Overview of Aluminum Related Coatings and Their Properties and Treatments

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Outline

- Background
- Protective Coating Properties and Treatments
 - Barrier Oxide
 - Porous Oxide
- Reflective Coating Properties
 - Bare Aluminum
 - Protected Aluminum
 - Enhanced Aluminum

Aluminum Background

- Readily available
- Inexpensive
- Good mechanical properties
- Easily machineable
- Oxidation tarnishing
- Highly reflective

Protective Coating: Barrier Oxide



- Formed by electrolysis process
- Supports high electric field; ~
 1 volt / nm
- At breakdown voltage of ~1000 volts, the oxide thickness is about 1um
- Substantial improvement over naturally oxidized layer (of ~2-3nm) but may not be enough for some industrial applications

Protective Coating: Porous Oxide



- Also formed by electrolysis process but with more soluble acidic electrolyte
- Oxides are dissolved to create porous structures
- Easily achieve porous film of 100um or thickner
- Does not require high voltage
- Must be sealed after oxide growth
- Different anodizing roughness and color options by proper combination of pore/cell sizes and color dyes

Reflective Coating: Bare Aluminum



- Highest reflectance of any metal in the 200-400nm and 3-10um range
- Above 90% average
 reflectance from 400-1200nm
- 2-3 nm thick of naturally forming barrier oxide
- Fine corrosion resistance in normal environment
- Prone to corrosion in harsh or changing environmental conditions
- Hard to clean and can be easily scratched
- Not sensitive to light polarization or angle of incidence

Reflective Coating: Protected Aluminum



- Typically coated with either disilicon trioxide or magnesium fluoride depending on incident light spectrum
- Improved corruption resistance and rugged enough to withstand ordinary handling and cleaning
- Some sensitivity to light polarization and angle of incidence
- Lowerd average reflectance across the visible spectrum

Reflective Coating: Enhanced Aluminum



- Used for improved optical performance and high reflectance
- Typically consist of multiple layers of customized dielectric coatings
- Can be expensive
- Similar ruggedness and durability as protective aluminum
- Very sensitive to light polarization and angle of incidence

Enhanced Aluminum: Optical Properties



- Leftward shift of spectral reflectance as function increased angle of incidence
- Peak reflectance is reduced with increased angle

Q&A:

Thanks!