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Education Guides
to Vacuum Coating Processing

Written by Donald M. Mattox

Titles of some of the sections include:

- Introduction to the Basics of PVD Processing
- Materials Science
- Vacuum Technology
- Plasma Technology
- Surface Preparation
- Vacuum Evaporation
- Sputter Deposition
- Arc Vapor Deposition
- Ion Plating
- Atomistic Film Growth and Resulting Film Properties
- Low-Pressure CVD and PECVD
- Surface and Film Characterization
- Applications
- Safety

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This indispensible publication contains individual, stand-alone, two-page guides on different aspects of the equipment and technology associated with vacuum coating processing by physical vapor deposition.

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Introduction:
- Physical Vapor Deposition (PVD) Processes
- Applications of Vacuum Coatings
- Factors Affecting the Properties of PVD-Deposited Films
- Patents and Copyrights
- Process Flow Chart
- Process Documentation
- Thermal Spray Processes

Materials Science:
- Glass as a Substrate Material
- Atomic Arrangement
- Crystalline Structure by Diffraction Techniques
- Metals as Substrate Materials
- Alloys, Compounds, and Dispersions
- Polymers as Substrate Materials

Vacuum Technology:
- What Is a Vacuum?
- Practical Vacuum Seals
- Heating and Cooling in Vacuum
- Gas Manifolds
- Vacuum Systems for PVD Processing
- Steady-State and "Transit" Conductance
- Deposition Chambers and Vacuum-Surface "Conditioning"
- In-Line Processing Systems
- Fixtures and Tooling
- Vacuum Gauging
- Heating and Temperature Measurement
- Mass Flow Control of Gases
- Reactive Deposition—Gas Control
- Mechanical Vacuum Pumps
- The Return of the Piston Pump
- Oil Contamination from Oil-Containing Mechanical Pumps
- Oil Diffusion Pumps
- Turbomolecular Vacuum Pumps
- Cryopumps, Sorption Pumps, and Cryopanels
- Ideal Gas Law
- Water and Water Vapor
- Leaks and Leak Detection
- Pumpdown—Leakup
- Reactive Plasma Stripping
- Purchasing and Characterizing Vacuum Deposition Systems

Plasma Technology:
- Plasma Chemistry, Etching, and Deposition
- DC Glow Discharges for Sputtering and Biasing
- Pulsed Power for Sputtering and Biasing
- Broad-Beam Reactive Plasma Sources—I: DC Sources
- RF and Microwave Plasma Sources
- Ion (Plasma) Guns
- Arcs, Microarcs, and Flashovers
- Vacuum Gauges for the Plasma Environment

Surface Preparation:
- External Cleaning
- Cleaning Environment
- *In Situ* Cleaning
- Plasma Cleaning
- Substrate Surface Modification
- Surface Energy, Wetting Agents, and Surfactants
- Pure and Ultrapure Water
- Cleaning with CO_2
- Reactive Cleaning
- Enclosed and Closed-Loop Cleaning Systems
- Cleaning Lines
- Substrates for Tribological Coatings
- Rinsing and Drying
- Basecoats for Vacuum Coating
- "Glow Bars" for Plasma Cleaning

Vacuum Evaporation:
- Vacuum Evaporation and Vacuum Deposition
- Vaporization Sources
- Evaporant Materials
- Heating and Cooling
- Substrate Fixturing and Fixture Cleaning
- Reactive Evaporation
- Feeding-Type Thermal Vaporization Sources
- Deposition Rate Monitors

Sputter Deposition:
- Physical Sputtering
- DC Diode Sputter Deposition
- DC Magnetron Sputter Deposition
- Reactive Sputter Deposition
- Sputtering Targets

Arc Vapor Deposition:
- Arc Vaporization and Arc Vapor Deposition

Ion Plating:
- Fundamentals of Ion Plating

Low-Pressure CVD and PECVD:
- Plasma Enhanced Chemical Vapor Deposition (PECVD)
- Atomic Layer Deposition (ALD) and Nanolayer Deposition (NLD)

Atomistic Film Growth and Resulting Film Properties:
- Film Formation by Atomistic Deposition — I
- Film Formation by Atomistic Deposition — II
- Pinholes
- Residual Film Stress
- Ultrafine Particles
- Topcoats and Postdeposition Processing

Postdeposition Processing:
- Anodization of Aluminum Films

Surface and Film Characterization:
- Gases and Vapors in Solids
- Wear of Vacuum Coatings
- Characterization of PVD Films
- Film Adhesion and "Deadhesion"
- Characterization of Surface Morphology
- Scanning Electron Microscopy (SEM)
- Auger Electron Spectroscopy (AES)
- X-Ray Fluorescence (XRF)
- Infrared (IR) Spectroscopy
- Rutherford Backscattering Spectrometry (RBS)
- X-Ray Photoelectron Spectroscopy (XPS)
- Scanning Laser Confocal Optical Microscopy
- Corrosion for Vacuum Coaters

Applications:
- Advanced Mirror Coatings
- Vacuum Web (Roll) Coating
- PVD Coatings on Polymers
- Diamond and Diamond-Like Carbon (DLC) Coatings
- Metallic Thin Film Electrical Conductors
- Optically Transparent, Electrically Conductive Oxide Thin Films
- Reflecting Coatings
- Antireflection (AR) Coatings
- Hard Coatings by PVD
- Ophthalmic Coatings
- Thermal Control Coatings

Safety:
- Safety Aspects of Vacuum Processing
- Safety Aspects of Cleaning

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