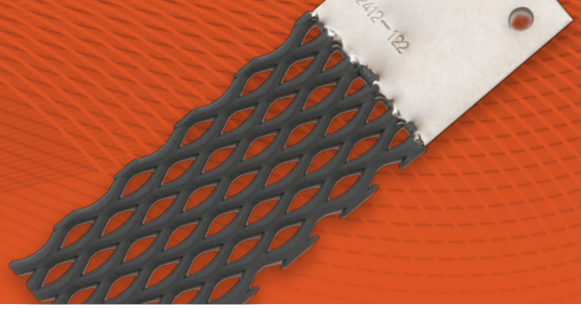
Lead Dioxide Electrode



What is a lead dioxide electrode?

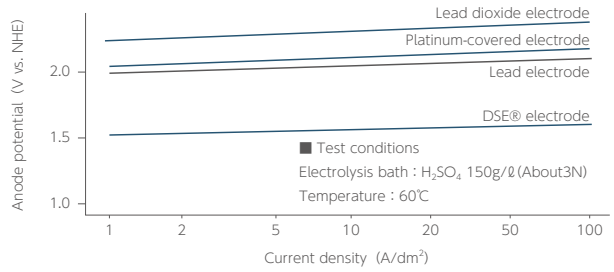
Our lead dioxide electrode is an electrode where the α type lead dioxide and β type lead dioxide are coated on the titanium substrate in layers. Since this electrode has a high oxygen evolution overvoltage, the organics etc. in waste water can be decomposed efficiently by anodic oxidation. When water electrolysis is performed with this electrode, high concentration ozone can be generated. This electrode can also be utilized as an anode for electrolysis ozone evolution.
[Our lead dioxide electrode was commercialized by joint development between the Science and Technology Institute, Agency of Industrial Science and Technology (Current National Institute of Materials and Chemical Research, Agency of Industrial Science and Technology, Ministry of Economy, Trade and Industry) and our company.]

Electrochemical characteristics

Anode potential (in sulfuric acid bath)

The anode potential of our lead dioxide electrode is about 200 mV higher than that of a platinum-covered electrode, or a representative dimensionally stable electrode for O_2 evolution. The lead dioxide electrode exhibits outstanding performance as an anode for anodic oxidation, in combination with its unique catalytic activity for oxidation. (See the following Figure 1.)

Figure 1 Potentials of anodes in sulfuric acid



Anode lifetime

01 Electrolysis in inorganic acid

Electrolysis bath : H_2SO_4 Temperature : 60℃

Current density	Lifetime
50A/dm^2	25,000-30,000 hours
100A/dm^2	10,000-15,000 hours
200A/dm^2	2,000-4,000 hours
Platinum-covered electrode for comparison	
100A/dm^2	500 hours or less

02 Electrolysis in organic-containing bath

Electrolysis bath : CH_3CN(Acetonitrile) 300g/L + H_2SO_4 150g/L
Temperature : 40℃

Current density	Lifetime
50A/dm^2	15,000 hours
Platinum-covered electrode for comparison	
50A/dm^2	20-25 hours

Applications of this electrode

01 Chromium plating in chromic acid solution and other strongly acidic water solutions

Hard chromium plating, production of tin-free steel in the steel industry

02 Chromate treatment

Surface-treated steel sheet, chromate treatment of metal products

03 Production of oxidizing inorganic compounds by electrolytic oxidation

Chromium acid, perchlorate, periodate, etc

04 Electrolytic recovery and extraction of non-ferrous metal in strongly acidic water solutions

05 Production of organic compounds in strongly acidic water solutions by electrolytic oxidation

06 Water clarification by electrolytic oxidation

※A preliminary test must be conducted in each electrolysis bath to determine whether the lead dioxide electrode can be used, thereby identifying and confirming its polarization properties and service life.

Precautions to take when using this electrode

01 Handling during non-energization

As long as the layer of lead dioxide is energized as an anode, it will have a long service life. If it is put into a reducing condition in an acid bath while not energized, however, the PbO_2 will be reduced and converted to Pb^{2+}, and will gradually dissolve into the bath. Hence, whenever the electrode is left in the bath, it is necessary to pass a current to protect the anode.

02 Do not heat

If the lead dioxide is heated to 180°C or more, it will be converted to lead sesquioxide, and will lose conductivity and accordingly its electrode function. Hence, when partially resining this electrode for corrosion prevention, it is necessary to perform the treatment at low temperatures.

03 Effect of chemicals

The lead dioxide electrode experiences a chlorine evolution reaction in hydrochloric acid, but the reaction is unstable. It cannot be used in hydrochloric acid as is the case with a lead or lead-alloy electrode. If it is operated in the presence of a chloride, its service life could be shortened. Furthermore, it is reduced by hydrogen peroxide or ozone, which could shorten its service life.

04 Handle carefully

The layer of lead dioxide is in close contact with the titanium substrate. If it receives a blow, shock, or similar, it may separate from the substrate. Hence, the electrode must not be overturned or dragged during transportation.

05 Do not use as a cathode

The lead dioxide electrode performs excellently when being used as an anode. If the electrode is used as a cathode, however, the lead dioxide will be reduced and converted to metallic lead. As a result, it will be rapidly consumed, greatly shortening its service life.

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