Electroplating of PA

Lanxess HK
Semi-Crystalline Product
Asia Pacific
Introduction

• Electroplating can provide a durable, high quality finished for variety of application.

• Many polymers can be electroplated, but only few can provide good adhesion and appearance required by high performance application.

• Special plating ABS and PA grades meets the requirement of many demanding automotive and appliance applications.
Electroplating Process

• Prior to the electroplating process, the non-conductive plastics surface must first undergo an electroless chemical process to deposite a conductive metal layer.

• The electroless process usually involves immersing the parts in series of special formulated, aqueous bath and rinses to clean, etch and activate the part surface.

• A metal layer, such as copper is chemically deposited on the part surface. After this treatment, more conventional metal-plating methods apply additional metal to the now-conductive layer, like nickel.
Electroplating Process of Polyamide

• The electroplating principle for PA is similar to plating ABS.

• In case of ABS, the polybutadien particles will be dissolved or removed by chromic acid, in case of PA the pre-treatment removes the amorphous sections mainly by glycol.

• This requires semicrystalline surfaces with high amount of amorphous sections.

• The less crystalline the surface, the better the plating result.

• Filler content (glass fiber or mineral) should not exceed 50% (lower adhesion)

• Black Polyamide cannot be plated
Electroplating Process of Polyamide

Best metallization results by following these rules:

- Tooling temperatures from 40 to 80 °C
- Noncrystalline surface of the plastic part (no mechanical treatment after the molding process)
- No use of releasing agent
Electroplating Process of Polyamide

- Before etching
- After etching
### Standard PA Plating Sequences - Atotech

**Plating on Plastics**

**Noviganth PA**

Standard Process Sequence and Products

<table>
<thead>
<tr>
<th>Standard Process Sequence</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swelling</td>
<td>♦ Sweller Noviganth PA Plus / HCl</td>
</tr>
<tr>
<td>Conditioning</td>
<td>♦ Conditioner Noviganth PA</td>
</tr>
<tr>
<td>Pd - Activation</td>
<td>♦ Noviganth Activator PA</td>
</tr>
<tr>
<td>Reducer</td>
<td>♦ Noviganth Reducer PA</td>
</tr>
<tr>
<td>Electroless Nickel</td>
<td>♦ Noviganth Ni PA</td>
</tr>
<tr>
<td>Nickel - Strike</td>
<td>♦ e.g. Permalume G</td>
</tr>
<tr>
<td>Electrolytic Metallization</td>
<td>♦ e.g. Cupracid 300 or CuFlex 330</td>
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<tr>
<td></td>
<td>♦ Unibrite B100, CR 843 Chrome</td>
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</tbody>
</table>
Material Selection

Glass Filled Material VS. Mineral Filled Material

- The mineral filler has no special function for plating. The mechanical bond between resin and metal is provided by dissolving/removing the amorphous areas at the PA-surface of the molded parts. This creates a micro-rough surface with very small undercuts, which allow the metal to fix/bond to the resin.

- Glass fibers provide additional micro-rough undercuts, allowing the metal to bond better. Therefore, glass fiber reinforced grades tend to show better adhesion than mineral filled grades.

Impact modifier

- Impact modified grades provide better adhesion than standard grades.
- It is presumed that the impact particles act like Polybutadien in ABS.
Lanxess Polyamide Grades for Electroplating

- Durethan BKV115 (PA6-GF15, impact modified)
- Durethan BKV130 (PA6-GF30, impact modified)
- Durethan BM240 (PA6-M40)
Service Provider for Electroplating Polyamide

• Keim Werdohl/Germany (http://www.keim-gmbh.de)
• DGM (http://www.dgm-gmbh.de/wir.htm)
• Saxonia (http://www.saxonia.de/Unsere_Produkte/Galvanote/galvanote.html)
• AHC
• Mc Dermid Hong Kong (Mr. Jeff Brassard)
• PAL Hong Kong (construction of plating lines)
• Shipley
• Schaal
• Atotech
Composition of Galvanic system
Composition of Galvanic system
Typical Galvanic System in Automotive

- Chemical Nickel: 0.01-0.1 µm
- Nickel Strike: about 0.1 µm
- Glossy Copper: about 20-30 µm
- Glossy Nickel: about 10-15 µm
- Glossy Chromium: up to 0.3 µm

Above 0.3 µm Chromium should be applied with micro-cracked surface.
Factors Affecting Electroplating Result

- Design
- Injection molding processing
- Electroplating processing
- Material Selection
Design Considerations

• Electric current density distribution over the part surface determine plating thickness.

• High current at edge, notch and outside corner can leads to excess plating buildup.

• Recess area at lower current densityies and tends to plate thinner than other areas.
Design Consideration – Planting Buildup

Better

Better
Design Considerations

• Apply a radius of at least 0.01 inch in to plated edge.
• Include a minimum 1/16 inch minimum radius on all outside corners.
• Avoid extreme recesses that could lead to inadequate plating thickness.
• Avoid features that may trap air during immersion in the baths, or hinder rinsing afterwards.
• Design clamping points that secure the part on the rack without flexing it.
• The wall thickness should be between 1.5 mm and 3 mm to prevent high molded-in stress.
• Avoid holes or recesses which can carry liquids from one chemical bath to the other.
• Avoid gating points in or near visible areas with cosmetic requirements.
Molding Considerations

• The molds must be absolutely clean. No demolding agents, greases or oils are allowed.

• Molding process affects the plating adhesion and end-use performance directly.

• High molded-in-stresses on the part surface can reduce adhesion and leads to cracking, blistering and warping in the plated parts.

• Proper drying prevent moisture-related surface defects that could appears worse after plating.

• Relatively low mold temperatures are recommended. If the mold temperature is high, there will be too less amorphous material at the surface which will affect the adhesion.

• Recycled material cannot be used.
Electroplating Considerations

- Swelling time should not be too long, otherwise, too much material is dissolved and the adhesion will be lower.

PA, after 7 min swelling

PA, after 15 min swelling
Another defect caused by over-swelling process is the formation of holes and bubbles.
Other Considerations

• Assuring that all molded part surfaces are free from oil, grease and contamination.

• Designing part and mold to facilitate the part ejection without mold-release agents, especially silicone.

• Using self-lubricating ejector pin to oil contamination.

• Designing and maintaining mold and parting line carefully to prevent sharp and ragged edges that could exaggerated by the plating process.

• Position the gate out-of-sight and trimming gate cleanly.

• Applying a light satin-finish to the mold cavity surface to enhance plating adhesion on the molded surfaces.
Segregation Failure

- Prevalent aftereffect is a poor adhesion of the metal layer to the polymer surface
- Reason mostly "over-activation" caused by carrying off activator substrate into the chemical Ni-bath
Failure Caused by the pollution of Cu Bath
Cross Hatch Test
Adhesion Test
Adhesion Test
Thank You.