Surface treatment technologies to contribute to a high-energy linear collider

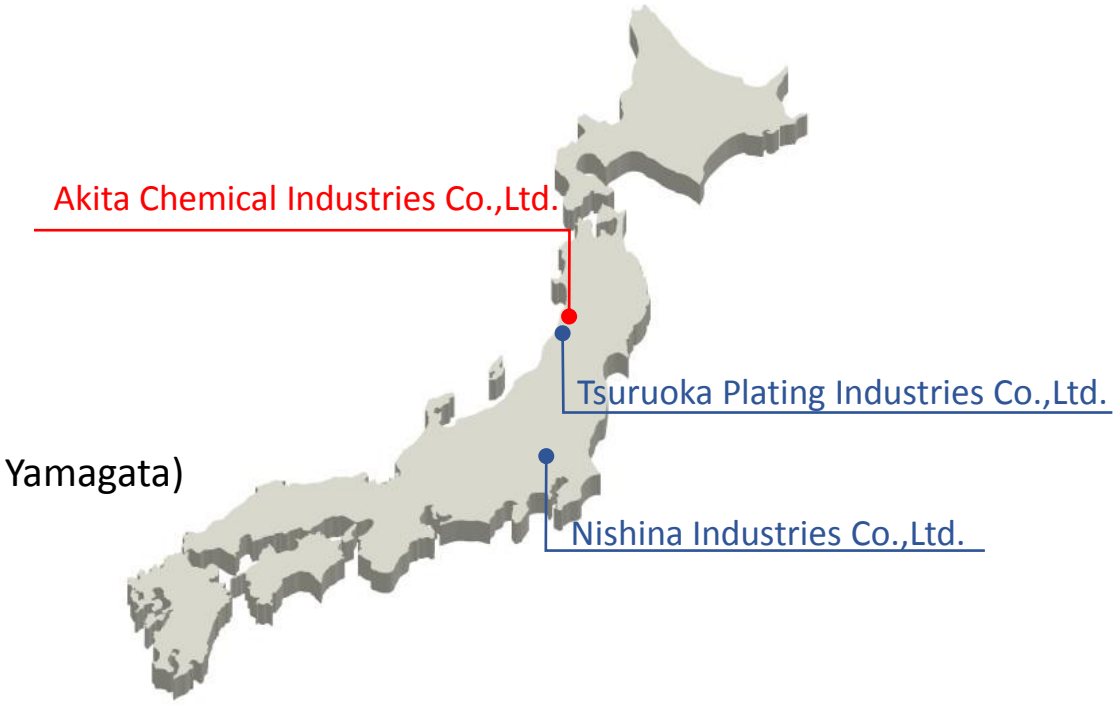
2018/5/29

Akita Chemical Industries Co.,Ltd.

General Manager
NATUHITO.SASAKI

Company overview

Company name : Akita Chemical Industries Co.,Ltd.
Representative : Representative Director Yasuyuki Tanno
Address : Idojiri 81, Hirasawa, Nikaho, Akita
Date established : February 17,1972
Capital : 1,2million yen
Employees : 75
Associated companies : Nishina Industries Co.,Ltd.(Saitama)
Tsuruoka Plating Industries Co.,Ltd.(Tsuruoka, Yamagata)
Description of business(Surface treatment of metallic parts)
Electroless nickel plating(Fe, SUS, Al)
Automatic zinc plating
SUS electrolytic polishing , chemical polishing
SUS acid cleaning , aluminum chemical treatment
Anodized aluminum(anodic oxidation)
Surface treatment for other metallic parts.



Company history

1972	**Akita Chemical Industries Co.,Ltd. Established.**
1972	Zinc plating started.
1973	Nickel and chrome plating started.
1974	Tinning of semiconductors started.
1982	Electroless nickel plating started.
1991	Stainless electrolytic polishing started.
1994	Large electrolytic polishing equipment installed.
1998	Magnesium chemical treatment started.
2000	Anodized aluminum treatment and Electroless nickel plating for aluminum started.
2002	Large anodized aluminum equipment installed.
2005	IOS14001 certified.
2006	Electroless dark black nickel plating started.
2008	Technical Center opened.
2016	Hard chrome plating started and JISQ9100 accredited.

Major facilities

- Electroless nickel plating line【3,000×600×1,500】
- Large electrolytic polishing, acid treatment line, large cleaning plant【4,500×3,200×2,200】
- Small electrolytic polishing, acid treatment line
- Zinc plating line【2,000×350×1,000】
- Automatic electrolytic polishing line
- Large anodized aluminum line【3,000×400×2,000】
- Small anodized aluminum line
- Automatic anodized aluminum line
- Electroless nickel plating line for aluminum materials【600×350×850】
- Hard anodized aluminum line for castings(pressure sealing)【1,000×1,000×1,000】
- Cleaning and packaging room(Cleaning room)
- Hard chrome plating line【500×650×750】
- Baking furnaces(5 units)【1,000×1,000×1,000】
- High pressure cleaning machines(6 units)

Baking furnace

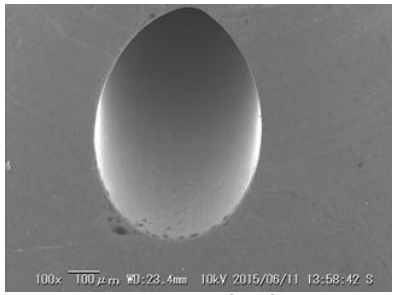
Autoclave for pressure sealing

Performance of electrolytic polishing

The metal which can work to electrolytic polishing it in us.

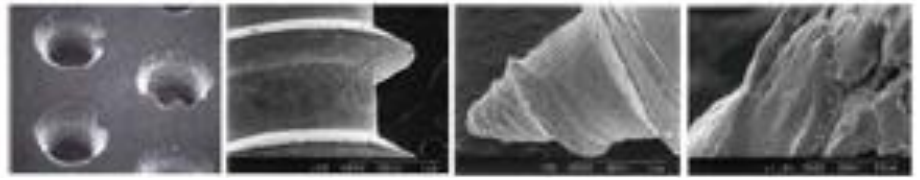
- Stainless(austenite , martensite)
- Aluminum
- Copper(oxygen free)
- Titanium
- Hasteroid
- Molybdenum
- Tungsten
- Niobium

Before polishing

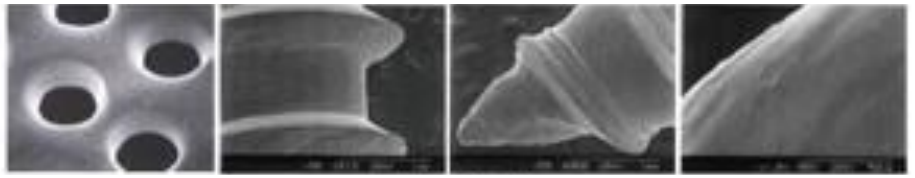


After polishing

Molybdenum ϕ0.5-micro crucible tapering portion



Before polishing

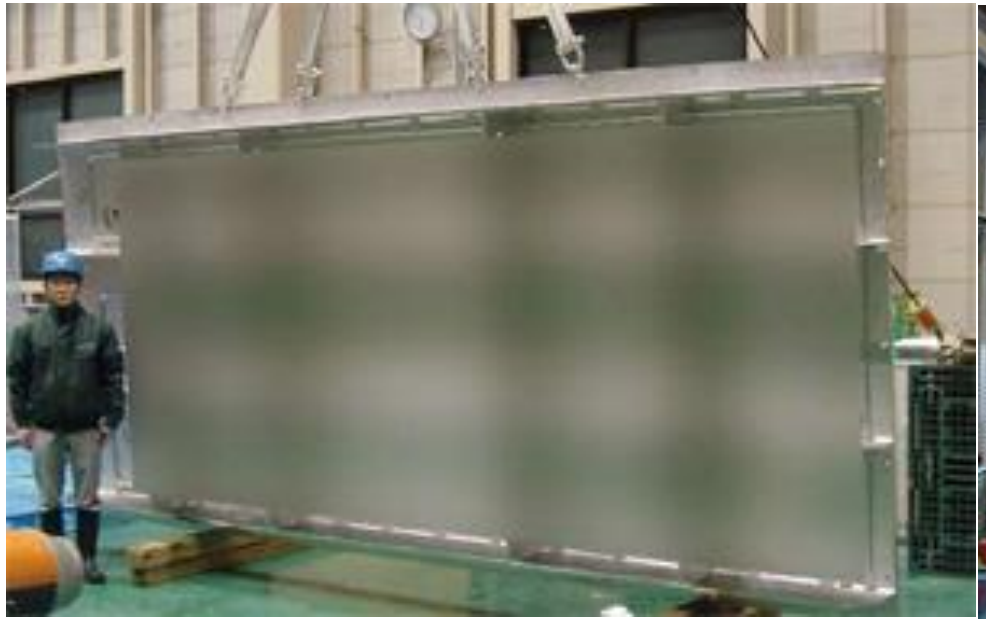


After polishing

Stainless electrolytic polishing

SUS electrolytic polishing plant

The tank capacity of the plant dedicated to electrolytic polishing is one of the most largest in Japan and it can polish a workpiece with a weight of up to 11 tons.



Door for large chambers

The electrolytic polishing plant inside

The large cleaning plant inside

Accelerator and ultra-high-vacuum

Why is ultra-high-vacuum necessary in accelerator facilities.

- If gaseous molecules remain on the particle beam path , particles collide with remaining gaseous molecules and part of them are lost.
  →To prolong life of the accelerated particle beam.

- If the particle beam collides with gaseous molecules close to the measuring apparatus , (fundamental) particles are generated and cause backgrounds (noise) of the measuring apparatus.
  →To reduce backgrounds (noise) of the measuring apparatus.

- If the particle beam collides with gaseous molecules , they are ionized to generate ions and electrons , which accelerate the particle beam and make it unstable.
  →To maintain the accelerated particle beam stable.

Actuality of ultra-high-vacuum

Pressure p in the vacuum device is expressed as follows.

$$p = \frac{q \times A}{S}$$

Where, q : speed of air released from the internal wall of the vacuum vessel ,

A : surface area of materials in the vacuum device ,

S : discharge speed of the vacuum pump.

↓

To increase the degree of vacuum(reduce the pressure) ,

reduce q → use materials releasing less air ,

increase S → use a vacuum pump with high discharge speed ,

reduce A → reduce surface roughness of the internal wall of the vacuum vessel.

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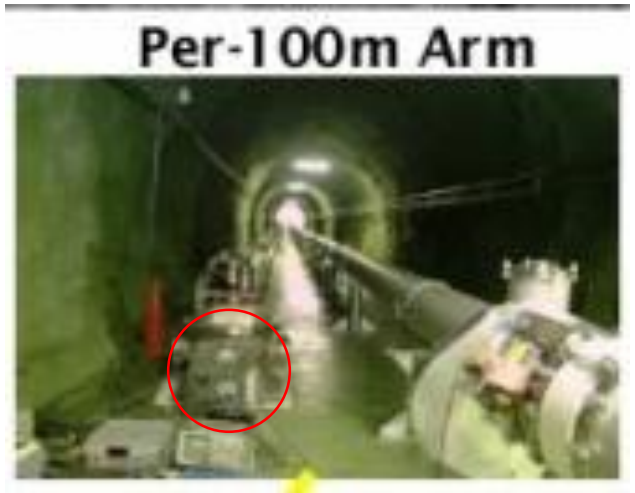
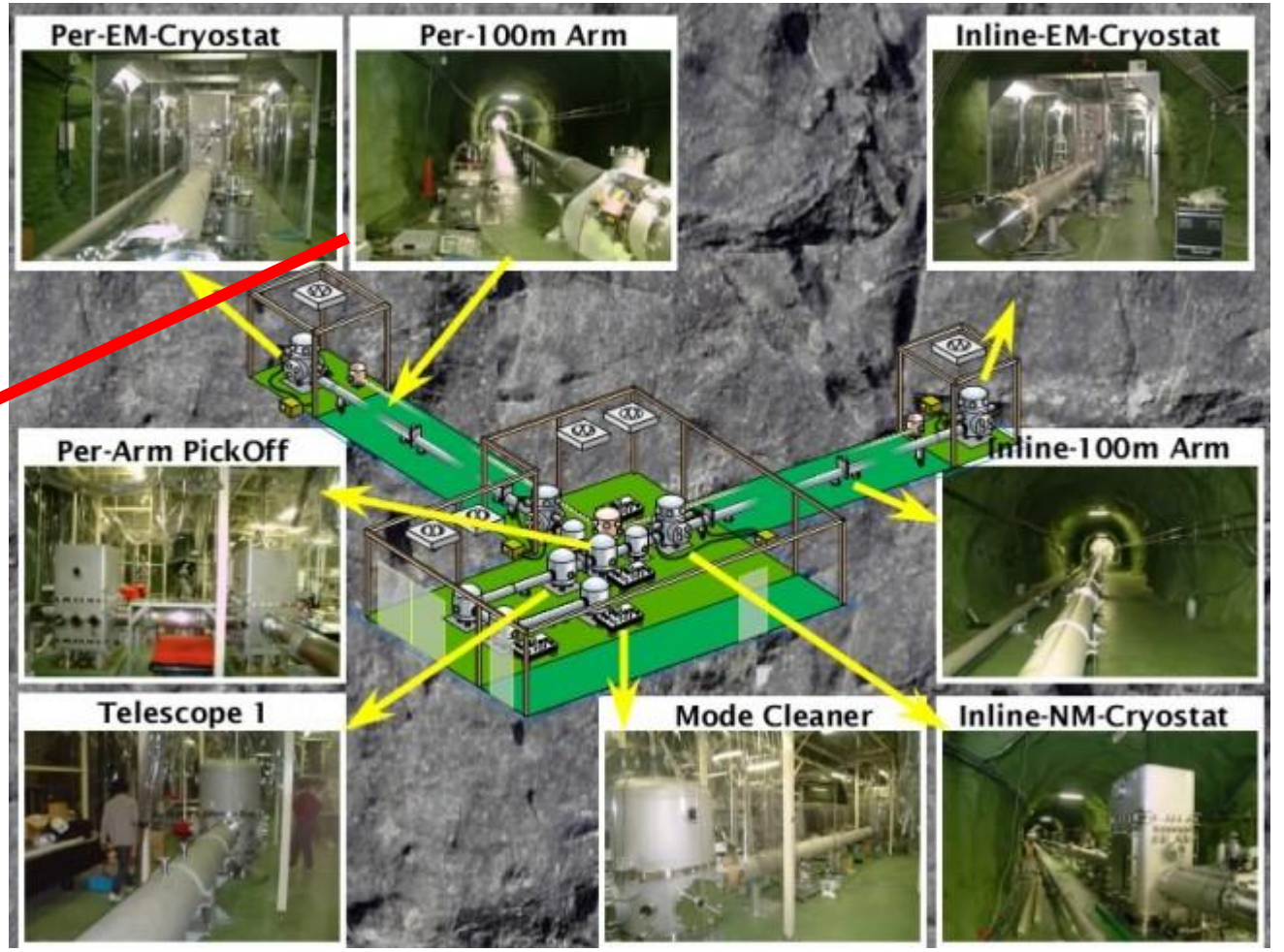
Electrolytic polishing is effective

KAGURA（in GIFU Prefecture）

We have done electrolytic polishing using 4-chambers as one of our past successful records. (March , 2013)

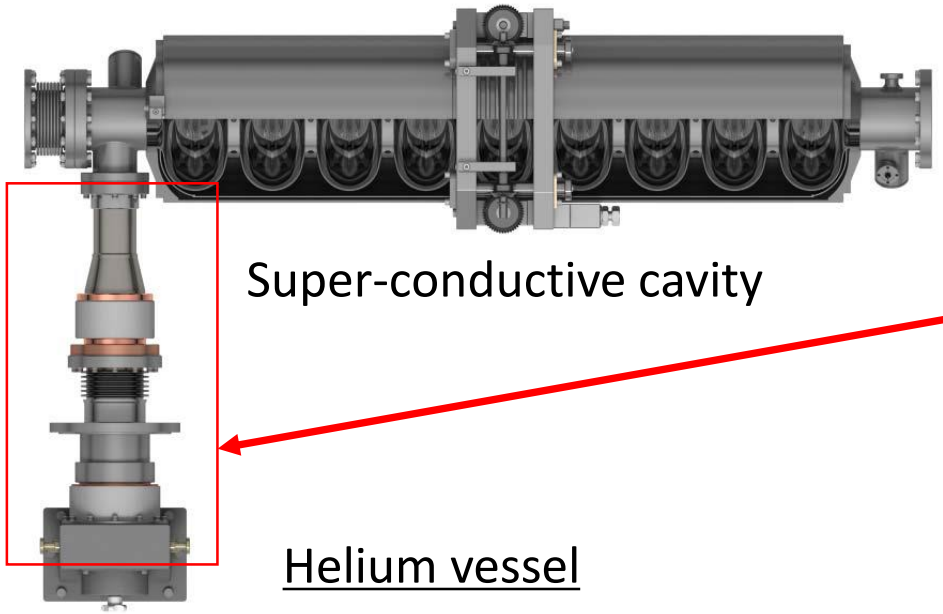




Approach to Copper Plating Process on the SUS316L Bellows ①

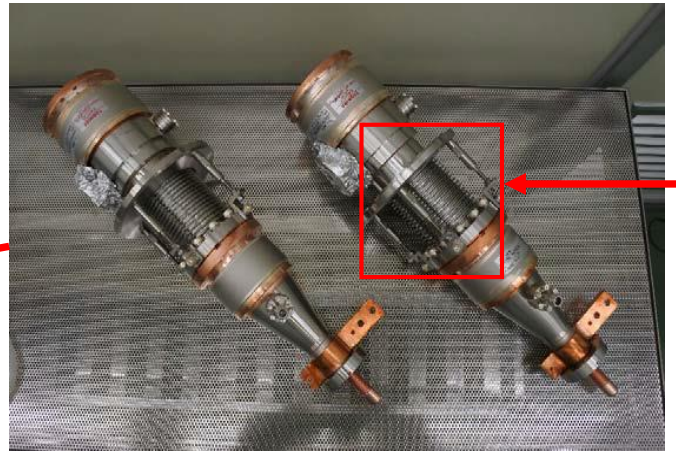
The inside of input couplers is copper-plated to reduce loss of high frequency.

These couplers are used under sever conditions and thus require stabilized plating quality.



Super-conductive cavity

Helium vessel



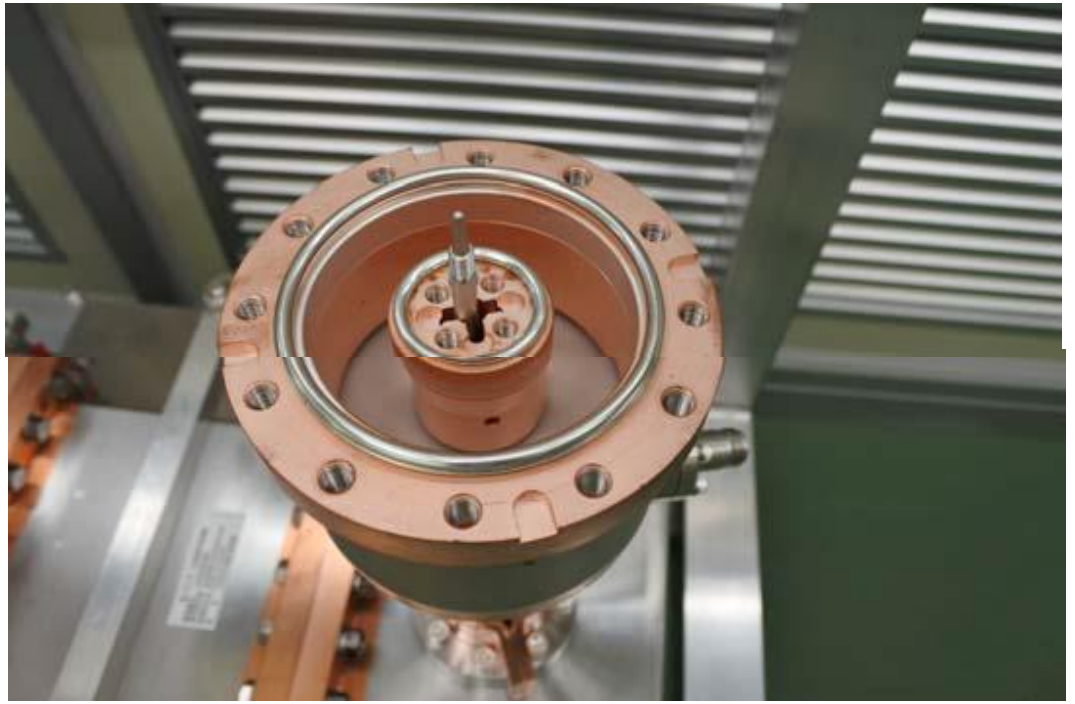
SUS316L Bellows

Coupler

Approach to Copper Plating Process on the SUS316L Bellows ②

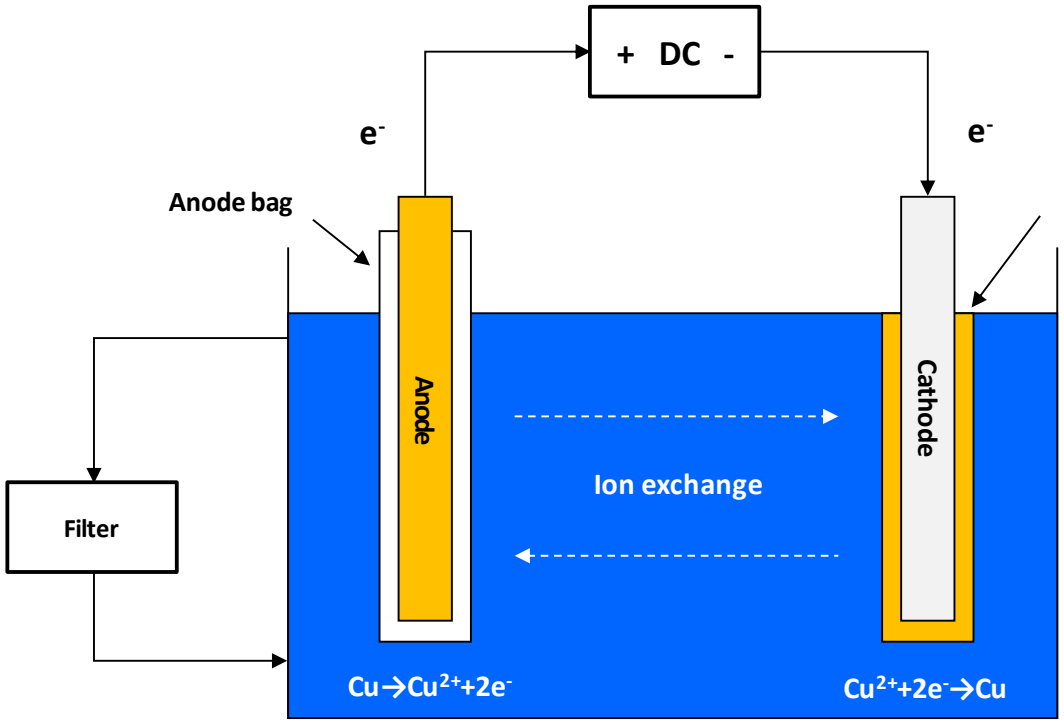
One of the technical issues needed to improve yields of the coupler manufacturing is to apply copper plating（20μm） on the SUS316L bellows.

We have the basic knowledge and facility to develop such plating.

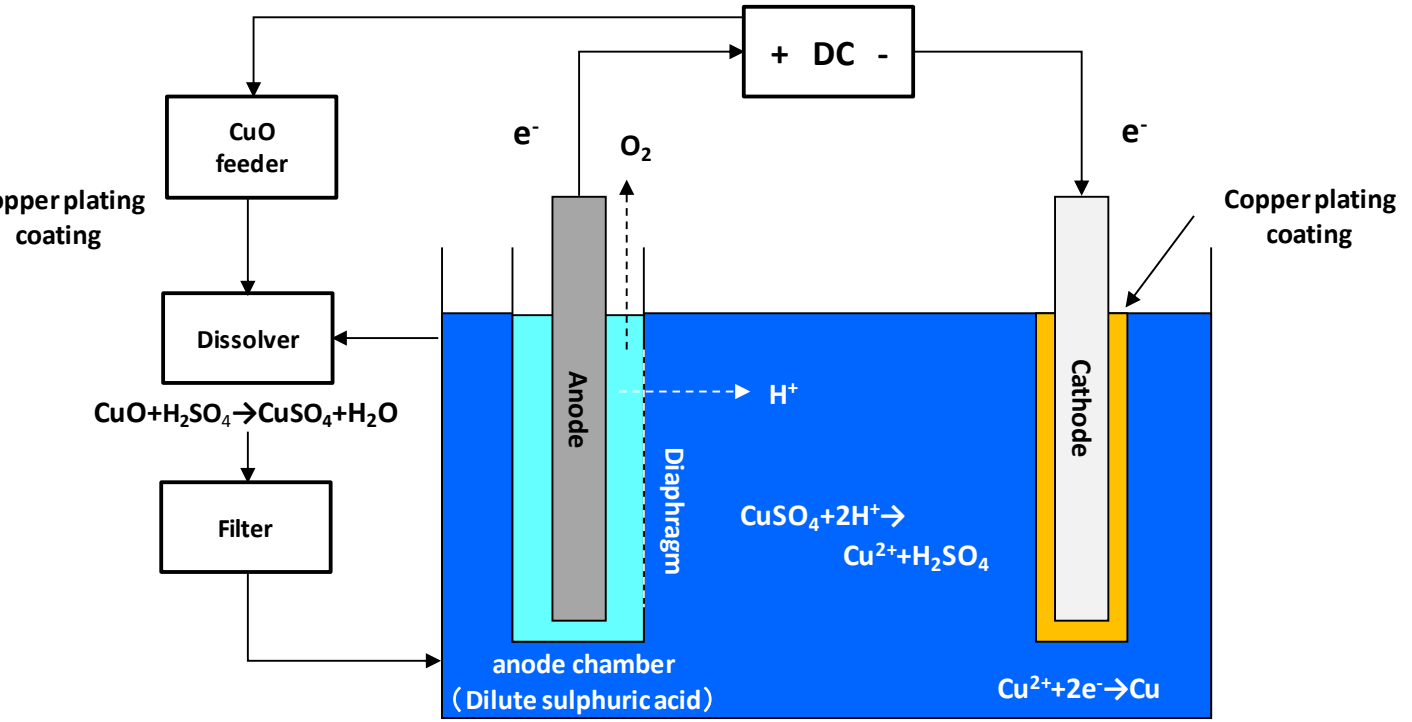


The internal surface is all copper-plated.

Copper sulfate plating process



soluble anode



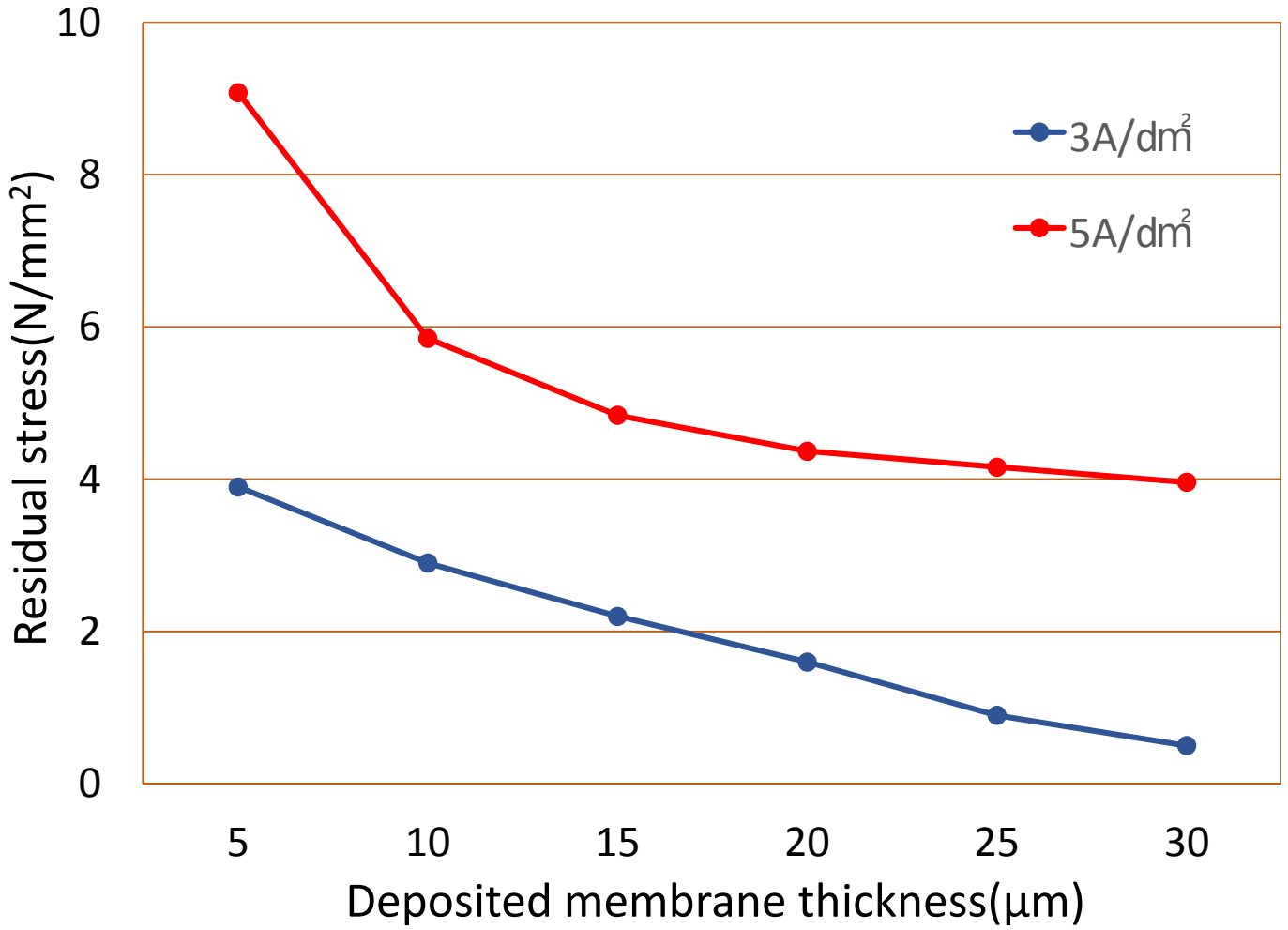
insoluble anode

Advantages of insoluble anodes

- Supply and maintenance of anodes are not required.
- Plating thickness is even due to no change in the anode size.
- No defects resulting from anode sludge (roughness and impurities)
- Management of anodes are easy.

Relation between residual stress and current density

The residual stress is likely higher when the current density is high and the membrane is thin.



Conclusion of challenge to copper plating

- Coating with highly uniform electrodeposition is suited for plating using insoluble anodes where the density of the plating solution hardly changes.

- In selecting plating solution , it is necessary to choose one that can produce membranes with extremely low residual stress and with high ductility superior in impact-resistance of temperature difference.

- We consider that it is our mission as surface treating company to contribute to the accelerator technology aiming to develop copper plating solution suitable for couplers.

Thank you for your kind attention.