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.

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. Electropolishing
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 (Sohire)
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, Pb (OH)2 . 2PbCO3
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 PH3
Properties
Phosphonium Iodide, PH4I
Hydrogen Hemiphosphide, P2H4
Hydrogen Diphosphide, P12H6
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, CuSO4 5H2O
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, AlCl3
Properties
Potash Alum, K2SO4. Al2(SO4)3. 24H2O
Amalgam Metallurgy

44. Hydrides of silicon
Silicon Tetrahydride, Silicane, or Monosilane, SiH4
Preparation
Properties
Silicoethane, Disilicane, Disilane, Si2H6
Properties
Silicopropane, Trisilicane or Trisilane, Si3H3
Preparation
Properties
Silicobutane, Tetrasilicane or Tetrasilane, Si4H10
Silicopentane, Si5H12 and Silicohexane, Si6H14
Silico-acetylene, (Si2H2)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
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.


NPCS also publishes varies 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.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.