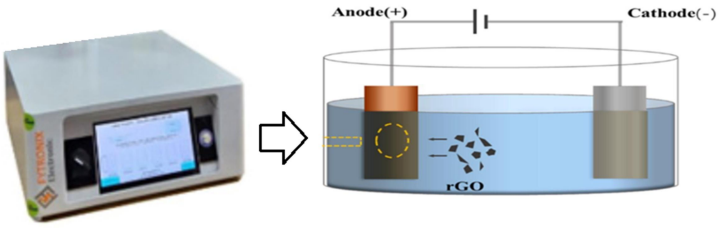
ELECTROPHORETIC DEPOSITION COATING SYSTEM

EPD 9820



Technical data

Electrophoretic deposition (EPD)SYSTEM is a complete coating system and has DC voltage source. System is controlled by software or manually.

Applications

Application of Electrophoretic Deposition

Of course! **Electrophoretic Deposition (EPD)** is a coating method that relies on the transport and deposition of charged particles onto a surface under an electric field. Below you can find the main application areas of EPD:

Voltage range: -40 V and +40V or more

Current range: 0-10 A

DC Voltage of EPD system is set to constant voltage

DC Current of EPD system is set to constant current

System has a software

i. System measure voltage as function of time

ii. System measure vcurrent as function of time

AC Voltage range: 0-40 V adjusted as manually

Current range: 0-10 A

Electrodes: stainless steel 20x30 mm

Ceramic Coatings

* Bioceramic coatings (e.g., hydroxyapatite)
* Thermal barrier coatings
* Electrolyte and electrode coatings for fuel cells
* Surfaces requiring high temperature and wear resistance

2. Biomedical Applications

* Implant coatings (biocompatible coatings on titanium implants)
* Tissue engineering scaffolds
* Drug delivery systems

Coatings on Metals and Alloys

Coatings to increase corrosion resistance

Coatings with nanomaterials (e.g., graphene, nanotube sheets)

Surface treatment in the automotive and aerospace industries

Composite Material Production**

Coating of composite fibers

CNT or graphene-reinforced composites

Ceramic-metal (Cermet) structures

Energy Storage and Conversion Systems**

Lithium-ion battery electrode coatings

Supercapacitor electrodes

Photovoltaic cell components

Microelectronics and Optoelectronics**

* Thin-film coatings
* Sensor production
* Microstructures and MEMS applications

Filtration and Separation Systems**

Coating of porous membranes

Surface modification of water treatment filters

Art and Restoration

Decorative coatings on glass, ceramic, and metal surfaces

Special pigment coatings for restoration purposes

Paint and Pigment Coatings

Electrophoretic paint (e-coating)

Automotive industry (especially anti-corrosion primer coatings)

Electrophoretic deposition (EPD) process is **based on the movement and deposition of charged particles under electric field onto a conductive electrode to develop thin or thick films and coatings**. EPD can be applied for a wide range of fine powder or colloidal particles of metals, ceramics, polymers, and the composites.

Electrophoretic deposition (**EPD**), is a term for a broad range of industrial processes which includes **electrocoating**, **cathodic electrodeposition**, **anodic electrodeposition**, and **electrophoretic coating**, or **electrophoretic painting**. A characteristic feature of this process is that colloidal particles suspended in a liquid medium migrate under the influence of an electric field (electrophoresis) and are deposited onto an electrode. All colloidal particles that can be used to form stable suspensions and that can carry a charge can be used in electrophoretic deposition. This includes materials such as polymers, pigments, dyes, ceramics and metals.

Voltage Conditions

In the electrochemical processing of Al to form an oxide layer, most studies have been made under the potentiostatic conditions of high voltage and low currents (refer to Figure 1). The voltages used are also dependent on the acid type and its molarity. Table 2 summarizes the voltage settings and times of the three main electrolytes used by several research groups in the manufacture of nano-porous oxide layer.

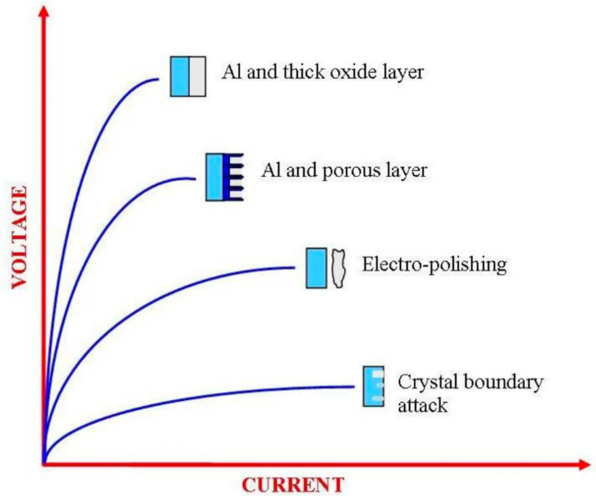


Figure 1 Voltage and current conditions

Anodic means positively charged conductor and cathodic means negatively charged conductor.

Anodic coating and cathodic coating are the two types of electroplating processes. They differ in their metal and process parameters, but they both work on a similar principle they coat metallic materials with a thin layer of an electrolyte to form an electrically conductive coating.

Anodic coating is the process of applying an electrical current to the surface of a metal that causes an oxide layer to form on its surface. Cathodic coating involves placing a negative charge over the metal surface which attracts oxygen ions and makes them adhere to the metal.

Another important benefit of cathodic coatings is that they reduce corrosion resistance in alloys.

Anode coatings are applied to obtain current production by use of naturally occurring ions in the presence of an electrolyte(s). Anodising occurs when metal ion migration leads to precipitation or electrodeposition on a substrate that acts as an anode material.

An anodic coating is a passivation layer on metal surfaces. Cathodic coatings on the other hand are used to create electric conductivity and help prevent corrosion.

The cathodic coating is steady protection but anodic is not steady protection.

Cathodic coatings are commonly used in electronics, aerospace, transportation, mining, chemical processing industries, etc. This type of coating reduces oxidation reactions between metals by adsorbing or attracting air molecules which can be harmful to electronic equipment like computers and other similar devices.

EPD Coating

AISI 316L stainless steel electrodes (dimensions of 30x25 mm) were cleaned with a mixture of acetone and ethanol, and then rinsed with deionized water and dried. The electrodes were kept parallel at a distance of 10 mm. A direct current (DC) cathodic EPD process was performed at different voltages and deposition times, as shown in Table 2. The zeta potential of suspended particles is one of the critical parameters of EPD, and has important e ects on both the deposition rate and the stability of the suspension. Zein molecules acquire a positive charge when dispersed in the aqueous ethanol solution at a pH of ~5.3 due to the protonation of carboxyl and amine groups. Similarly, HA dissolves best in aqueous ethanol at pH 3–5. According to experiments performed by Ba¸stan et al., HA particles have a positive charge at a pH lower than 6. This explains the cathodic deposition of the zein/HA particles, as observed in this study (pH was maintained at 4–4.5).

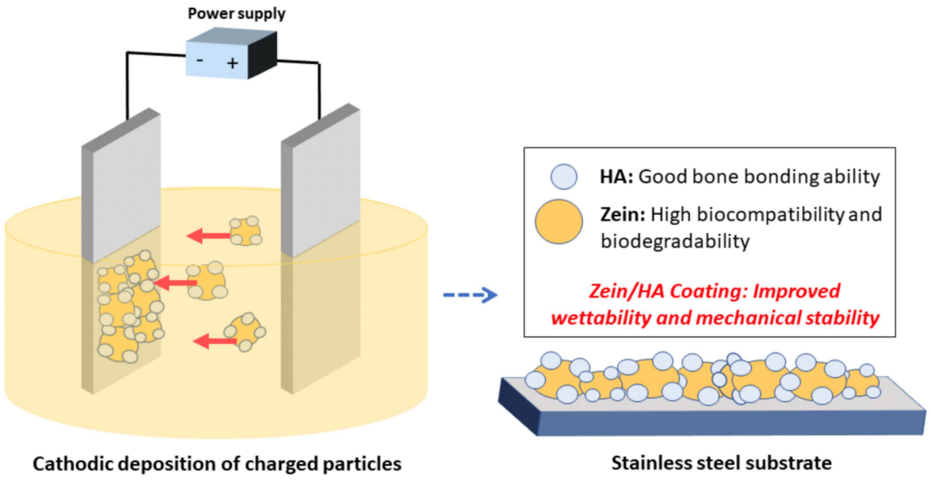


Table 1. Selected factors and levels.

Symbol	Control Factor	Levels 1	2	3	4
A	Concentration of HA in the suspension (g/L)	1.25	5		
B	Voltage (V)	3	5	7	9
C	Time (min)	6	9	12	15

This method allows the study of each parameter at various levels by averaging deposition yield, standard deviation and corresponding S/N ratios at each level. The deposition yield, S/N ratio for deposition yield and standard deviation in deposition yield were calculated using the following formula [30]

$$Deposition\ yield = \frac{\Delta\ Weight}{A}\ in\ (\frac{mg}{cm^2}) \quad (1)$$

where Δ *Weight* = weight after coating – weight before coating and *A* = Area of coating.

$$\frac{S}{N} ratio\ of\ deposition\ yield = -10 \log [\frac{1}{n}(\Sigma\ 1/y^2)] \quad (2)$$

where *y* = *deposition yield* and *n* = number of observations.

$$\frac{S}{N} ratio\ of\ deposition\ yield = -10 \log [\frac{1}{n}(\Sigma\ y^2)] \quad (3)$$

where *y* = standard deviation and *n* = no. of observations.

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Wettability Studies

The measured contact angle of zein/HA coatings (obtained at a deposition voltage of 15 V, with a deposition time of 3 min and 5 g/L HA in the suspension) was measured to be 50 ± 2°, which is near the ideal wettability value of 35–80° for the initial protein attachment.

Aluminum Anodizing Operation

Anodizing is an electrolytic passivation process that increases the thickness of the natural oxide film on the surface of a part. The created film or layer is durable, stable, and enhances aluminum's natural corrosion resistance. Aluminum anodizing is a controlled oxidation process that involves the use of an acidic electrolyte bath in tanks with direct electrical current (DC) supplied to anodes and cathodes.

Aluminum parts being anodized act as the anode. A cathode plate or rod made of platinum, stainless steel, lead, or carbon supplies the negative part of the electrical circuit. As voltage is applied to the circuit, an aluminum part loses positive ions and attracts negative ones, which causes a layer of aluminum oxide to grow on the aluminum part.