

# Handbook on Electroplating with Manufacture of Electrochemicals

**Author:** Dr. H. Panda

**Format:** Paperback

**ISBN:** 9788178331706

**Code:** NI300

**Pages:** 496

**Price:** Rs. 1,695.00 US\$ 150.00

**Publisher:** Asia Pacific Business Press Inc.

Usually ships within **5** days

Electroplating is an electro deposition process for producing a dense, uniform, and adherent coating, usually of metal or alloys, upon a surface by the act of electric current. The term is also used for electrical oxidation of anions onto a solid substrate, as in the formation silver chloride on silver wire to make silver/silver-chloride electrodes. Electroplating is primarily used to change the surface properties of an object (e.g. abrasion and wear resistance, corrosion protection, lubricity, aesthetic qualities, etc.), but may also be used to build up thickness on undersized parts or to form objects by electroforming.

Electrochemical deposition is generally used for the growth of metals and conducting metal oxides because of the following advantages: (i) the thickness and morphology of the nanostructure can be precisely controlled by adjusting the electrochemical parameters, (ii) relatively uniform and compact deposits can be synthesized in template-based structures, (iii) higher deposition rates are obtained, and (iv) the equipment is inexpensive due to the non-requirements of either a high vacuum or a high reaction temperature. An electrochemical process where metal ions are transferred from a solution and are deposited as a thin layer onto surface of a cathode.

In the recent years, developments in electronic and chemical engineering have extended the process of electroplating to a wide range of materials such as platinum, Alloy, Silver, Palladium, Rhodium, etc. The electroplating market is an application driven market, which depends largely on the net output of the manufacturing industry.

The electroplating technology allows electro-deposition of multiple layers as thin as one-millionth of a centimeter which makes it an indispensable part of the semiconductor industry. Rising demand for computing devices is expected to create significant market opportunities for electroplating service providers. Growing net output of manufacturing industry, rising demand for consumer goods which mandates more surface finishing services, growth of the electronics industry are some of the key factors driving the growth of the global electroplating market.

The book gives comprehensive coverage of Electroplating Uses, Application Manufacturing, Formulation and Photographs of Plant & Machinery with Supplier's Contact Details. The major contents of the book are Metal Surface Treatments, Electrolytic Machinery Methods, Electroless Plating, Electroplating Plant, Electroplating of Aluminium, Cadmium, Chromium, Cobalt, Copper, Gold, Iron, Lead, Nickel, Bright Nickel, Silver, Alloy, Platinum, Palladium, Rhodium, Bright Zinc, Tin and Plastics Barrel, Zinc Electroplating Brightener, Colouring of Metals, Metal Treatments, Electrode position of Precious Metals and Stainless Steel, Case Hardening, Electroless Coating of Gold, Silver, Manufacture of phosphorus.

It is a very useful book that covers all important topics of Electroplating. It will be also a standard reference book for professionals, entrepreneurs, those who are interested in this field can find the complete of Electroplating. It will be very helpful to consultants, new entrepreneurs, technocrats, research scholars, libraries and existing units.

## Contents

- 1. Electrochemical Processing
  - INTRODUCTION
  - THE ELECTROCHEMICAL CELL
  - INORGANIC
    - Hardware for Electrochemical Processing
  - PRODUCTION CONDITIONS
  - Electrolysis of Chloride Solutions
  - Organic
  - HARDWARE FOR ELECTRO-ORGANIC PROCESSING
  - Cells
  - Electrodes
  - Electrolytes
  - Diaphragms
  - Cell Designs
  - Scale-Up-Consideration
- 2. Metal Surface Treatments
  - CLEANING, PICKLING, AND RELATED PROCESSES
  - Cleaning
    - Solvent Cleaning
    - Wiping
    - Emulsifiable Solvents
    - Emulsion Cleaning
    - Diphasic Chlorinated Solvents
    - Vapour Degreasing
    - Ultrasonic
    - Alkaline
    - Immersion
    - Spray
    - Ultrasonic Alkaline
    - Steam
    - Electrocleaning
  - Pickling
    - (a) Chemical for Pickling
      - Sulphuric Acid:
      - Hydrochloric Acid:
      - Nitric Acid:
      - Phosphoric Acid:
      - Chromic Acid:
      - Hydrofluoric Acid:
      - Other Pickling Acid:
      - The practice of Electrolytic Pickling:
  - CHEMICAL AND ELECTROLYTIC PICKLING COMPARED
  - Anodic Cathodic Pickling Compared:
  - Tin and Lead Additions:

Regeneration of Pickling Solutions

Pickling Before Electroplating

3. Electrolytic Machinery Methods

PRINCIPLES OF THE ECM PROCESS

The Solution Gap

Electrolytes

Temperature Effects

Corrosion products

Pressure Effects

TYPES OF ECM OPERATIONS

MODERN DEVELOPMENT OF THE ECM PROCESS

Electrolyte Development

Fundamental Investigation

Innovations in ECM Operation

Static Fixture Finishing and Sizing

Embossing

Broaching

Uses

4. Electroless Plating

THEORY

EQUIPMENT

Plating Tanks

Rack Design and Loading Factors

Safety and Waste Disposal

Plating on Metals

Preparation of the Substrate

Plating on Nonconductors

Plating of Plastics

Process Details

Printed Circuits

Printed-Circuit Etchants

Emerging Printed-Circuit Technologies

Plating on Glass

Architectural Glass

Ceramic Plating

Composite Plating

ELECTROLESS COMPOSITE COATINGS

USES AND APPLICATIONS:

Nonelectrolytic Plating Processes

Immersion Plating

Autocatalytic Plating

POSTPLATING TREATMENTS

SPECIFICATION AND TESTS

Thickness

Corrosion Resistance

Adhesion

APPLICATIONS

Decorative Plating

Plating for Protection

Special Surface Effects

Engineering Applications

Electroforming

5. Electroplating

## THE SUBSTRATE IN ELECTROPLATING PREPARATION OF THE SUBSTRATE

Cleaning

Rinsing

Acid Dipping

Drag-Out and Drag-In

Special Preparation Cycles

Aluminium and Magnesium

Zinc-Base Die Castings

Refractory Metals

Other Metals

Nonconductors

The Electroplating Process

Continuous Plating

Materials of Construction

Economics

Safety

Waste Disposal and Metal Recovery

## PLATING SOLUTIONS

Current Density Range

Throwing Power

Acidity

Anodes

Temperature

Purity

Bright Plating

Maintenance of Plating Baths

## INDIVIDUAL PLATING BATHS

6. Electroplating Plant

### PLANT REQUIREMENTS

Buildings

Supporting the Work to be Plated

Tanks

Filtration

Air Agitation

Water Supply

Heaters

Maintenance of the Solution

Effluent

## ELECTROPLATING PLANT

7. Electroplating of Aluminium

Surface Roughening

Anodising

Zincating

Note :

Alstan Process

Plating Process

Silver-Tin Plating

Alstan Process

8. Electroplating of Cadmium

The Solution

Additions to the Solution

Anodes

Thickness of Deposit  
Operating Conditions  
Anti-Corrosion Properties of Cadmium  
Nickel on Cadmium  
Heat Treatment of Cadmium Deposits  
Cadmium and Food Stuffs  
Bright Cadmium Plating  
Applications of the Cadmium-Plating  
9. Electroplating of Chromium  
The Electrolyte  
Chromium Plating Process  
Regeneration of Chrome Plating Solutions  
Coloured Chromium Plating  
Chromium Plating on Aluminium  
10. Electroplating of Cobalt  
Principles  
Functions of Constituents of Bath  
Operating Conditions  
Maintenance and Controls  
PREPARATION OF BASIS METALS AND FINISHING OF DEPOSITS  
Tests of Deposits  
11. Electroplating of Copper  
COPPER SULPHATE PLATING BATH  
Operating Condition  
BRIGHT PLATING  
CYANIDE BATH  
Composition  
SODIUM FORMULATION  
Operating Condition  
POTASSIUM FORMULATIONS  
12. Electroplating of Gold  
STRIPPING GOLD  
GOLD BATHS  
Bath for Gold Gilding  
Current-Density, 0.15 Ampere  
GOLD BATHS FOR HOT GILDING  
Tanks for Gold Baths  
Execution of Gold-Plating  
FOR GOLD-PLATING IN THE COLD BATH THE PROCESS  
IS AS FOLLOWS :  
Re-Gilding  
Application of Gold-Deposition  
GOLD THREAD  
Process  
GOLD PLATING OF STAINLESS STEEL ORNAMENT  
Methods of Plating Stainless Steel  
Plating Procedures  
13. Electroplating of Iron  
Principles  
THE IRON CHLORIDE BATH  
THE IRON SULPHATE BATH  
THE FLUOBORATE BATH  
14. Electroplating of Lead

## ANALYSIS OF LEAD SOLUTION

Free Acid

## APPLICATIONS OF LEAD PLATING

15. Electroplating of Nickel

### TYPES OF NI SOLUTIONS

Engineering Application

### NI AND UR PLATING BUTTERWORTHS

Electroplating Baths used

Watts Nickel Bath

Hard Watts Bath

Nickel Sulphate Bath

Nickel Sulphonate Bath

Nickel Fluoborate Bath

Barrel Nickel Plating

Black Nickel :

Black Ni Plating Processes

### TYPES OF NICKEL PLATING SOLUTIONS USED

16. Electroplating of Bright Nickel

### CARRIERS

### NICKEL ELECTROPLATING BRIGHTENERS

17. Electroplating of Silver

Silver (Atomic weight=107.88) and Its Properties :

Silver Bath for a Heavy Deposit of Silver (Silvering by Weight):

PREPARATION OF BATH I, WITH SILVER CHLORIDE

PREPARATION OF BATH II WITH SILVER CYANIDE

SILVER BATH FOR ORDINARY ELECTROPLATING

Tanks for Silver Baths

### EXECUTION OF SILVER-PLATING

Silver Plating by Weight

### BRIGHT SILVER PLATING

Source of Brightening in Carbon Disulphide Electrolytes

18. Electroplating of Alloy

Electrodeposition of Zinc-Iron Alloy

Lead-Tin Plating

Speculum Plating

Gold Alloy Plating

Bright Alloy Plating

Ni-Alloy Plating

Bronze Plating

Copper Solution

19. Electroplating of Platinum

(1) KEITAL AND ZSCHIEGNER PROCESS

(2) POWELL AND SCOTT PROCESS

CONDITIONS OF OPERATION

MAINTENANCE OF ELECTROLYTE

20. Electroplating of Palladium

(A) SOLUBLE ANODE PROCESS

Condition of Operation

Properties of the Deposit

(B) DIAPHRAGM PROCESS

Condition of Operation

21. Electroplating of Rhodium

PREDEPOSITION

Palladium Plating  
SOLUTION AGITATION  
Raw material used for Palladium Plating  
Equipment  
RHODIUM PLATING

Tank  
Tank Installation  
Solution Heating  
Rectifier  
Rectifier Control  
Current Control  
Temperature Control  
Making of Rhodium Plating Bath  
RHODIUM

Method A—Colorimetric  
Discussion of the Method  
Method B  
Discussion of the Method  
Method C—Hydrazine Reduction  
Discussion of the Method  
Sulphate

## APPLICATIONS OF THE PRECIOUS METALS

22. Electroplating of Bright Zinc

### BRIGHT ZINC-PLATING PROCESSES

Chemical Control  
Electrolytic Impurities  
Anodes

### ADVANTAGES OF BRIGHT ZINC PLATING

23. Electroplating of Tin

### INTRODUCTION

24. Electroplating of Plastics

### THE PLATING OF PLASTICS AND NON-METALLIC MATERIALS

1. Polishing with Plumbago
2. Metallising with Copper Bronze Powder
3. Metallisation by Molten Metal Spraying
4. Metal Surfacing of Ceramics by “Firing”
5. Vacuum Evaporation and Electrical Sputtering
6. Silver Mirror Process as Applied to Plastics

Removal of Glaze

Cleaning

“Sensitising”—The next step is to

Silvering

Coppering

Silver Recovery

25. Electroplating of Barrel

### BARREL NICKEL-PLATING

Barrel Coppering

Brass Barrelling

Barrel Cadmium

Barrel Zinc

Barrel Silver

Electro-Galvanising Tray

Barrel Polishing

Barrel Tin

## APPLICATIONS

26. Zinc Electroplating Brightener

### USES AND APPLICATIONS

### PROPERTIES OF THE BRIGHTENER

### FORMULATIONS

### OPERATING CONDITIONS

Temperature

Current Efficiencies

Throwing Power

Conductivity and polarization

### MANUFACTURING PROCESS

### FORMULATION

27. Colouring of Metals

1. Direct Coloration of Iron and Steel by Cupric Selenite :

2. Coloration of Copper and Brass with Cupric Selenite :

### METAL BROWNING BY OXIDATION

### COPPER COLOURING

(a) Blacking Copper

(b) Red Colour to Copper

### COLORING OF BRASS

Brass Colouring

Coloring Brass

### BRONZING

Art Bronzes :

Antique Bronzes

Vert Antique

Brass Bronzing

Copper Bronzing

### BRONZING OF CAST IRON

Liquid for Bronze Powder

Bronzing of Cannon

Green Bronzing

### BRONZING OF STEEL

### TIN BRONZING

### ZINC BRONZING

28. Metal Treatments

### MECHANICAL TREATMENTS

Workability Testing

Plastic Deformation

Hot Working

Cold working

Primary Forming Processes

Secondary Forming Processes

### THERMAL TREATMENTS

Annealing

Heat Treatment of Steel

Homogenization

Thermo mechanical Processing

### RECENT DEVELOPMENT AND OUTLOOK

Powder Metallurgy of Superalloys

29. Electrodeposition of Precious Metals

Physical Properties



## 30. Electropolishing of Stainless Steel

Application

BATHS

EXPERIMENTAL

Bath Composition

Hull Cell Studies

Rates of Dissolution

Effect of Polishing Time

Life of the Bath

PRACTICE OF ELECTROPOLISHING

(i) Sequence of Operations

(ii) Electropolishing

(iii) Treatments After Electropolishing

(iv) Equipment for Electropolishing

(v) Technical and Economic Aspects

APPLICATIONS OF ELECTROPOLISHING

1. Decorative Finishing

2. Polishing of Parts Exposed to Friction

3. Electropolishing Cutting Tools

Drills and Taps

Wood Working Tools

Solutions Employed

4. Polishing of Measuring Instruments

31. Case Hardening

PROCESSES

Carburizing

Gas

Liquid

Pack

Carbonitriding

Gas

Cyaniding

Nitriding

Gas

Liquid

Microcasing

Ionitriding

Siliconizing

Boronizing

Tufftriding

Triniding

Applied Energy

Induction Hardening

Flame Hardening

Other

Hardening

32. Electroless Coating of Gold, Silver

Methods for Mirroring

ELECTROLESS PROCESS

Equipment

SILVER COLOURING FOR MIRROR (SILVER COATING)

Formulation-1

Preparation

Formulation-2

Preparation

PROCESS OF MANUFACTURE

1. Selection of glass sheet
2. Cleaning of glass sheet
3. Sensitizing
4. Silvering on glass

PLATING PROCEDURE

SILVERING OF GLASS

Chemical Silvering

To prepare the bath

Cleaning

GOLD COLOURING FOR MIRROR (GOLD COATING)

FORMULATIONS FOR ELECTROLESS GOLD BATH

MANUFACTURING PROCESS FOR GOLD PLATING

BLUE SILVERING ON GLASS WITH COPPER COATING

FORMULATION OF BLUE SILVERING ON MIRROR

MANUFACTURING PROCESS

COPPER COATING

PLATING BATH FORMULATION

Bath Constituents

THE OPERATION OF ELECTROLESS COPPER BATHS

Red Mirror by Electroless Dipping Method

Electroless Copper Plating of Plain Glass to Manufacture Red Mirror

MANUFACTURE PROCESS OF RED MIRROR

TEST FOR ELECTROLESS PLATED RED MIRROR ADHESION

Baking Test

Burnishing Test

TEST FOR CONTINUITY

Ferroxy Test

MARKING

33. Buffing and Industrial Metal Polishing Compounds

Abrasives for Buffing

1. Tripoli
2. Vienna Lime
3. Aluminium Oxide (Sopfire)
4. Rouge
5. Amorphous Crystalline Silica
6. Emery

Buffing & Polishing Compositions

MANUFACTURING METHOD OF BUFFING COMPOUNDS

CARBORUNDUM FOR POLISHING

34. Tin and its compounds

Discovery

Mineralogy

Extraction

Metallurgy

Refining of Crude Tin

Properties of Tin

General Account of Tin and its Compounds

35. Lead and its compounds

Discovery

MINERALOGY

Smelting in a Blast Furnace  
Purification of Lead  
Properties of Lead  
Chemical  
Technology  
White Lead,  $\text{Pb(OH)}_2 \cdot 2\text{PbCO}_3$   
Super-sublimed White Lead  
36. Manufacture of phosphorus  
Modern Electric Process  
Manufacture in India  
Purification  
Smithel's Cold Flame  
Luminescence  
Manufacture of Red Phosphorous  
37. Hydrides of phosphorus  
Phosphorous Trihydride, or Phosphine  $\text{PH}_3$   
Properties  
Phosphonium Iodide,  $\text{PH}_4\text{I}$   
Hydrogen Hemiphosphide,  $\text{P}_2\text{H}_4$   
Hydrogen Diphosphide,  $\text{P}_2\text{H}_6$   
Other Hydrides of Phosphorous  
38. Chemistry of sodium  
Mineralogy  
Metallurgy  
Down's Process—Electrolysis of Sodium Chloride  
Castner's Process ( From fused sodium hydroxide)  
Properties  
Technology  
Caustic Soda Industry in India  
39. Copper and its compounds  
Mineralogy  
Extraction  
Extraction from sulphide ores  
Concentration  
Metallurgy furnace for Smelting Copper  
Extraction from Non-Sulphide Ores  
Properties  
Chemical  
Technology  
Cupric Sulphate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$   
Properties  
40. Silver and its compounds  
Mineralogy  
Metallurgy  
Purification  
Properties  
Chemical  
Technology  
Silver Nitrate  
Industrial Applications  
Photography  
41. Gold and its compounds  
Mineralogy

Metallurgy  
Cyanide Process  
Purification  
Properties  
Chemical  
Technology  
Electroplating  
42. Complex salts of copper, silver and gold  
Complex compounds of Silver  
Complex Salts of Gold  
43. Aluminium and its compounds  
Mineralogy  
Extraction  
Metallurgy  
Properties  
Chemical  
Technology  
Aluminium Chloride,  $AlCl_3$   
Properties  
Potash Alum,  $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$   
Amalgam Metallurgy  
44. Hydrides of silicon  
Silicon Tetrahydride, Silicane, or Monosilane,  $SiH_4$   
Preparation  
Properties  
Silicoethane, Disilicane, Disilane,  $Si_2H_6$   
Properties  
Silicopropane, Trisilicane or Trisilane,  $Si_3H_8$   
Preparation  
Properties  
Silicobutane, Tetrasilicane or Tetrasilane,  $Si_4H_{10}$   
Silicopentane,  $Si_5H_{12}$  and Silicohexane,  $Si_6H_{14}$   
Silico-acetylene,  $(Si_2H_2)_n$   
Structural Considerations  
Short Note on Silicones  
45. Chemical and Electrochemical Conversion Treatments  
PHOSPHATING  
Coating Formation  
Process Parameters  
Uses  
ANODIZING  
METAL COLOURING  
ENERGY CONSIDERATIONS  
46. Electrostatic Sealing  
THEORY  
THE TECHNIQUE  
SEAL PROPERTIES  
USE  
47. Photographs of Plant & Machinery with  
Supplier's Contact Details

# About NIIR

**NIIR PROJECT CONSULTANCY SERVICES (NPCS)** is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the related industries.

Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Start up Business Opportunities, entrepreneurship projects, Successful Business Plan, Industry Trends, Market Research, Manufacturing Process, Machinery, Raw Materials, project report, Cost and Revenue, Pre-feasibility study for Profitable Manufacturing Business, Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Business Opportunities, Investment Opportunities for Most Profitable Business in India, Manufacturing Business Ideas, Preparation of Project Profile, Pre-Investment and Pre-Feasibility Study, Market Research Study, Preparation of Techno-Economic Feasibility Report, Identification and Section of Plant, Process, Equipment, General Guidance, Startup Help, Technical and Commercial Counseling for setting up new industrial project and Most Profitable Small Scale Business.

NPCS also publishes various process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

---

**NIIR PROJECT CONSULTANCY SERVICES** , 106-E, Kamla Nagar, New Delhi-110007, India. **Email:** [npcs.india@gmail.com](mailto:npcs.india@gmail.com) **Website:** [NIIR.org](http://NIIR.org)

Wed, 21 Feb 2018 03:12:04 +0530