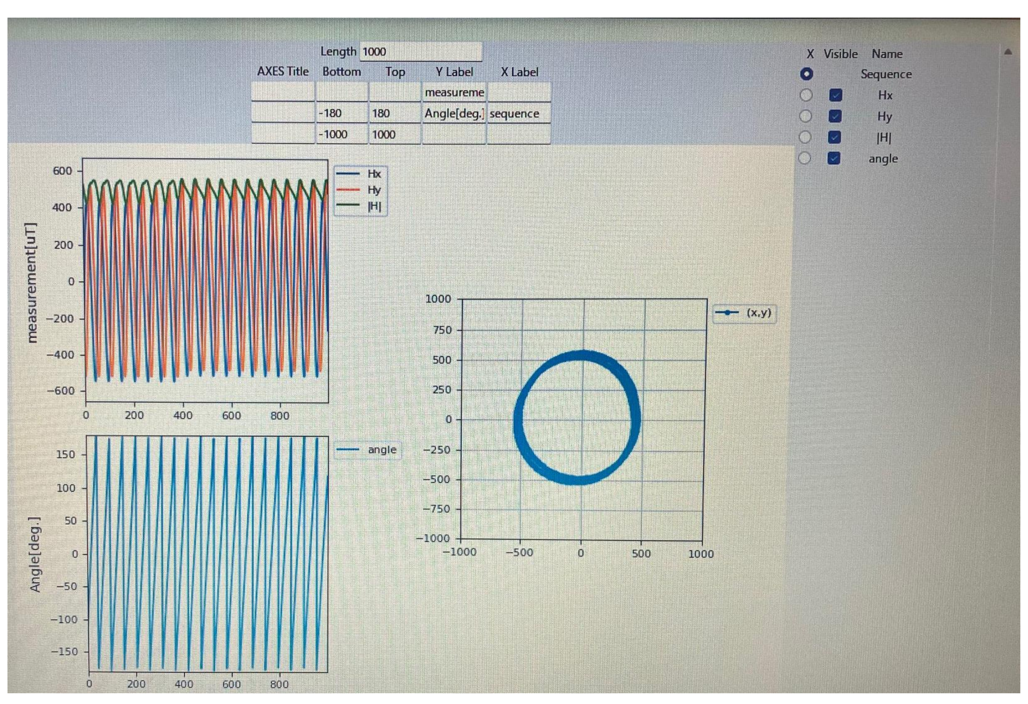
＊Prototyping of a Rotational Test Apparatus

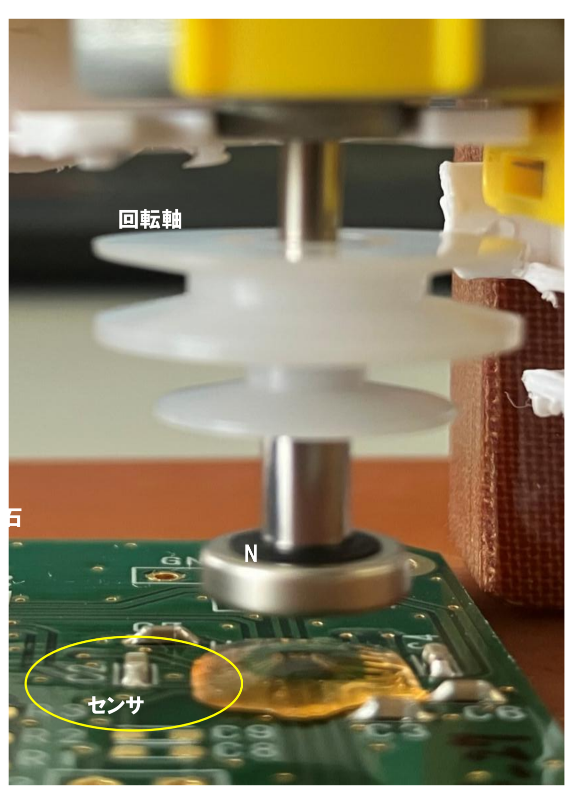
Prototype of a magnetic rotary encoder

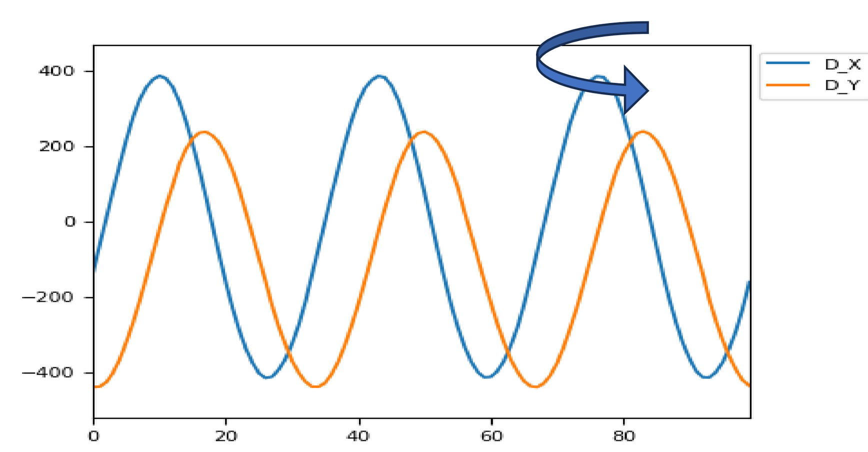


【Development Challenges and Development Framework】

Magnetic Rotary Encoder Test Equipment



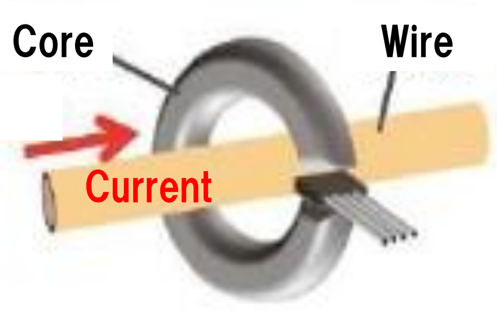
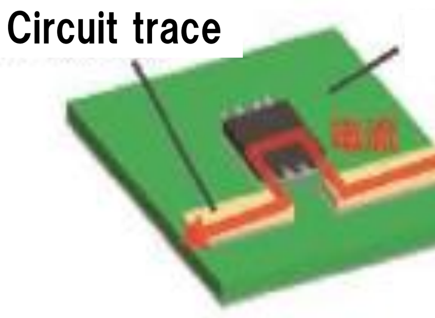
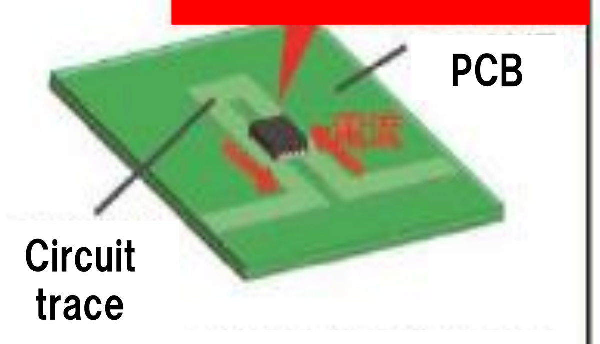




Challenging the realisation of compact, high-sensitivity board-mounted type current sensors using GSR sensors

【Background: Current Sensor's status & types】

Current Detection Methods

Detection Type	Resistance detection type	Magnetic Field Detection Type (Hall effect sensor, PCB-mounted type)		Magnetic Field Detection Type (MI sensor)
Configuration Image	Shunt resistor + high-speed op-amp 	With core  Core, Wire, Current	Coreless  Circuit trace, PCB	Coreless, Contactless detection  PCB, Circuit trace
Reliability	△	◎	×	◎
Loss/Heat	×	◎	×	◎
Mounting Area	△	×	○	◎

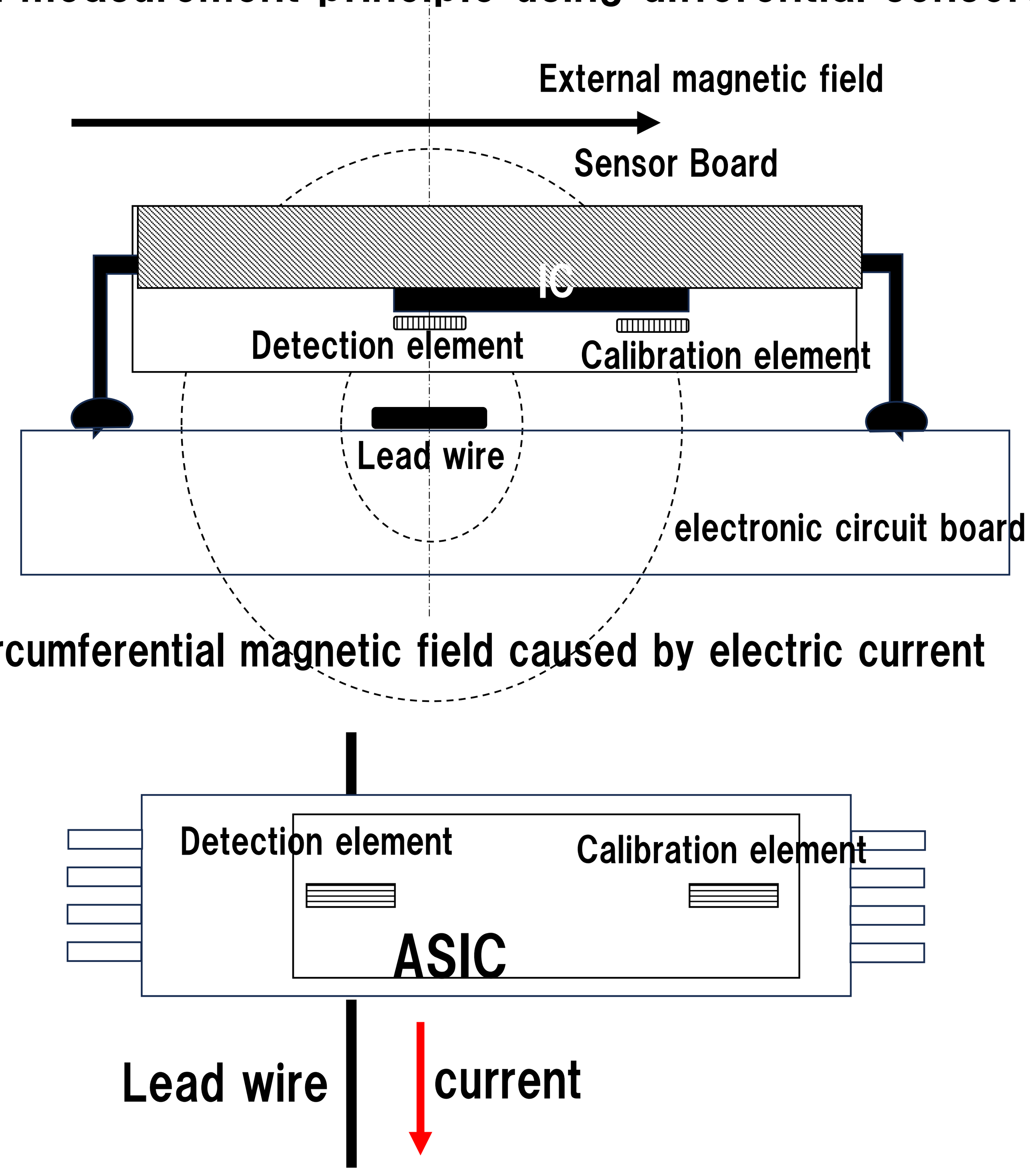
・sensitivity 1.3mV/mT ⇒100 times 130mV/mT

【New design & measurement principle】

Adopt GSR sensor (Sensitivity1,300mV/mT(10 times up)
→measurable board-mounted current sensor remain straight wiring

→ The differential GSR element cancels the external magnetic field and calculates the current from the differential strength of the circumferential magnetic field created by the current.

Current measurement principle using differential sensors



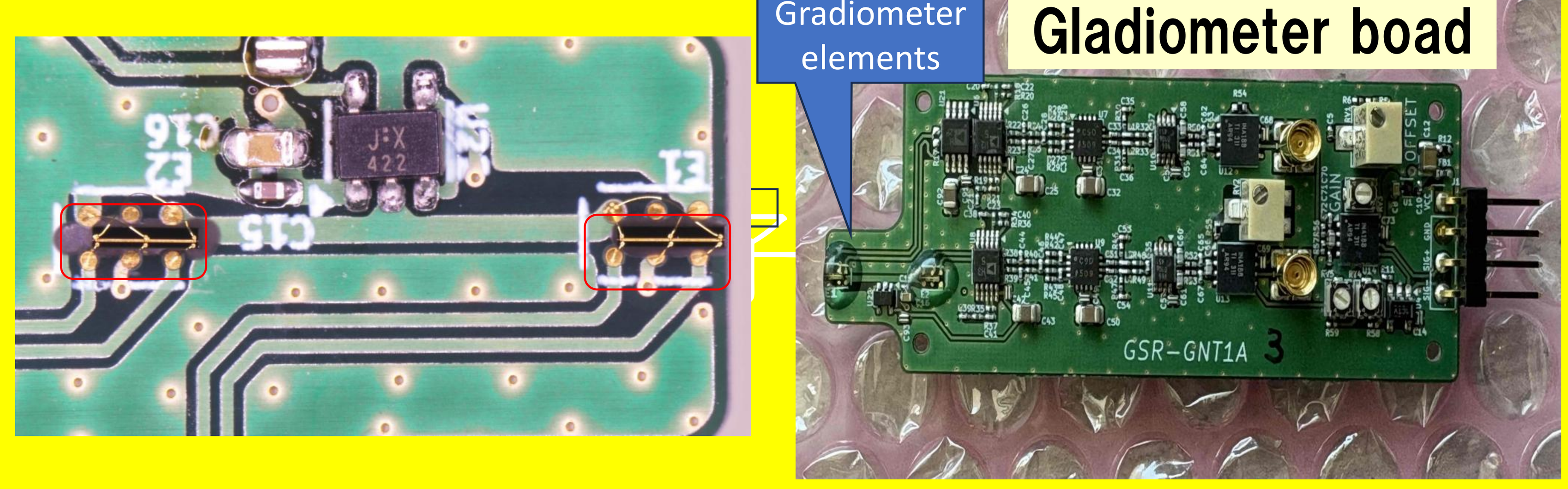
【Development goal】

- Easy to install, PCB-mounted type
- Excellent linearity: 0.2%
- Wide measurement range and high resolution: 4 digits, from1mA to 10A
- High-speed ODR: 500kHz
- High environmental durability and reliability
- Small package size: 2mm wide x 4mm long
- Excellent mass production (completed using existing semiconductor processes) Affordable

【Development issues and development structure】

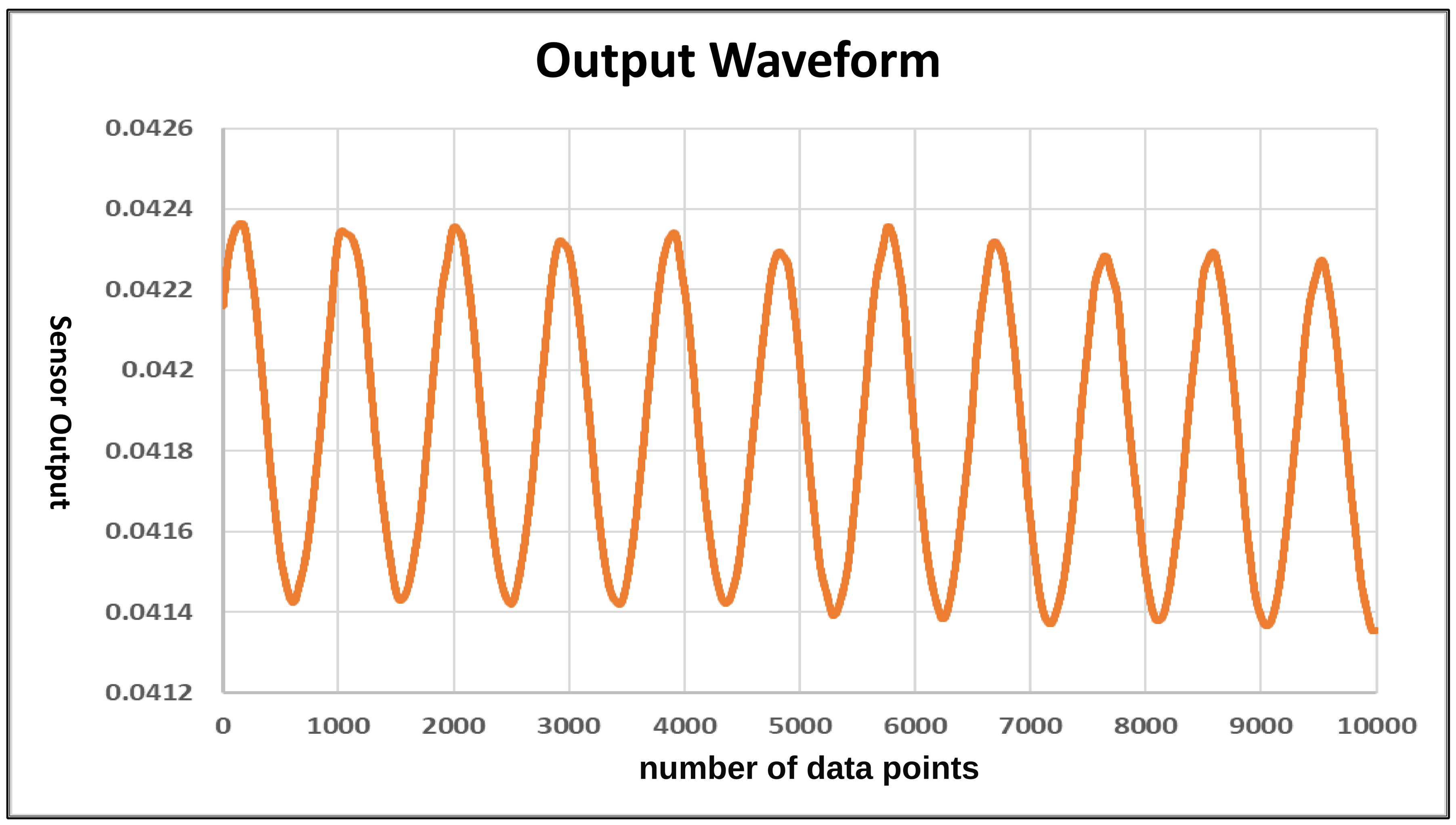
- Differential GSR element by MagneDesign
- High-speed measurement ASIC by Prolific/ITRI (Taiwan)
- Motor inverter implementation by Armis
- Support for a variety of applications

Gladiometer Sensor



【Development Examples】

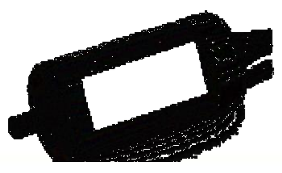
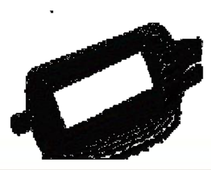
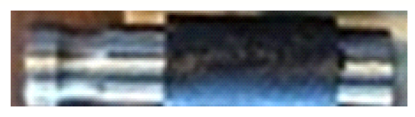
Current sensor
(e.g., AC current measurement)



Challenging a 50% reduction in size and weight for SPM motors for robots

Development Grant Programme for the 2024-2026 Fiscal Years
by NEDO (Japanese public research and development agency)

【Development Goal : 50% smaller and lighter】

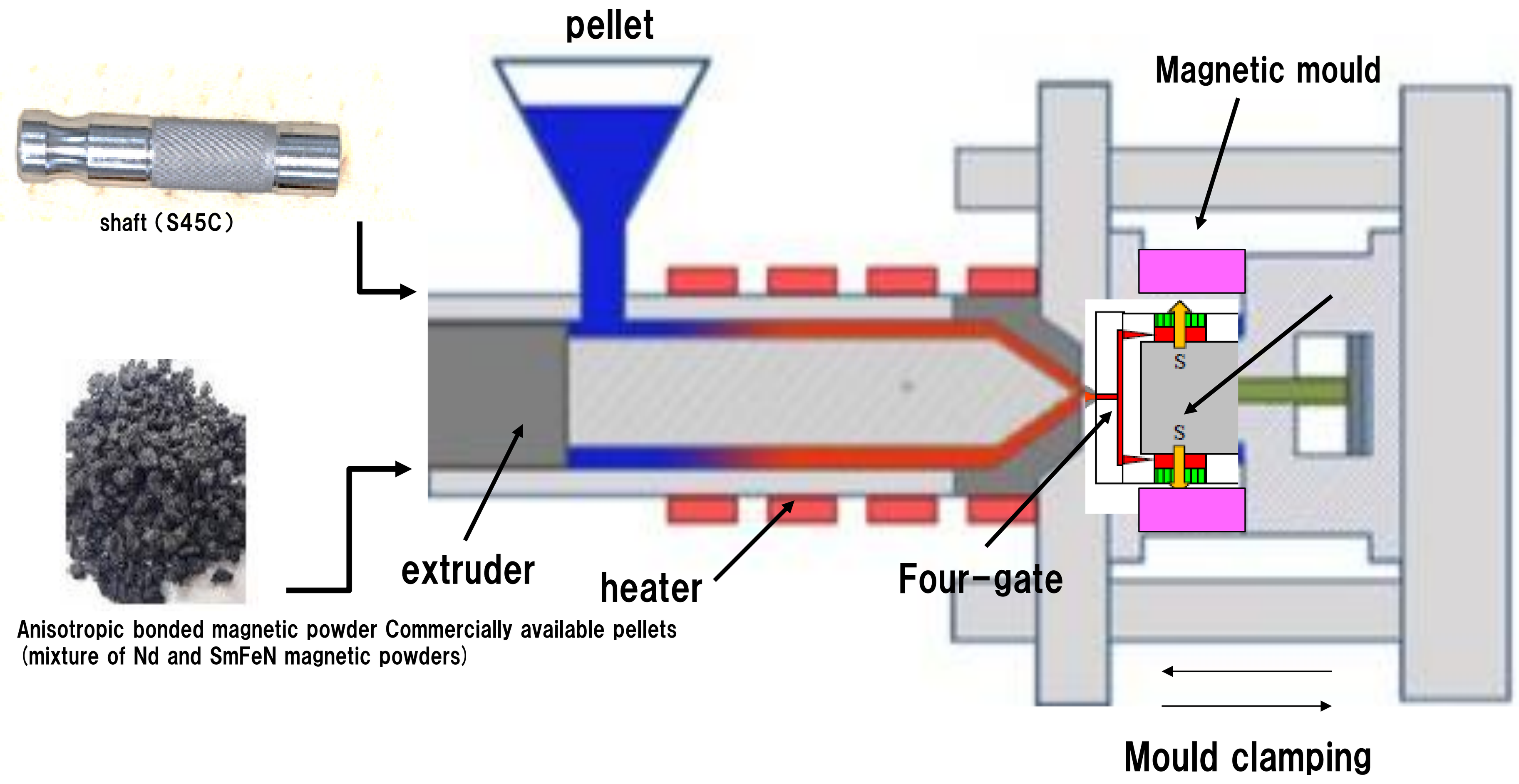
	Current motor	Development motor
Shape	 Φ19mm×58mm	 Φ18mm×30mm
Performance	100W, 100g 60,000rpm	100W, 50g, 200,000rpm
Structure	  Neodymium sintered magnet ・Shatterproof case for magnets. ・Nd sintered magnet 4g (3-piece assembly) 2 poles ・Air gap+case thickness:1.5mm ・The manufacturing process is complicated due to the shatterproof case for magnets.	  Rare earth anisotropic bonding strength ・No shatterproof case required ・Nd bonded magnets 1g(4poles) ・Air gap:0.2mm ・The manufacturing process is simplified because the magnet and rotor can be integrally injection molded and the magnet can be magnetized simultaneously.
Inverter	60Hz	600kHz ～ 3MHz

< Miniaturisation measures >

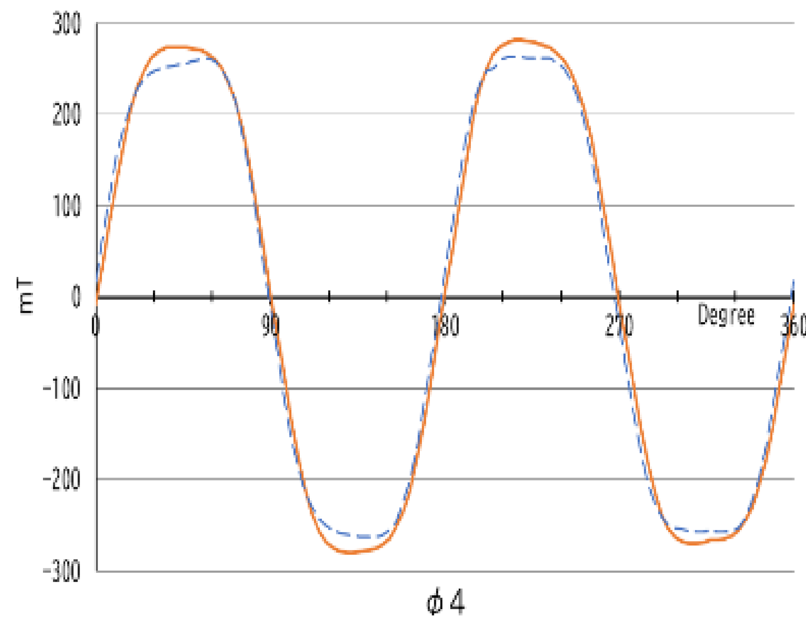
① Nd-Fe-B sintered magnets ⇒Changed to bonded magnets
② number of poles ⇒from 2-pole to 4-pole
③Rotational Speed60,000 to 200,000 RPM
④ Gap0.7 mm to 0.3 mm

【Previous research results】

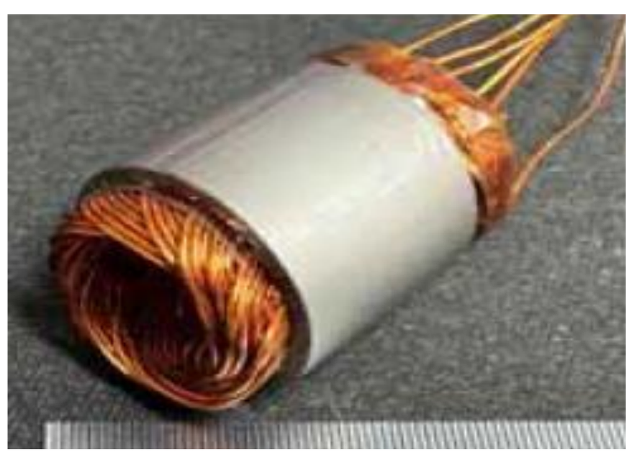
① Rotor shaft and magnet body moulding:4-pole anisotropic magnet
② Centrifugal force countermeasure ⇒ Enhanced adhesion between injection-moulded magnet and rotor
③ Heat generation countermeasure ⇒ Changed from sintered Nd magnet to bonded magnet
④ Successful prototyping of 50% lighter motor (200,000 rpm)

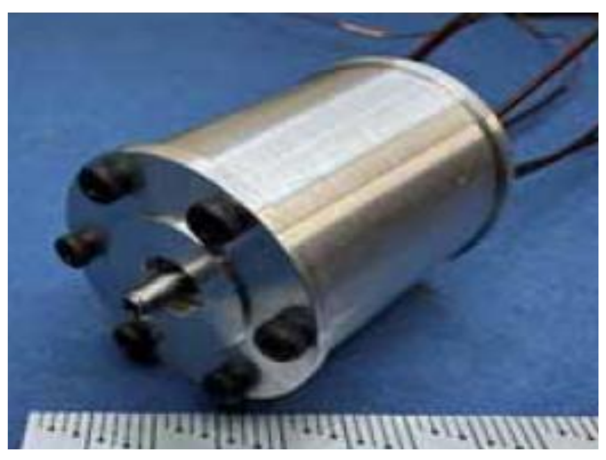


Rotor: 50% reduction in size
(Magnet and shaft integrated moulding)



Sine waveform: Good

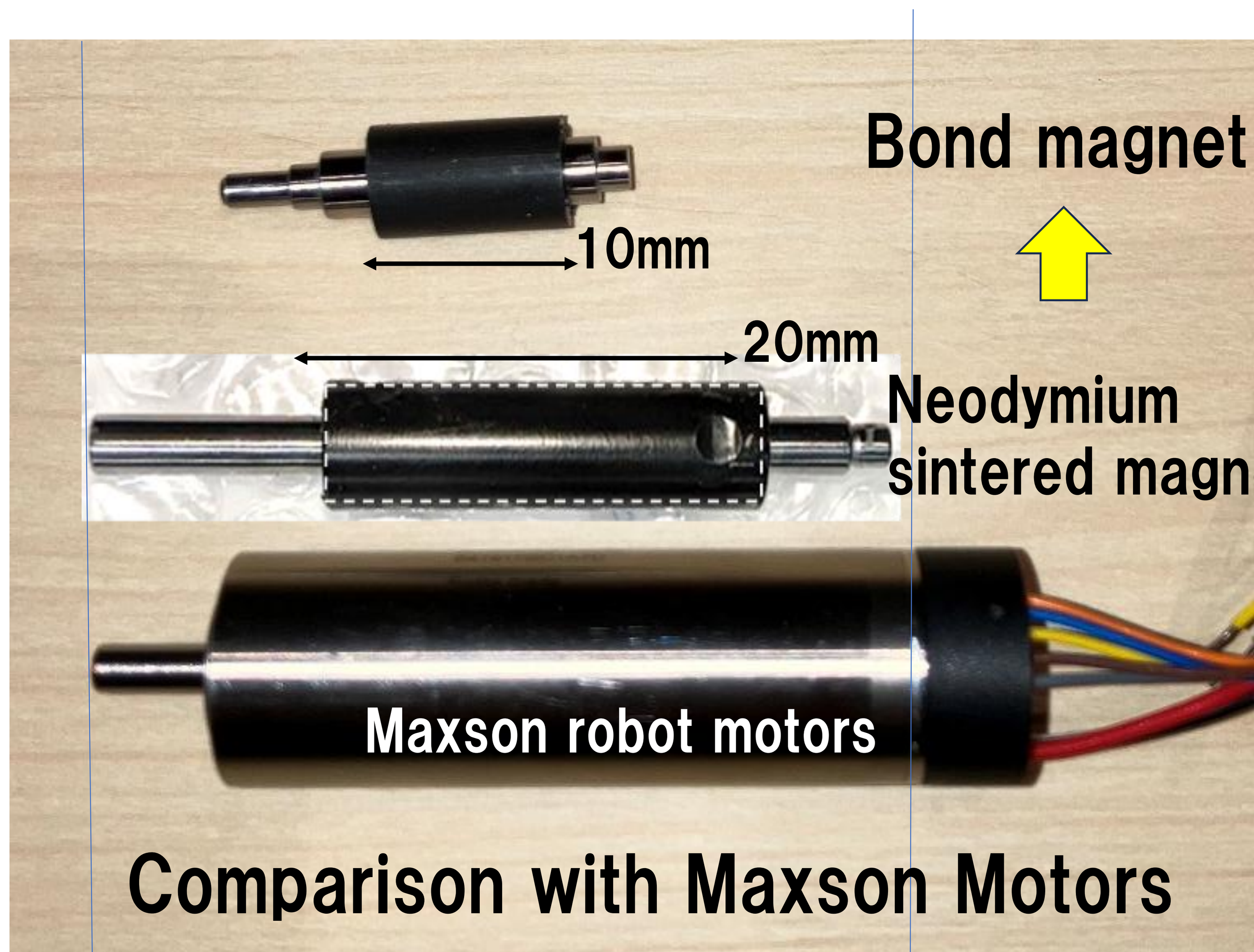

Stator


Motor


inverter

【Development Plan for Fiscal Year 2025】

①Commercialisation Design: Balancing Torque and Efficiency, Reducing Cogging Torque
②Application 1: Motors for Handpieces
③Application 2: Motors for Robots
④Application 3: Motors for Automobiles and Other Applications

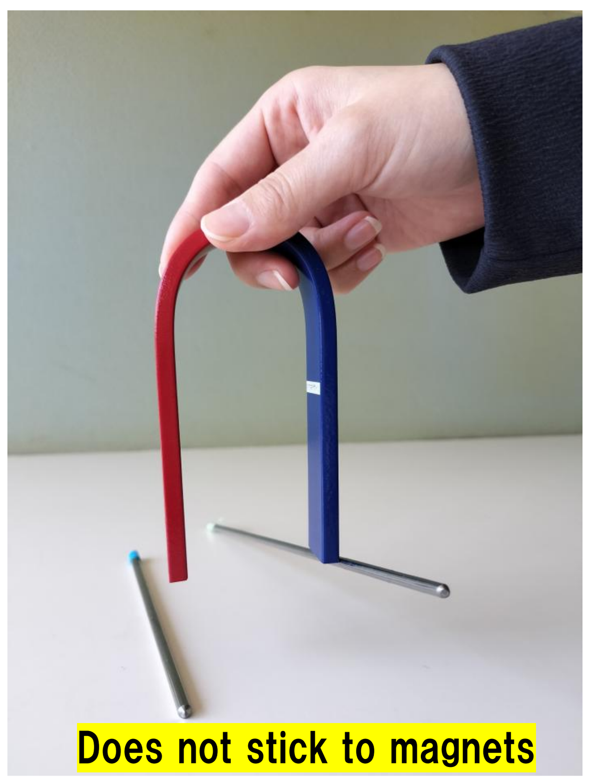


Comparison with Maxson Motors

Company Profile
History・Career
Laboratory
GSR Sensor
GSR Sensor application
Motor
Dental Magnet
Outlook

Invention and commercialization of stainless steel magnets

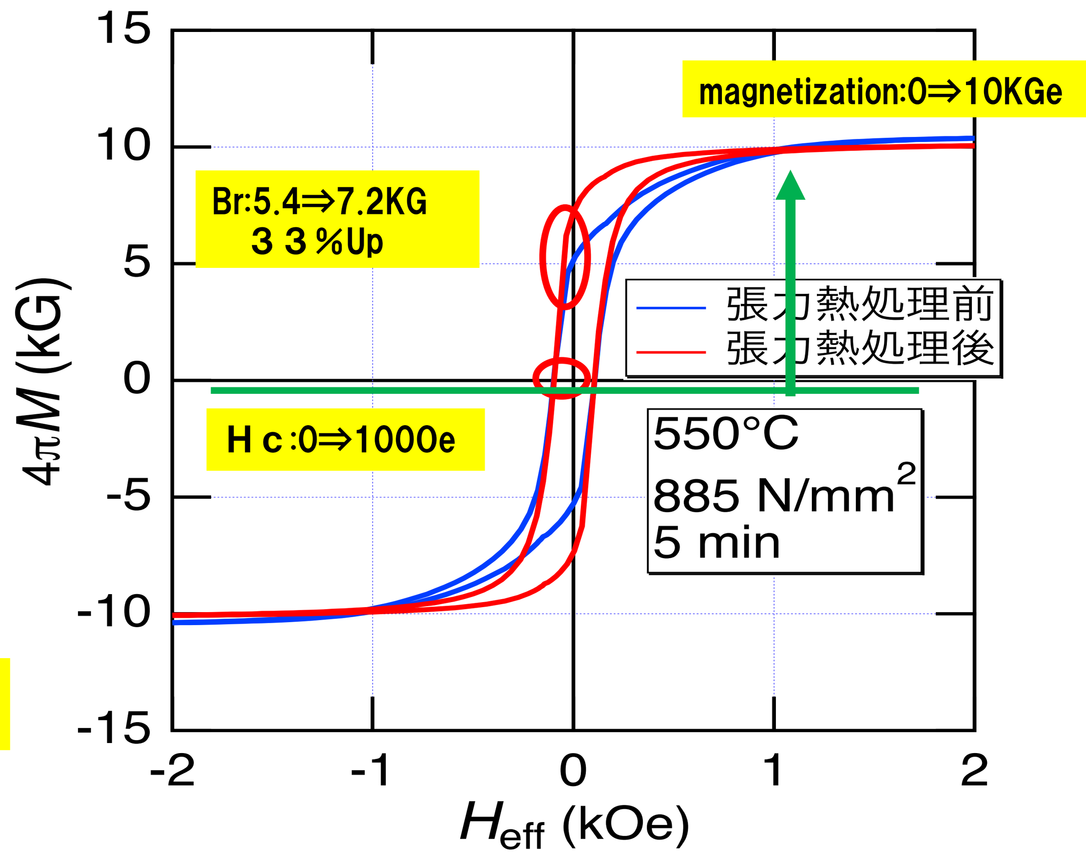
【Invention of stainless steel magnets】 Non-magnetic stainless steel becomes a magnet



Special processing

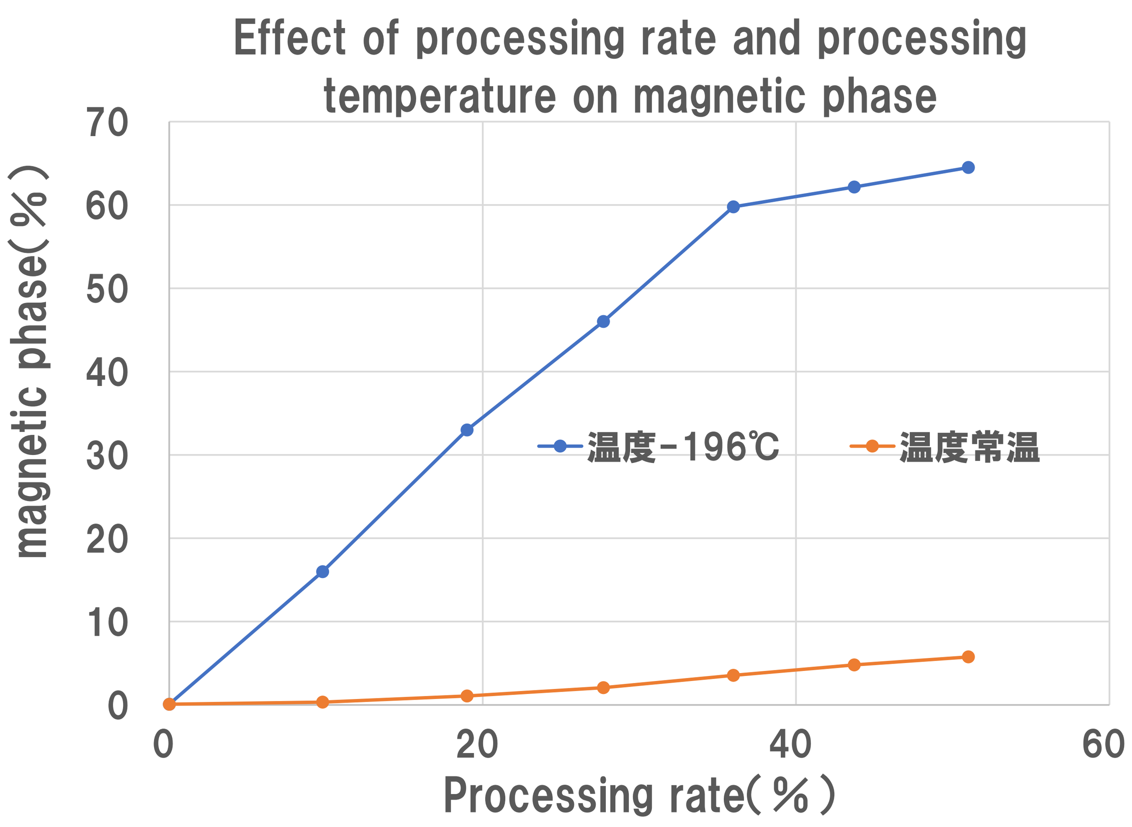
Lifting iron

Stainless steel magnet performance

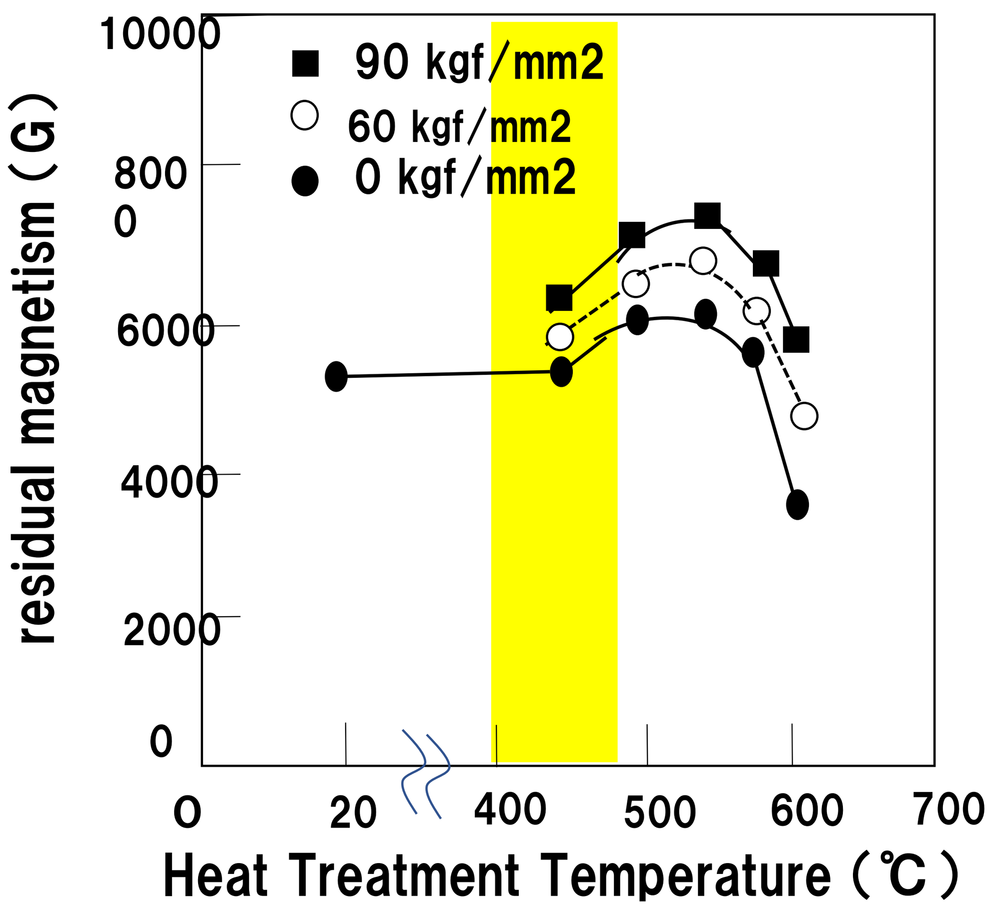


- How to make a stainless steel magnet
(cryogenic processing ⇒ tension heat treatment in the direction of the fiber structure ⇒ magnetization)

Transform into a magnetic material through cryogenic processing
-196° C x 30% or more processing
⇒Convert non-magnetic material to magnetic

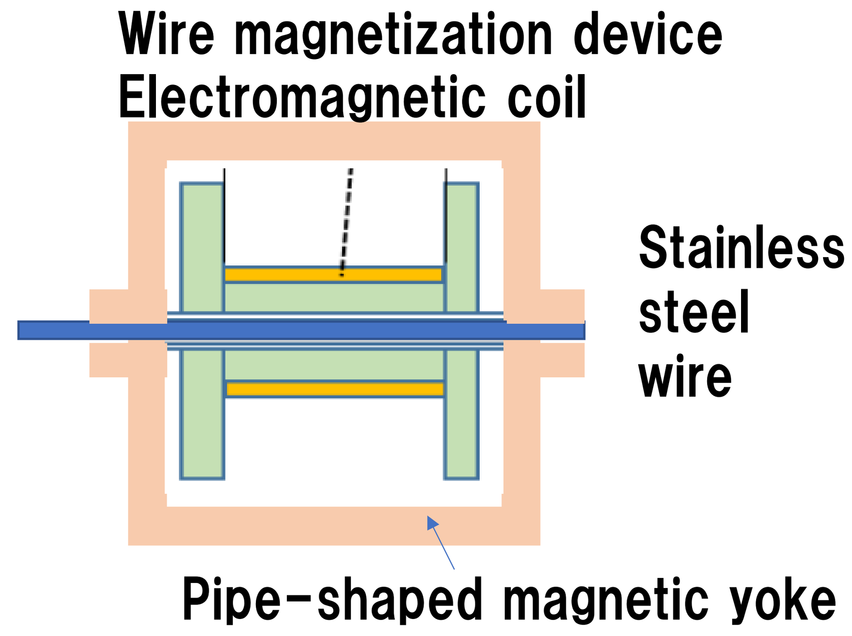


Anisotropy by tension heat treatment



【Magnetization】

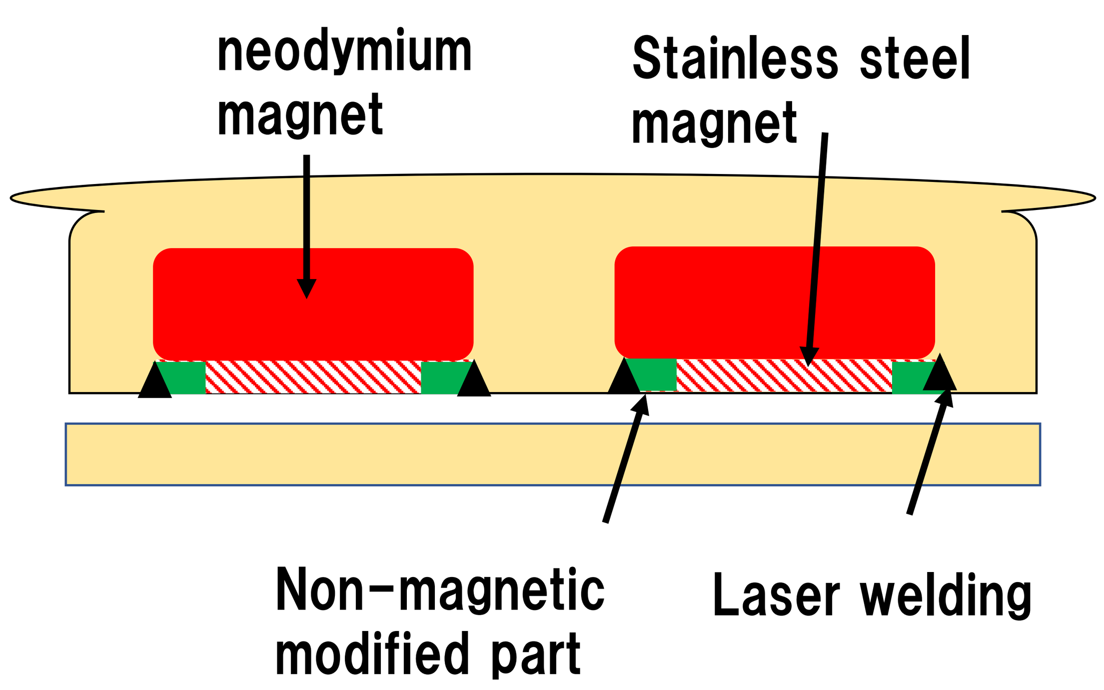
magnetization (Bhmax)

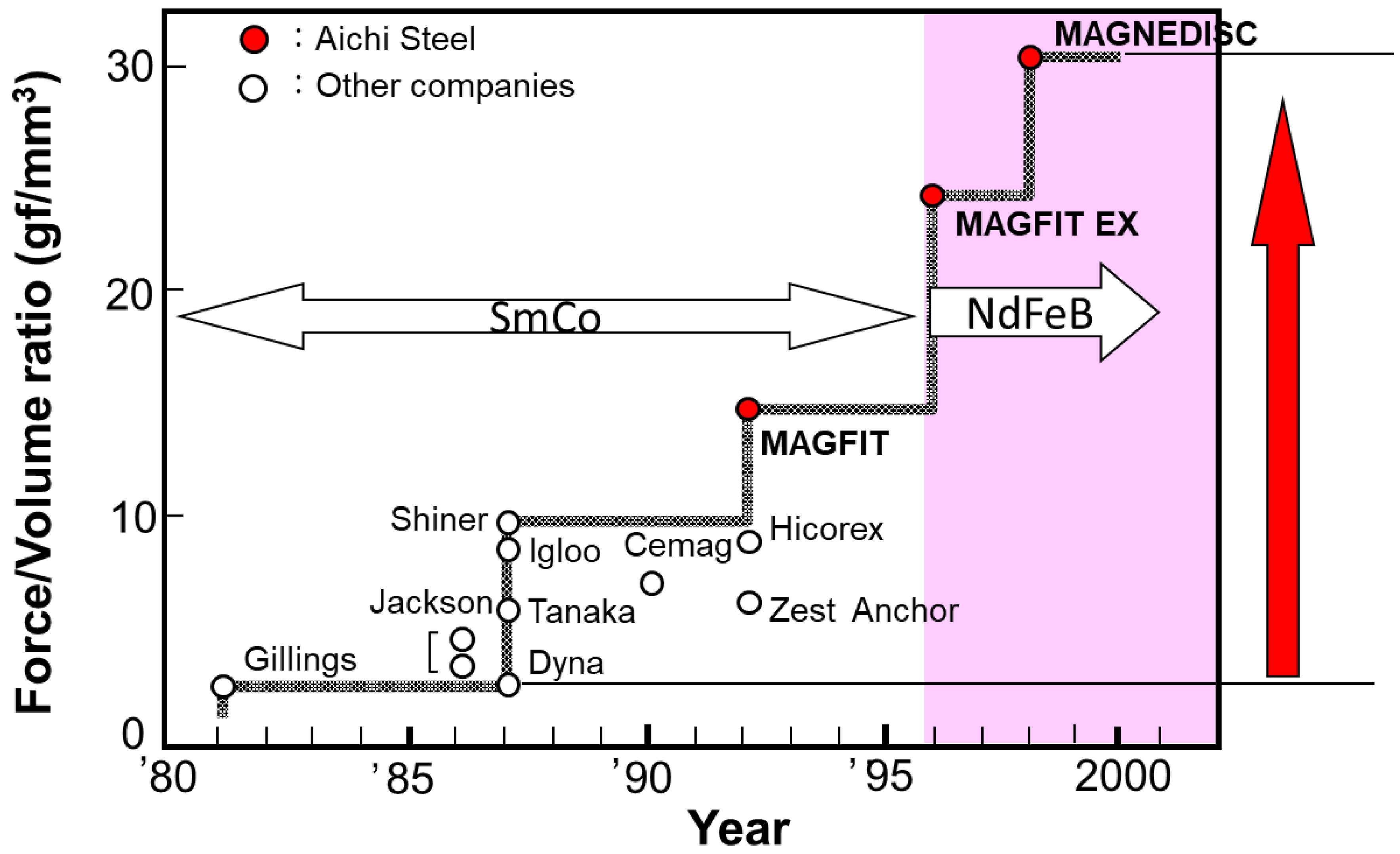


【Applications of stainless steel SUS magnets】

1)Application to dental magnets

The combination of a stainless steel magnet, a non-magnetic material, and an Nd magnet doubles the suction power.



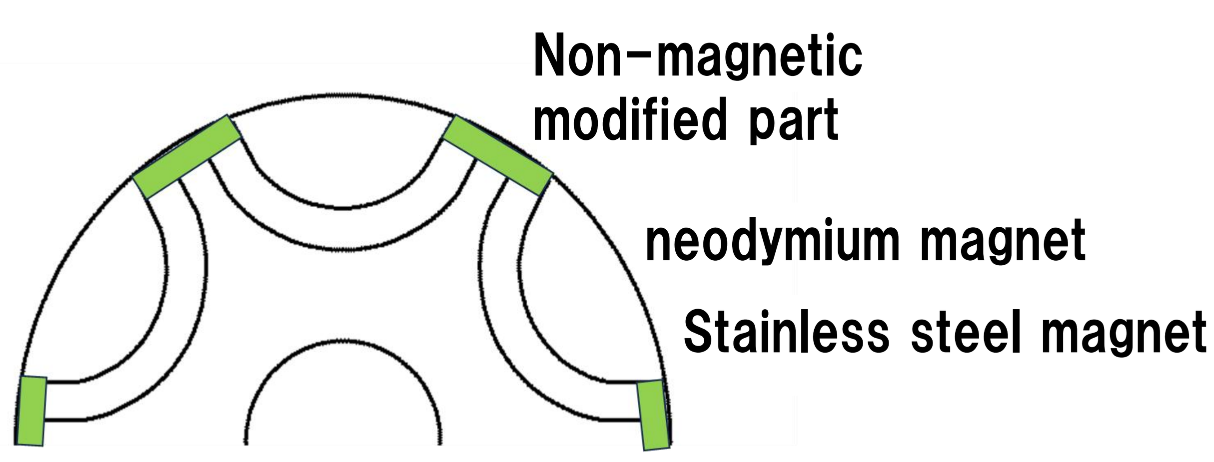


2)Application to catheter treatment guidewires

The tip of the wire is modified to a SUS magnet.
→Comparable to Nd magnets

3)Application to motor core materials

Increased torque with a combination of SUS magnets, non-magnetic magnets, and Nd magnets



Company Profile
History・Career
Laboratory
GSR Sensor
GSR Sensor application
Motor
Dental Magnet
Outlook

Developing the world's strongest dental magnet using new technology
MagTeeth series Launched in Indonesia

Company Profile
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GSR Sensor application
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Dental Magnet
Outlook

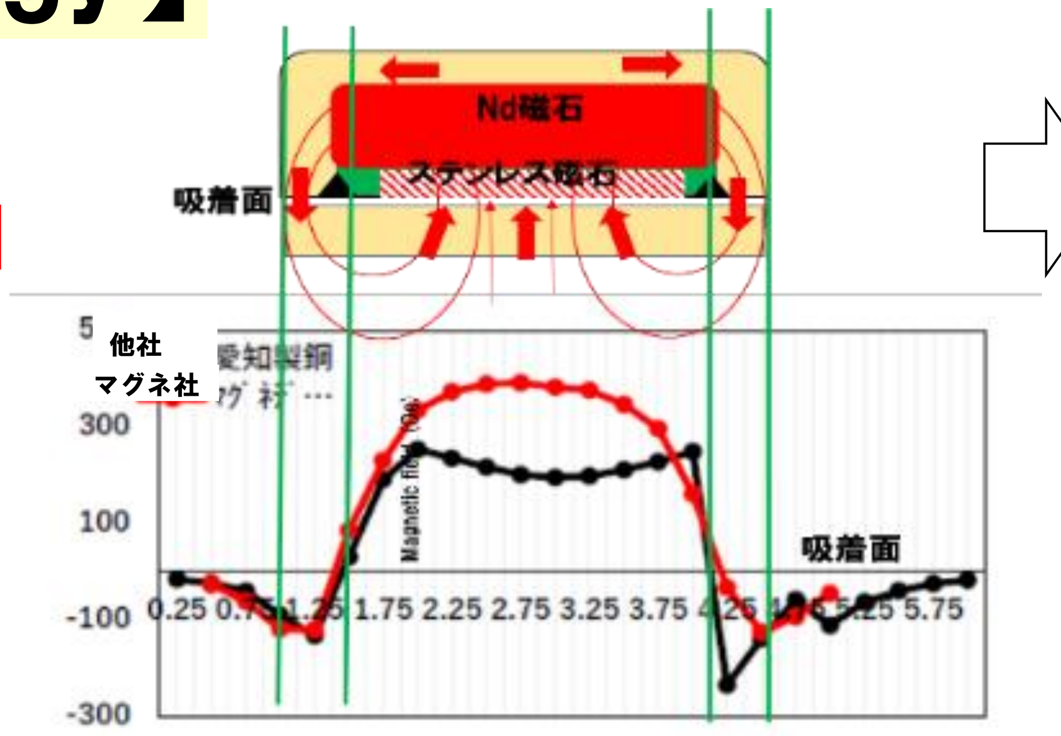
【Features】

- 50% increase in suction power
- Uses highly corrosion-resistant stainless steel SUS316 and SUS436S
- Non-magnetic laser modification technology strengthens welds and simplifies manufacturing processes
- All parts are press-processed for lower costs

【World's first new technology】

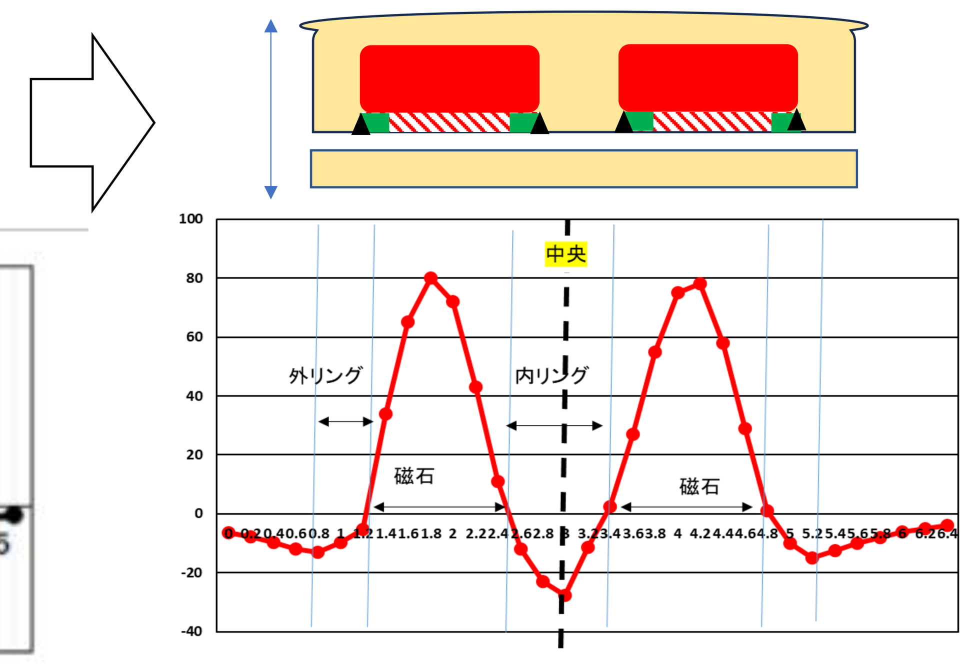
① A magnetic circuit is formed using a composite magnet made of stainless steel and neodymium magnets.
⇒1.5x improvement in suction power.
②Ring structure is used.
⇒3x improvement in suction power.

Standard type



Unimodal distribution

Thin type



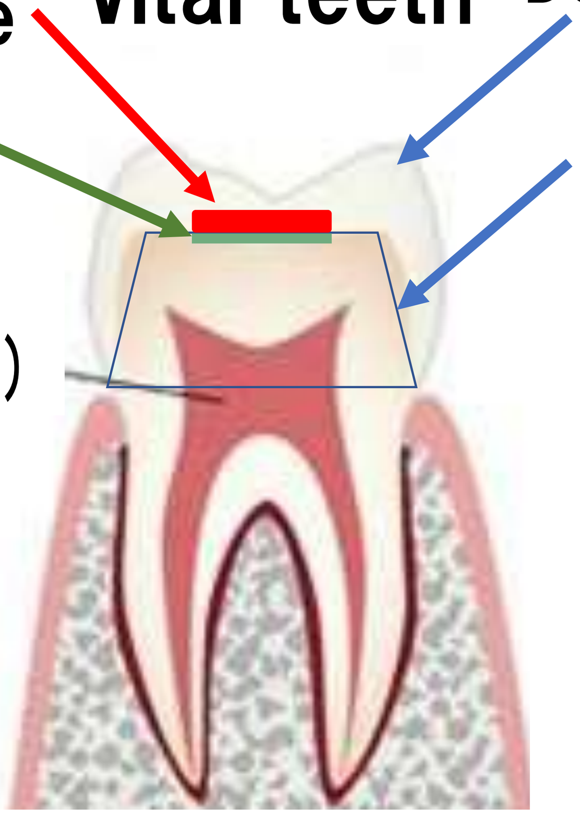
bimodal distribution

【Product lineup】

	Standard product			Thin type product			
Product number	MT500	MT700	MT900	MTS500		MTS700	
magnet structure (Size (mm))	3.0 / 1.1	3.6 / 1.2	4.0 / 1.3	3.0 / 0.6		4.0 / 0.6	
Keeper	3.0/3.6/4.0 / 0.8 / 4.9 / 1.3		3.0/3.6/4.0 / 0.8	3.0 / 0.2	3.0 / 0.4	4.0 / 0.2	4.0 / 0.4
suction power (gf)	500 ± 50	700 ± 70	900 ± 90	450 ± 45	500 ± 50	600 ± 60	700 ± 70

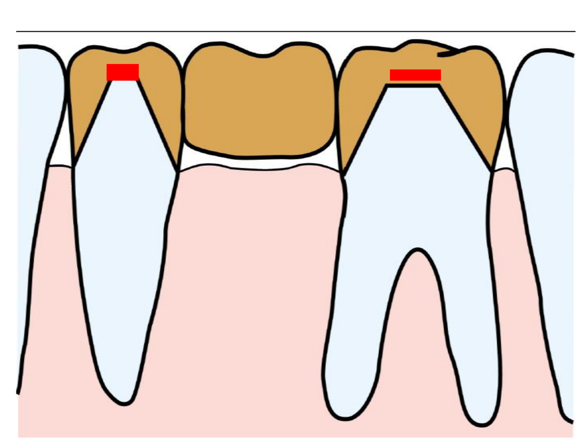
【Clinical applications】(natural tooth specifications)

Dental magnets are tooth-friendly denture retainers. Magteeth improves suction power, reduces costs, and enables treatment without damaging nerves. At the same time, it solves the MRI problem.

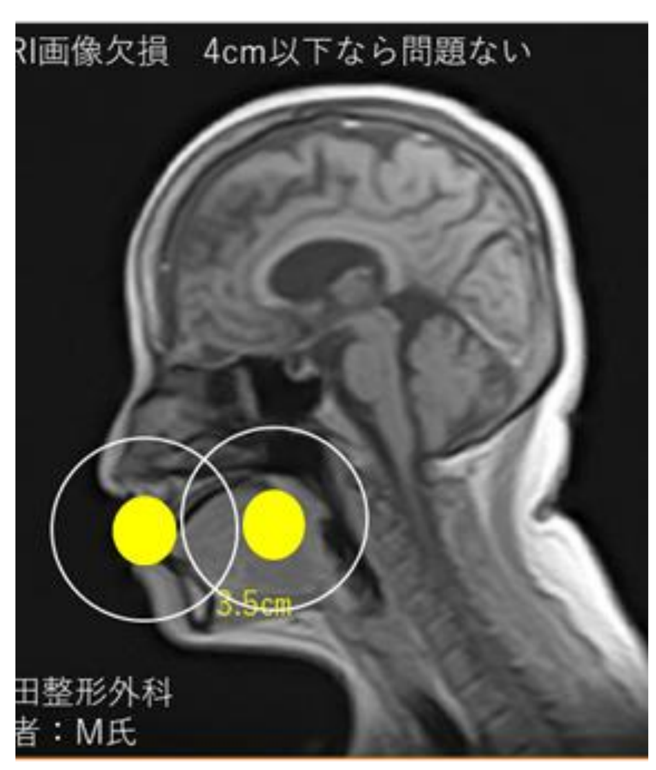


magnetic dentures

Magnetic bridge



MRI examination and defect images

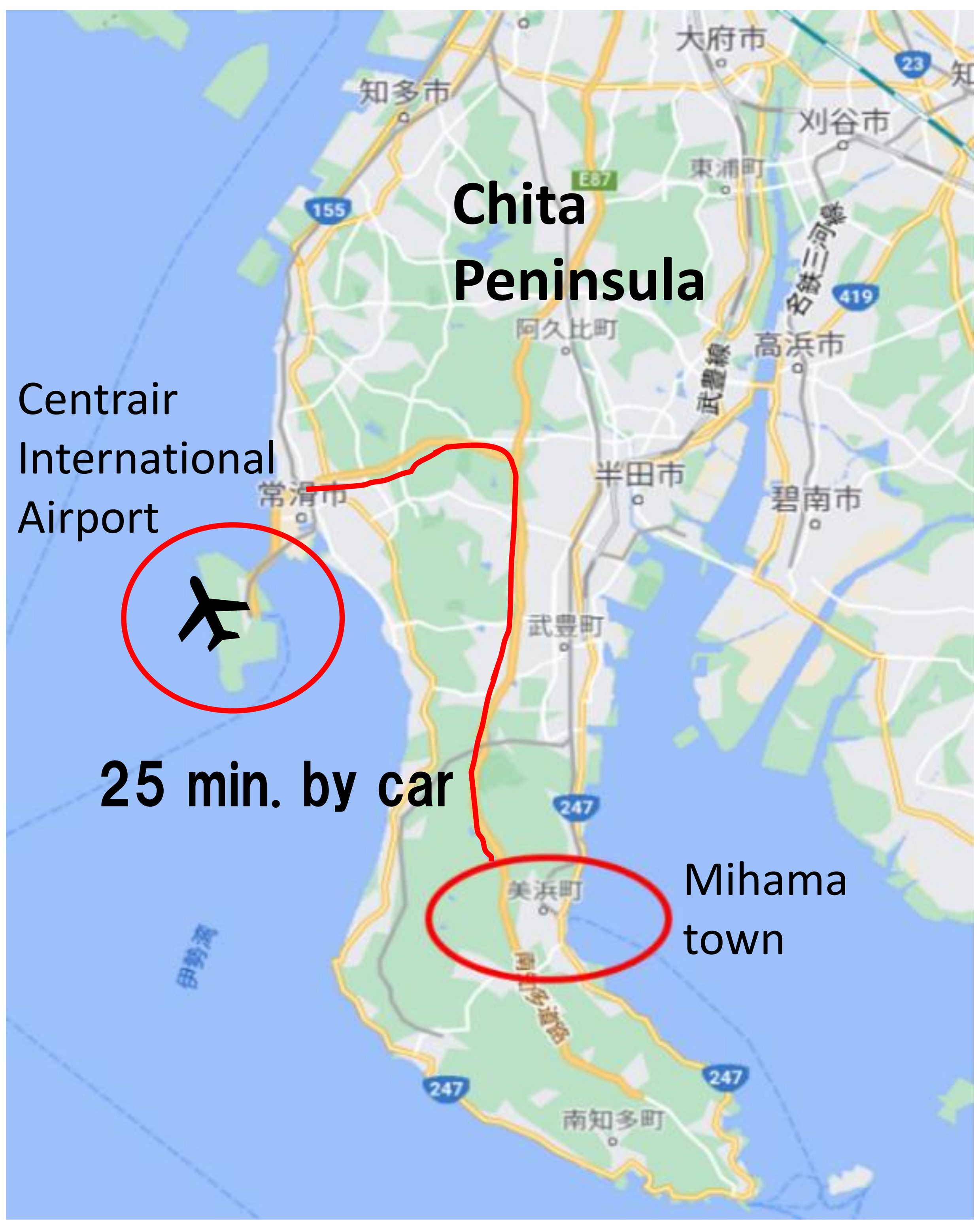


MagneDesign

【Mihama Research Institute】

【A location open to the world】

Southern Aichi Prefecture



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