Interior Color & Appearance Technologies

Bruce Mulholland
Global Color Technology Manager
Overview of Topics:

- Appearance Products Overview
  - Low Emission/Low VOC Technologies
  - Controlled Gloss Resins
  - MetaLX<sup>tm</sup> molded-in-metallic resins
  - Decoration Technologies
    - Lasermarking (functional)
Historically, interior design features were painted to achieve:
- A desired color
- A desired level of UV performance
- A desired level of gloss (i.e., low gloss)
- A desired appearance effect (i.e., metallic)
Celanese Appearance Polymers

► Provides “Green” solution
  – Eliminate VOC’s from paint process
  – Eliminate chemical handling/disposal for painting and plating operations
  – Ability to recycle molded-in-color resins

► Lower part cost (“Green”) versus painting or plating
  – Typical savings: $1/part
  – Eliminate secondary operation
  – Eliminate warranty claims
  – Eliminate multiple tools/materials required for trim level differentiation

Celanese Appearance Polymers provide the solution for both drivers
Risks of Chromed and Painted Parts Exposed to Heat, Chemicals, and the environment

► Bubbling
► Peeling
► Cracks
► Severe issues can lead to recalls

Recalls are Expensive and Time Consuming
Getting “Green” Without the Paint

- What’s your objective?

Celanese Appearance Polymers get you Green either way
Getting “Green” Without the Paint

► Replacing painted or plated resins
  – Eliminate paint VOCs and chemicals/solvents

► Initiative within most major industries

<table>
<thead>
<tr>
<th>Automotive</th>
<th>Cosmetic Packaging</th>
<th>Kitchen &amp; Bath</th>
<th>Consumer Electronics</th>
<th>Appliances</th>
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<td><img src="image1" alt="Automotive" /></td>
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  - **Controlled Gloss Resins**
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Controlled Gloss Materials

Tailor Formulation

- Glossy: specular reflection
- Dull/matte: diffuse reflection
What is Gloss?

- Incident light beam
- Specular reflection
- Diffuse reflection

60°

glossy: specular reflection

dull/matte: diffuse reflection
What is Gloss?

- Glossy: specular reflection
- Dull/matte: diffuse reflection

Incident light beam

- Specular reflection
- Diffuse reflection

60°
Grade: SX90Z XAP2

► Piano Black
  
  - High gloss, jet black
    
    - Significantly darker, jetter compared to POM standard black (UV90Z CD3068, C 9021 LS 14)
    - UV Stability same as UV90Z
    - Jetter compared to competitive ABS piano blacks
GM strives to boost profits through better interiors

Trends in Automotive: Appearance

GM strives to boost profits through better interiors

By Rhoda Miel
PLASTICS NEWS STAFF

Detroit — Automakers are putting a new emphasis on interior design. They are trying to make car and truck interiors more functional and user-friendly, and they’re looking to acknowledge the little touches that bring car buyers back to their brands.

Why then, industry followers ask, do some vehicle interiors still appear as if they are not on time with today’s automotive market?

The award-winning Ford Thunderbird interior brings the exterior body color inside.

Introspective automakers realizing it’s what’s inside the car that counts

Clever designs can spark breakthroughs

DaimlerChrysler offers indirect lighting incorporated into the headliner on its Mercedes-Benz CLS and S class. The feature allows certain front interior lights to be dimmed without affecting the amount of light in the rear of the car.

BMW's 2006 7 series features illuminated strips in the door panels that make it easier to find switches. At the same time, the subtle lighting gives the car a more relaxed feeling.

To make interiors more comfortable, carmakers are replacing plastics with traditional materials such as leather, wood and fabrics on seats, door panels and instrument panels.

“Quality and craftsmanship will rule interior designs,” said Monty Callans, Mazda’s design director.

Introspective automakers realizing it’s what’s inside the car that counts

“Creating a better interior ambiance is important because people cannot drive fast on today’s congested roads,” said Mutlu Gurak, Volkswagen Group’s design director.

“People spend a lot more time in their cars waiting in traffic, so they have time to look around and notice the inside of their cars,” Gurak said.

On the 2006 Passat sedan, VW has integrated the color and style of the instrument panel and door panels so they appear as a single unit that enhances the car’s occupants. VW also is using better-quality materials and fabrics in the Passat.

Peugeot is working on interior design innovations. Owners of the new 1807 small minivan can pull out and change interior trim pieces such as the instrument panel air vents or the seat inserts.

“You can modify the interior to taste by replacing smaller trim pieces with different colored pieces,” said Bette Brille, project manager for the Peugeot 1807.

“Designers agree that lighting is playing an increasingly important role in improving interior ambiance.

“Special lighting effects can improve people’s feeling of well-being inside a car,” said Stefan Shlaib, director of DaimlerChrysler AG’s interior competence center.

The award-winning Ford Thunderbird interior brings the exterior body color inside.

Introspective automakers realizing it’s what’s inside the car that counts

...
Controlled Gloss Materials: Low Gloss

1. Tool surface texture / vapor honing
   - Does not yield desired low gloss with most polymers by itself
   - High tool maintenance

2. Painting or other secondary process
   - Generally higher cost and scrap

3. Use inherently low-gloss material UV140LG XAP
   - Requires no additional part handling or secondary processing
   - Environmentally friendly: Eliminates harmful VOCs and disposal costs associated with painting
   - Enables regrind use to reduce scrap
   - Eliminates need for expensive custom paint fixtures

Hostaform® UV140LG XAP is the most cost-effective solution
Controlled Gloss Materials: Low Gloss

Conventional Acetal

Low Gloss Acetal
UV140LG XAP
Controlled Gloss Materials: Low Gloss Hostaform UV140LG XAP

- Achieves desired low gloss
  - General Motors Gloss “GLG”
  - Ford Gloss “K”
  - Chrysler approved

- Achieves the desired color

- Achieves the desired UV performance

- Low emissions (< 10 ppm VDA 275)

- Other attributes:
  - Soft touch, warm, matte-feel as-molded
  - Resistant to cleaning solutions
  - Excellent dimensional stability
  - Retains design flexibility of acetal
    - Example: snap-fits
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# Getting “Green” Without the Paint

## Interior Door Handle – Trim Level Differentiation

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<th>Low Trim</th>
<th>Mid Trim</th>
<th>High Trim</th>
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<tbody>
<tr>
<td>Ford Focus</td>
<td>Black</td>
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<td>Chrome</td>
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<td>Chrome</td>
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Getting “Green” Without the Paint

- Chrome plated handle molded from PC/ABS
  - Secondary plating operation $\$
- Black color molded from GF nylon
- Requires a minimum of two separate molds $\$
- Generally involves two separate molders $\$
- Two specifications and two material/part qualifications $\$

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Trim differentiation historically costs money & adds complexity
Get “Green” Without the Paint

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Design elements push down from luxury trim levels to economy
Getting “Green” Without the Paint

Celanese Appearance Polymers Solution

- Metallic colors molded from UV POM
- Black molded from UV POM
- Interior matched colors molded from UV POM
- Other colors/effects/dye diffusion for special editions
- One mold, one molder
- One spec, one material/part qualification

Celanese Appearance Polymers offer greater trim level differentiation at lower cost
MetaLX™ molded-in-metallic resins

Mold design/injection molding challenges

- No visible flow lines
- Uniform surface
- Acceptable processing window
  - CAD/MoldFlow for gate location, flow line prediction
  - Molding studies for gate size/geometry
  - Key process parameters understood

Leadership Position with Design/Molding Technology
Painted PC/PET
Molded-in-Metallic
Hostaform LX90Z
Painted PC/PET
MetaLX™ Hostaform® Acetal Copolymer
2011 Honda Odyssey – Front & Side Door Handles
MetaLX™ Hostaform® Acetal Copolymer
General Motors Chevy Cruze

Steering Wheel Bezel
Getting “Green” Without the Paint

Achieve the desired metallic look with MetaLX™ POM

► Other colors available: Anodized, Bronze, Brass, etc.
**Scratch Resistance**

- **Test Name:** 5-Finger Scratch Test
- **Test Method:** Ford FLTM BN108-13(01)
- **Force:** 2N force used
- **Pin Diameter:** 1mm and 7mm pins used

<table>
<thead>
<tr>
<th>Grade</th>
<th>Color</th>
<th>Pin Diameter</th>
<th>Scratch Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>LX90Z</td>
<td>Satin Chrome</td>
<td>1 mm</td>
<td>Rating = 1</td>
<td>Meets Requirements</td>
</tr>
<tr>
<td>LX90Z</td>
<td>Satin Chrome</td>
<td>7 mm</td>
<td>Rating = 1</td>
<td>Meets Requirements</td>
</tr>
<tr>
<td>LX90Z</td>
<td>High Gloss</td>
<td>1 mm</td>
<td>Rating = 1</td>
<td>Meets Requirements</td>
</tr>
<tr>
<td></td>
<td>Satin Chrome</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>LX90Z</td>
<td>High Gloss</td>
<td>7 mm</td>
<td>Rating = 1</td>
<td>Meets Requirements</td>
</tr>
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*Hostaform® MetaLX™ POM meets typical scratch resistance requirements*
Hostaform® MetaLX™

► Abrasion Resistance

- Method: WSS-M2P188-A1, 3.6.3
- Abrasive Wheel: CS-10
- Load: 500g
- Vacuum Pickup: 65%
- Cycles: 1,000

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<th>Color</th>
<th>Visual Evaluation</th>
</tr>
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<tr>
<td>LX90Z</td>
<td>Satin Chrome</td>
<td>Slight loss of gloss; no loss of grain pattern</td>
</tr>
<tr>
<td>Painted PC/ABS</td>
<td>Metallic Silver</td>
<td>Mild abrasion and discoloration</td>
</tr>
</tbody>
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Hostaform® MetaLX™ POM out performs painted PC/ABS in abrasion testing
Hostaform® MetaLX™

**Resistance to Suntan Lotion**

- **Test Method:** Ford FLTM 113-08(08)
- **Exposure Time:** 24 hours @ 23°C
- **Requirement:** Visual Rating

<table>
<thead>
<tr>
<th>Grade</th>
<th>Color</th>
<th>Agent</th>
<th>Comments</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>LX90Z</td>
<td>Satin Chrome</td>
<td>Suntan Lotion</td>
<td>No visual change</td>
<td>Rating 1 (best)</td>
</tr>
<tr>
<td>Painted PC/ABS</td>
<td>Metallic Silver</td>
<td>Suntan Lotion</td>
<td>Discoloration/spotting</td>
<td>Rating 2</td>
</tr>
</tbody>
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Hostaform® MetaLX™ POM outperforms painted PC/ABS in resistance to suntan lotion
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► Decoration Technologies
  – Lasermarking (functional)
Traditional Marking Technologies

- Adhesive Labels
- Pad Printing
- Ink-jet Printing
- Ink Filling
- Sublimation Printing
- Embossing and Stamping
- Two-shot, two-color molding

Issues

- Inventory & Costs of Printing Supplies
- Solvent Disposal Issues & Costs
- Complex Operation
- Long Set-up & Process
- Limited Durability
Laser Marking

Advantages
- Indelible marks
- No surface contact
- Sharp images
- No pre-/post-treatment
- No solvents/disposal
- Precise placement
- Quick changes via software
- 2-D-Symbology
- No effect from surface moisture
- Low operating costs
- Low maintenance

Disadvantages
- Localized heat generation
  • Reduced by shorter pulse lengths
- Higher capital costs
  • Prices decreasing
- Limited color capability
  • Technology expanding
Laser Marking

► Can mark recessed surfaces
Functional Laser Marking Applications

► Barcodes
  – 1 dimensional
  – High and low reflectance converted to 0s and 1s
  – Read by laser or camera
  – About 20 alphanumeric character limit
  – Requires ~80% contrast from substrate
  – Requires up to several seconds to mark by laser

► Data matrix codes
  – 2 dimensional
  – Read by camera
  – 25 – 100 times more information than barcodes
  – Size 10 to 100 times smaller than barcodes
  – Requires ~20% contrast from substrate
  – Typically marked in milliseconds
Functional Laser Marking Applications

► Machine Vision Code
  – Unique unit level identification
  – Track part from manufacture to end-of-life
    – Date & time of manufacture
    – Equipment ID
    – Operator ID
    – Material ID
    – Material batch number
    – Other parameters
Laser Marking

Wear Resistance of Image  Taber Abrasion ASTM D4060  Acetal Copolymer Samples

Before Test

After Test

Pad Printed  Laser Marked
Lasermarkable Acetal Copolymer
Celcon LM90/LM90Z  Nd:YAG Laser

High contrast white marks on black substrate
Lasermarkable Acetal Copolymer
Celcon LM90/LM90Z  Nd:YAG Laser

► Half-tone images
Lasermarkable Acetal Copolymer
Celcon LM90/LM90Z  Nd:YAG Laser

► White marks on colored substrate
Colored marks on black substrate
Lasermarkable Polyester PBT

PBT Polyester
- Indelible marks even in harsh chemical environments such as under-the-hood
- Enabling coding for high temperatures
- Eliminates more costly options such as adhesive labels

30% Glass/PBT

Glass/FR PBT
Lasermarkable Technology

► Laser marking generally offers a cost reduction versus conventional labeling techniques such as pad printing
► Laser marking creates extremely sharp indelible images with surface contact or smudging
► Laser marking allows precision placement of marks even on irregular, recessed or curved surfaces
► Laser marking enables quick design changes and unique unit level identification via computer interface
  – Ideal for data matrix code identification
► Enhanced lasermarkable engineering resins are available in a wide range of products to produce numerous combinations of substrate color and laser mark color

Celanese Lasermarkable Grades provide alternative decorating solutions
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