
2017 Continued Advancements in Decorative PVD Chromium Coatings



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2017 Updates for SUPERCHROME PVD Coating



Discussion Topics



- Current/Future Status: Chrome in EU
 - REACH Initiative
 - ECHA European Chemicals Agency
 - Volumes
- PVD advantages
- Recent SUPERCHROME PVD Coating developments
- Summary



REACH and ECHA - Refresher



- REACH (EC 1907/2006): The Regulation also calls for the progressive substitution of the most dangerous chemicals (referred to as "substances of very high concern") when suitable alternatives have been identified
- Cr6 or Chrome Trioxide is a substance of very high concern
- ***Late 2016 and early 2017:***
Very Active dialogue between ECHA and concerned parties on both sides of the POP/Industrial equation: Traditional Chrome platers and PVD Chrome alternatives- TBD what extensions may be granted.....



Global POP Market Growth Trends*

- In 2016:
 - 91 million square meters
 - \$403 million USD
- In 2023:
 - 142 million square meters
 - \$650 million USD
- Europe & Asia: 73%, USA 21%
- ABS, PC, ABS/PC: 91%
- Automotive market: 80%

Advantages of SUPERCHROME PVD Coating



- Bright or dark, gloss or matte
- REACH-conform
- Environmentally-friendly
- Corrosion resistance
- Safety

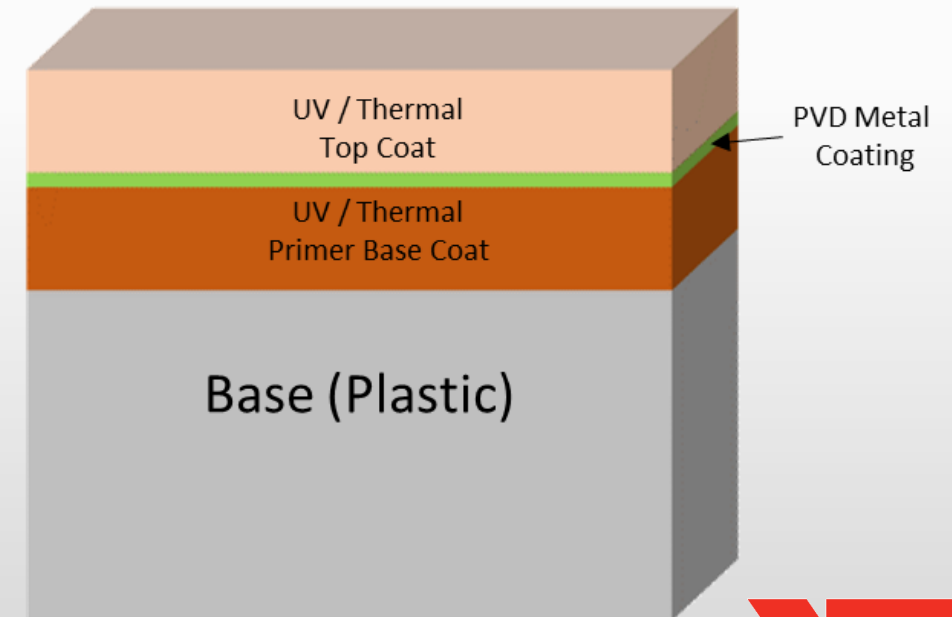
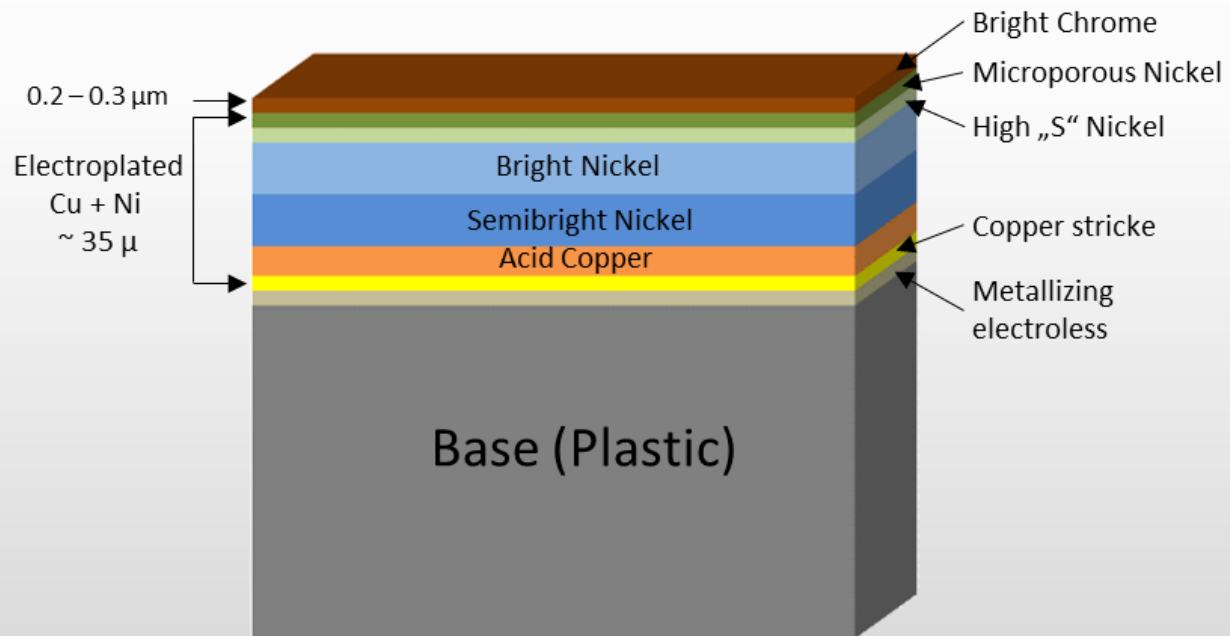


PVD Metallizing versus Chrome Plating

Chrome Plating



PVD Metallizing Traditional Triple Stack: Base Coat/PVD/Top Coat

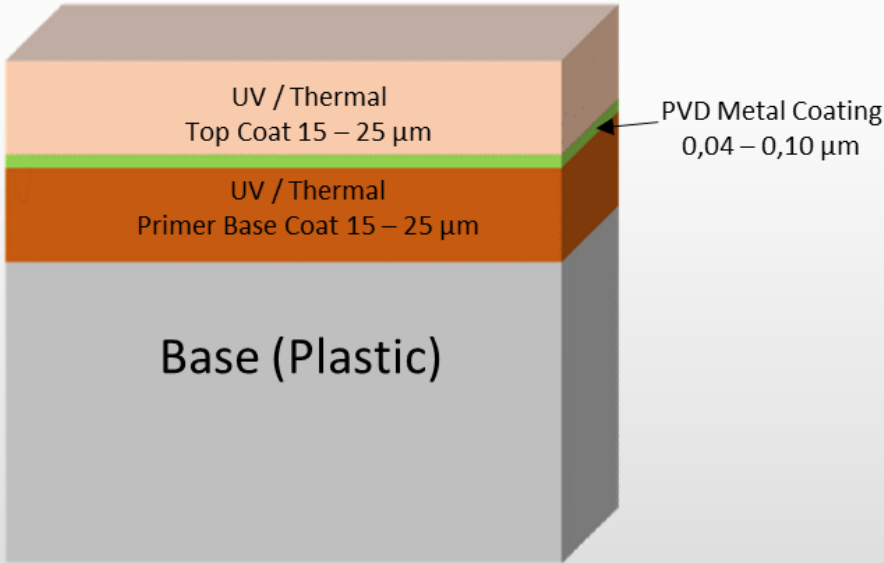


SUPERCHROME PVD Coating vs. Triple Stack Coating

PVD Metallizing

Traditional Triple Stack:

Base Coat/PVD/Top Coat



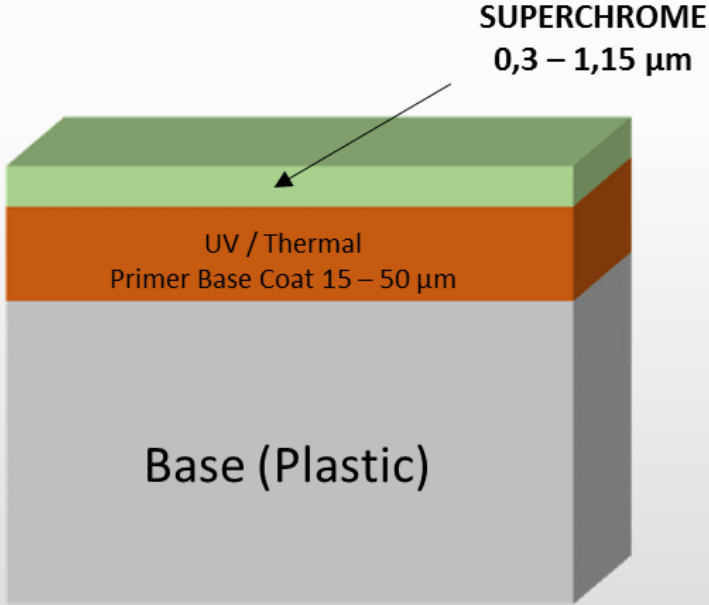
Top Coat alters visual appearance

SUPERCHROME PVD Coating

Double Stack:

Base Coat/PVD

No Top Coat necessary



Natural Chrome Color

Functionality and Design Choices

- **Substrate materials:**
PC/ABS, ABS,
- **Temperature range:** -40° to 85°C
- **Full integration** into paint lines using UV-cured base coat
- **Day/Night Design** with laser etching
- **Radar-Transparency**
metalized components do not block crash avoidance and lane changing monitoring systems
- Integration of **Capacitance Sensing**



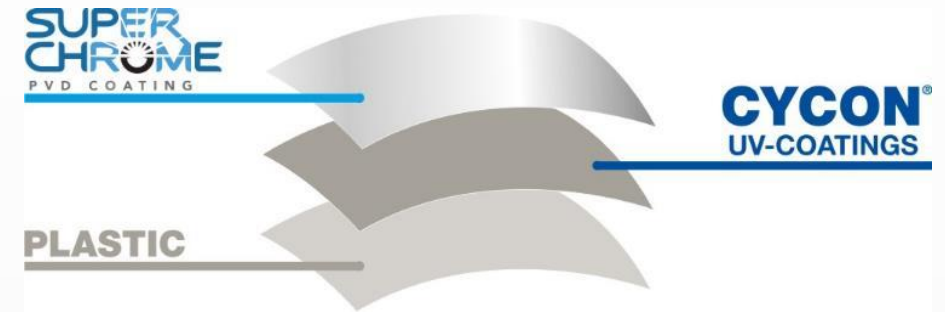
SUPERCHROME PVD Coating

Versatile & Durable



Two Layer Decorative Coating for Automotive Interior/Exterior Parts:

- Substrate + UV-Base Coat + SUPERCHROME PVD Coating: No top coat necessary
- Possibility to apply on different plastics and metal alloys
- Several UV-cured base coats (Mankiewicz) for different SUPERCHROME PVD Coating finishes tested and approved
- No corrosion risk, excellent adhesion, thermal stability and humidity resistance



UV Base Coat for SUPERCHROME PVD Coating PVD Coating



- Superior product properties
 - Specification-compliant properties: mechanical and chemical resistance
 - Excellent surface for support and adhesion of PVD coatings
- Short process times
 - CYCON® UV coatings are fully cured within seconds
 - Complete elimination of oven drying
- Low capital expenditure requirements:
 - Requires less production floorspace
- Shorter processing saves energy and investment costs
- Low VOC



UV Streamlines Manufacturing for Profitability



3 – 5 min



- Short, fast processing time
- Low scrap rate
- Smaller footprint than thermal cure paint lines
- Integrates into LEAN synchronous manufacturing



Technical Performance: Met or Exceeded

- Formal Specifications

- Appearance
- Adhesion
- Weathering
- Mechanical
- Chemical resistance



S1 ➤ S2

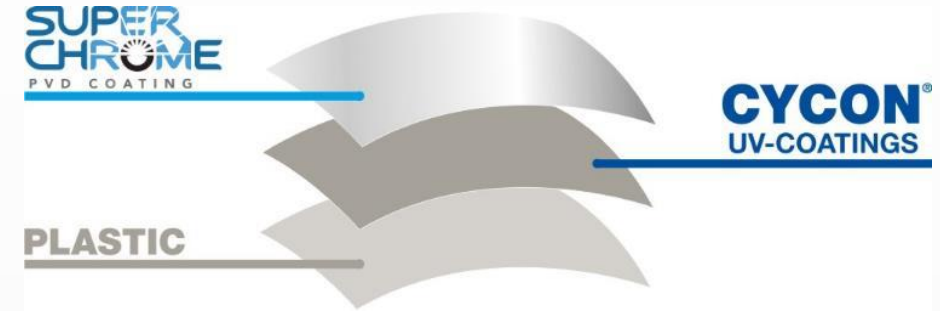
- New Attributes

- Weight savings
- Flexibility
- Laser etch ➤ day/night
- Capacitive sensing



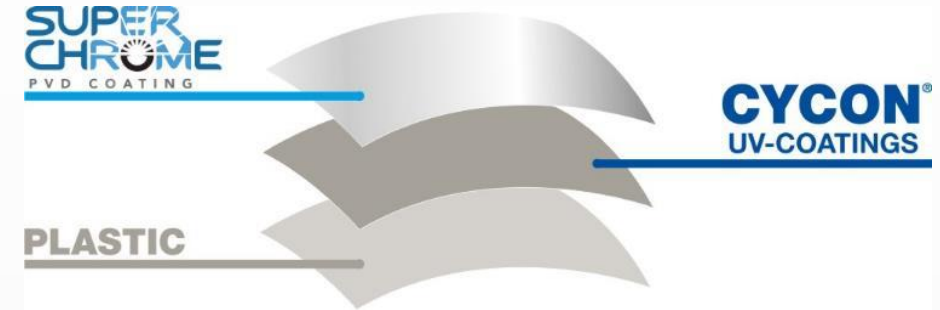
Test Results – Visual, Adhesion, Weathering

Standards Tested - Visual, Adhesion, Weathering	SUPERCHROME with UV Base Coat
Visual Appearance Interior VW TL226	PASS
Initial Adhesion Interior VW TL226 & Exterior VW TL211/528	PASS
Visual Appearance after 2d 60°C Interior VW TL226	PASS
Adhesion after 2d 60°C Interior VW TL226	PASS
Visual Appearance after 24 h 90°C Interior TL226	PASS
Visual Appearance after Constant Climate 240h 40°C, >96% relative humidity Interior VW TL211	PASS
Adhesion after Constant Climate 240h 40°C, >96% relative humidity VW TL211	PASS
Artificial Aging UVB Procedure A PSA B72 0200/2013-04	PASS
Water Absorption BAC FORD PSA B72 0200/2013-04	PASS
PV1200 Climate Change Test VW TL211	PASS
Neutral Salt Spray VW TL528	PASS
Salt Spray ASTM B117-11	PASS 1000 Hours
CASS	PASS 120 Hours
PV3930 Florida Sunshine VW TL211	PASS 2400 Hours
Russian (CaCl ₂)Mud per ASTM B995	PASS 336 Hours
Hydrolysis 95°C, 95% RH, 72 hour	PASS



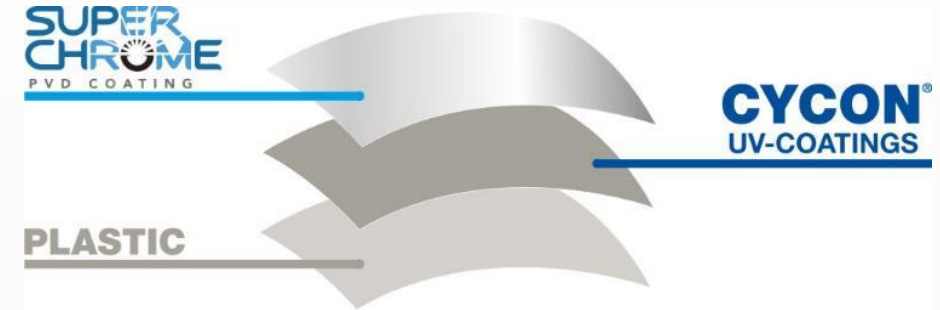
Test Results - Mechanical

Standards Tested - Mechanical	
Resistance to Gritting Renault 47-03-003/L-2013	PASS
Stone Chipping, VW TL211	PASS
Stone Chipping, PSA B72 0200/2013-04	PASS
Gravelometer/70 CASS	PASS
Resistance to Scratching by Abrasion Renault 47-03-003/L-2013	PASS
Crockmeter BMW Exterior	PASS
Car Wash Brush Resistance VW TL211	PASS
Abrex	PASS
Martindale	PASS



Test Results - Chemical

Standards Tested - Chemical	
Cream A Interior VW TL226	PASS
Cream B Interior VW TL226	PASS
High Pressure Cleaning VW TL 211	PASS
Hydrolysis Interior BMW	PASS
FAM test fuel VW TL211	PASS
Gasoline E10 VW TL211	PASS
Diesel B7 VW TL211	PASS
Isopropanol VW TL211	PASS
Ethanol/Water Exterior BMW	PASS
Sodium Hydroxide 5% VW TL211	PASS
Sulfuric Acid 10% VW TL211	PASS
Hydrochloric Acid 10% VW TL211	PASS
Hydorchloric Acid 30% Suspended in Vapors	PASS 24 Hours
Bird Droppings VW TL211	PASS
Liquid Tree Pitch VW TL211	PASS
Vomit Exterior BMW	PASS
Deionized Water Exterior BMW	PASS
Wheel Cleaner Exterior BMW	PASS
Underbody Sealant BMW	PASS



SUPERCHROME PVD Coating System

Integrated production - Batch



SUPERCHROME 660

PVD Coating System

- Batch-type rapid cycle metallizer
- Sputter-coating
- Deposit metals such as chromium, aluminum, brass, copper, stainless steel, nickel - chrome alloys, etc.



Molding

Cleaning

CYCON UV-Coating
Paint Line

SUPERCHROME PVD
Batch System



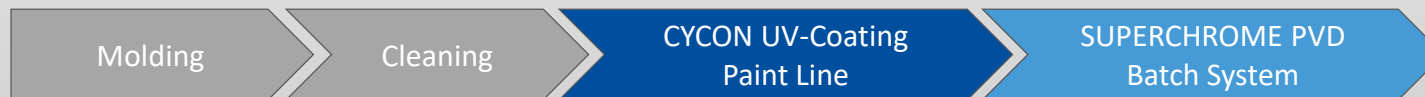
SUPERCHROME PVD Coating System

Integrated production - Batch



SC 660 PVD Coating System

- Single-point loading and safety enclosure
- Robotic load/unload available



Substrate Coating Zone



- Coating zone 2.725 square meters
- Single or dual axis rotation, optimizes coating zone
- Load/Unload fixtures off line
- Double door design minimizes open vacuum chamber time
- 4 cycles per hour, 22,880 cycles per year or 62,348 coated square meters per year
- Capital Expense for painting and PVD equipment (\$2mm) amortized 5 years = \$3.21 per square meter

Latest Developments

- US Patent Approved, EU/Asia Pending
- Daimler grants S1 Approval, S2 trials currently underway with parts on cars.
- Field test at Volvo Trucks and Opel ongoing
- First European installation and commissioning of SUPERCHROME PVD Coating system in France: Société de Peinture sur Pièces Plastiques (SPPP)
Tier 2 Supplier to EU Tier 1's

Latest Developments



- Matte finishes continue to be improved
- SUPERCHROME PVD Coating on Steel and Aluminum Wheels in USA
- “Black Chrome” Advancements
- Cost models continue to demonstrate 10-20% savings over POP



Conclusions



- PVD process and equipment technology is making strong headway for safe replacement of some applications of electroplated chromium on plastic substrates
- SUPERCHROME PVD Coatings are gaining acceptance for internal and external automotive applications as well as for use in sanitary and appliance markets

Thank You!



Our European distributor for sales and service
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