Electroplating of PA

Lanxess HK

Semi-Crystalline Product

Asia Pacific

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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.

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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

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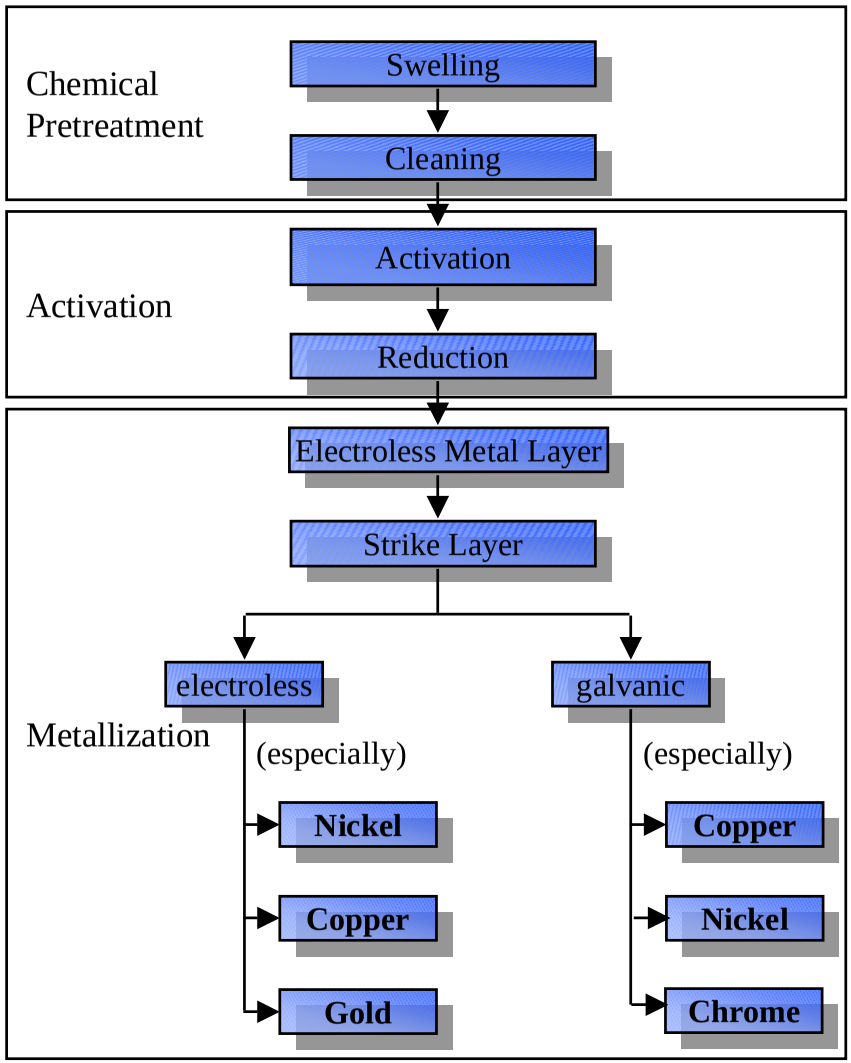
Electroplating Process of Polyamide



Best metallization results by following these rules:

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

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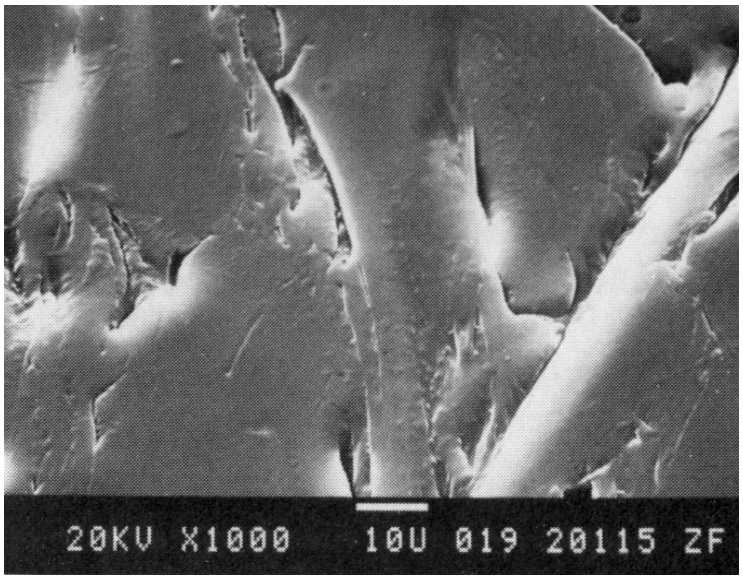
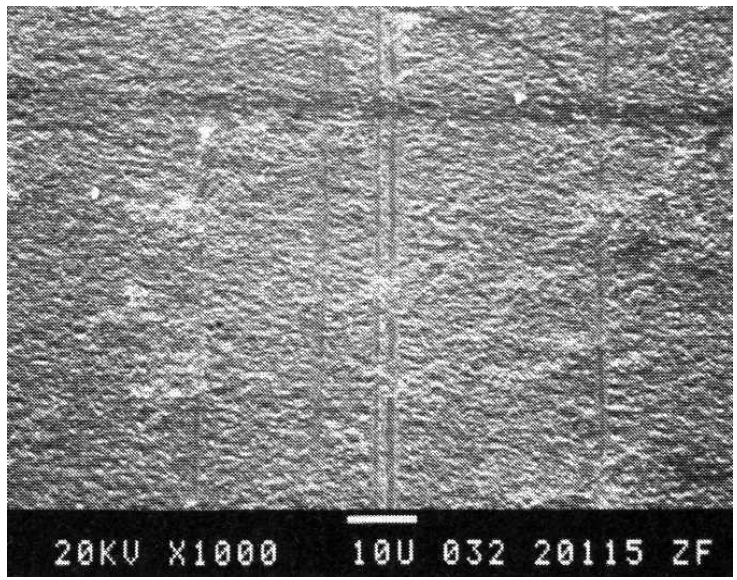
Electroplating Process of Polyamide

- Before etching



- After etching



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Standard PA Plating Sequences - Atotech

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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 persumed that the impact particles act like Polybutadien in ABS.

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Lanxess Polyamide Grades for Electroplating

- Durethan BKV115 (PA6-GF15, impact modified)
- Durethan BKV130 (PA6-GF30, impact modified)
- Durethan BM240 (PA6-M40)

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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

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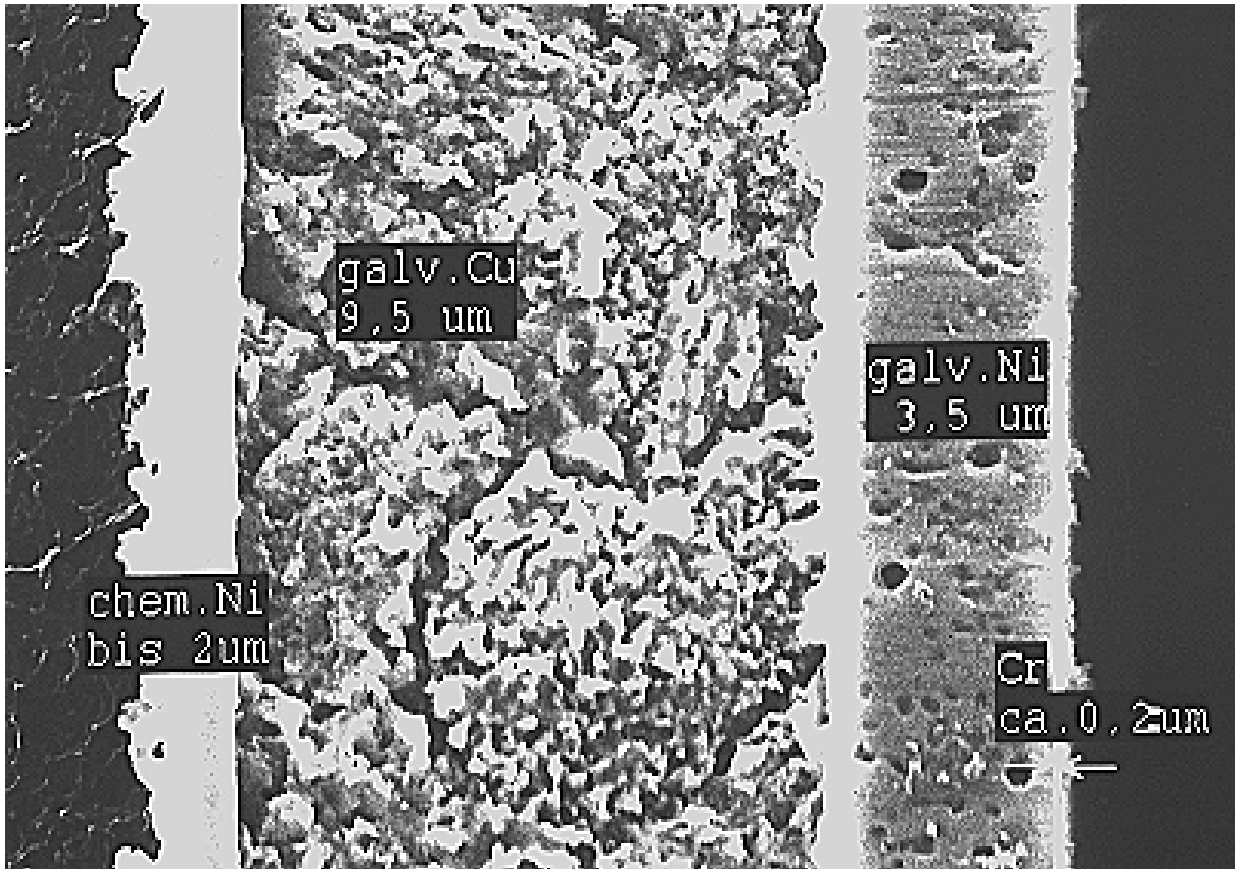
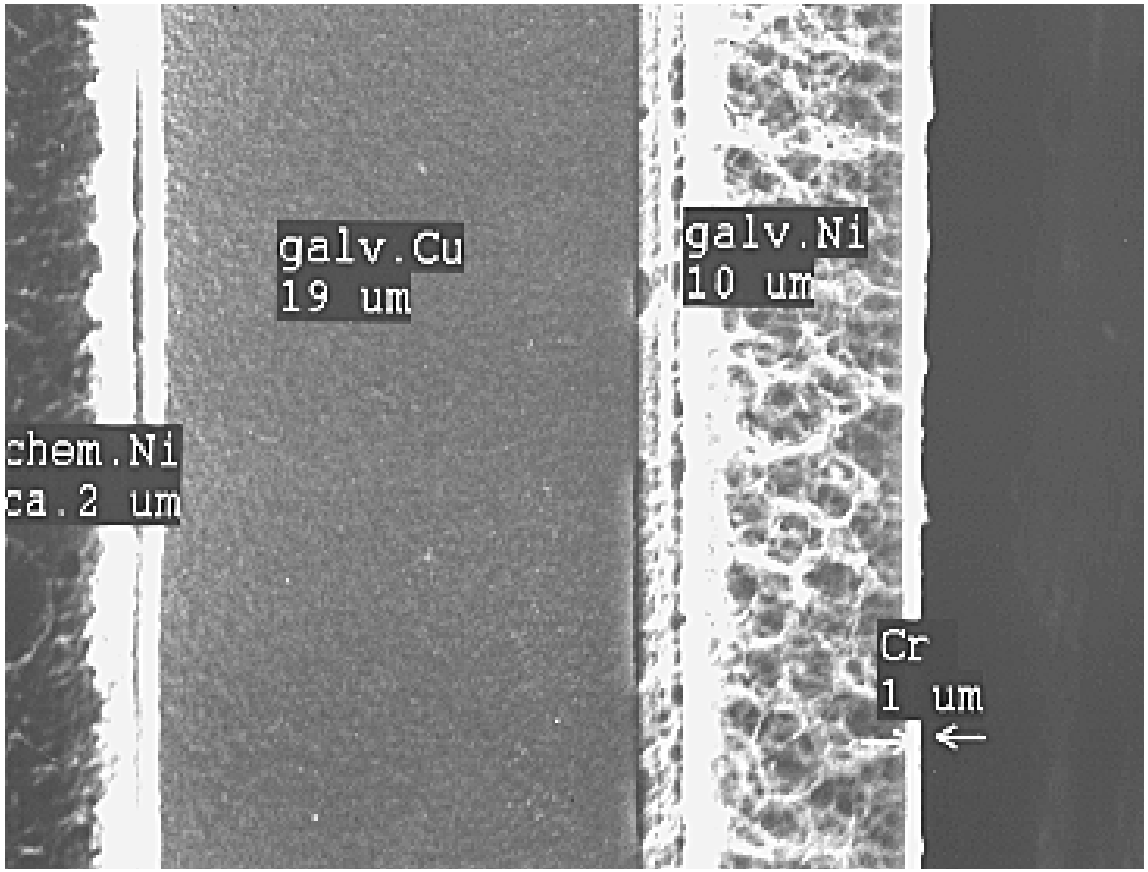
Composition of Galvanic system



Composition of Galvanic system



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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

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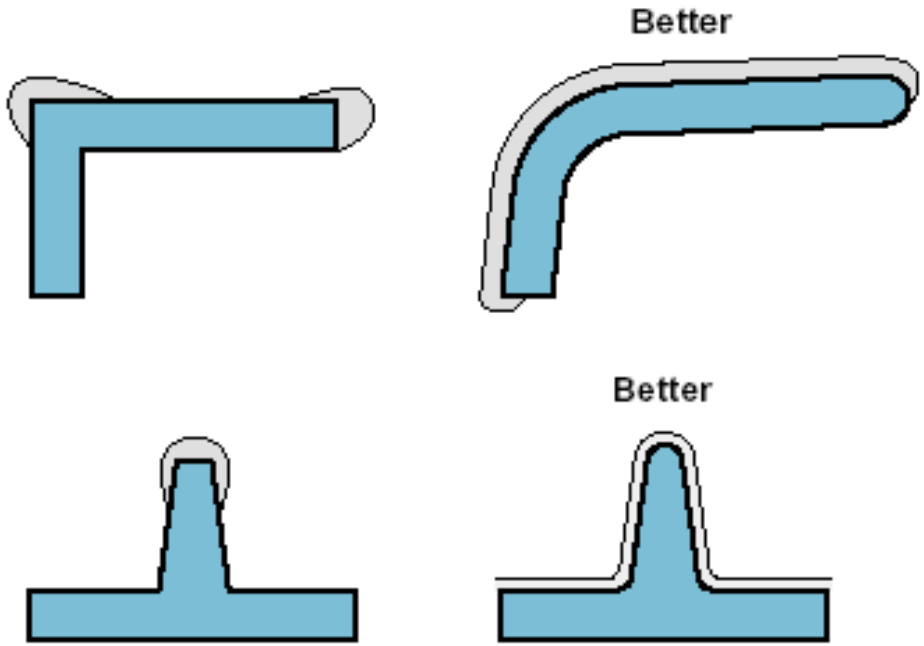
Factors Affecting Electroplating Result

- 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



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Design Considerations

- Apply a radius of at least 0.01 inch in to plated edge.
- Inlcude 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 liquides from one chemical bath to the other
- Avoid gating points in or near visible areas with cosmetic requirements

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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.

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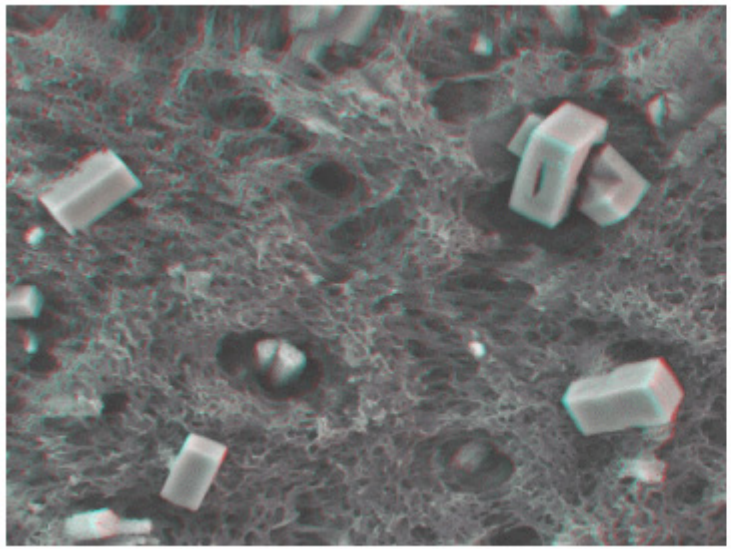
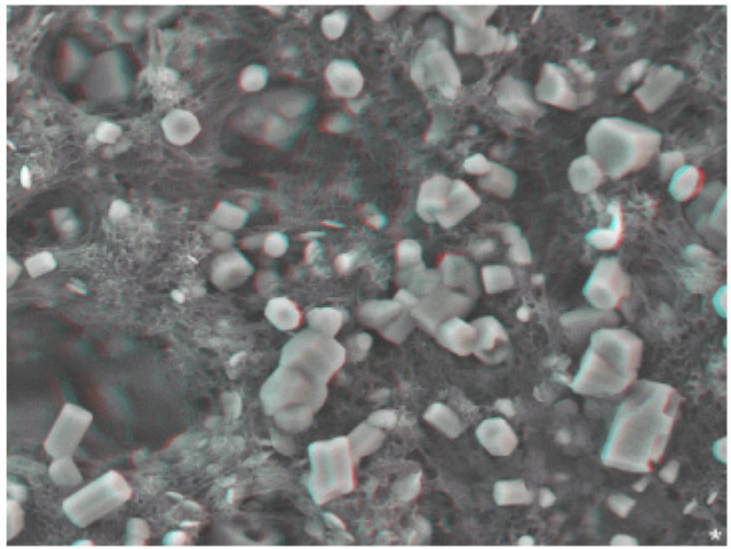
Electroplating Considerations

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



PA, after 7 min swelling



PA, after 15 min swelling

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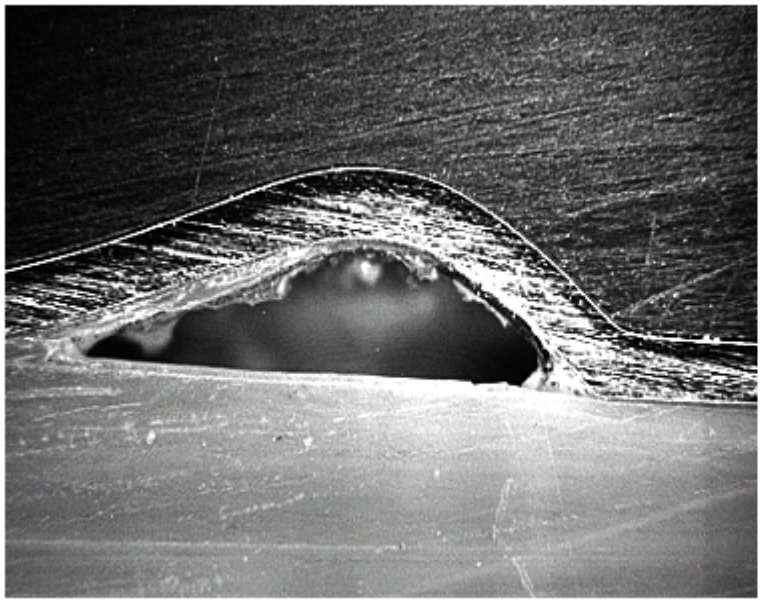
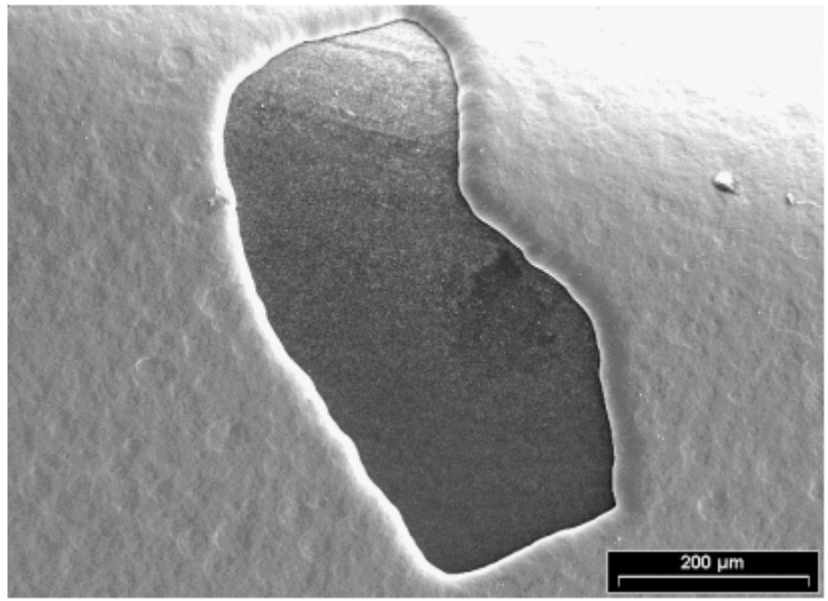
Electroplating Considerations





Another defect caused by over-swelling process is the formation of holes and bubbles.

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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.

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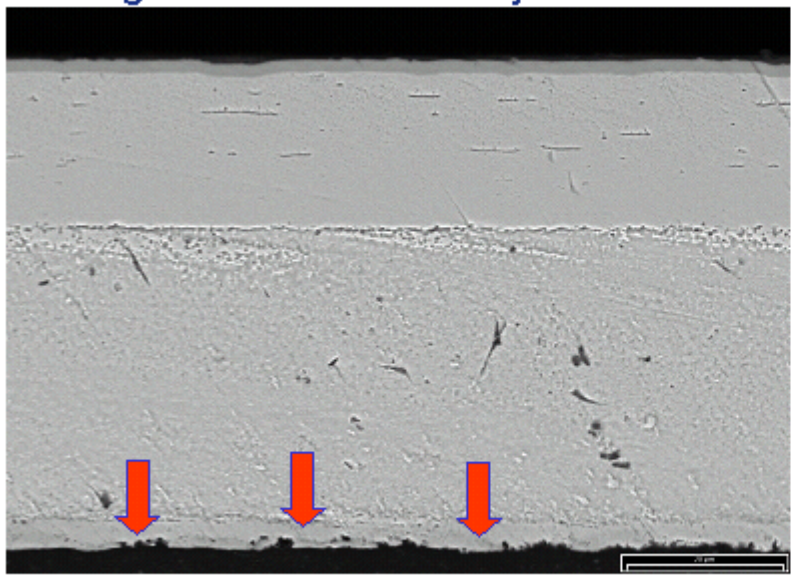
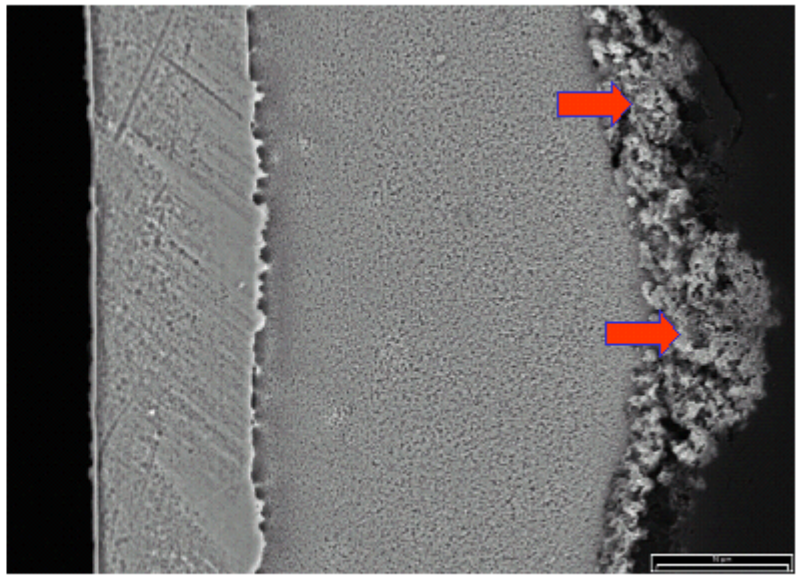
Segregation Failure

Regular chemical-nickel-layer



Amorphous chemical-Nickel = Nickel powder



- 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

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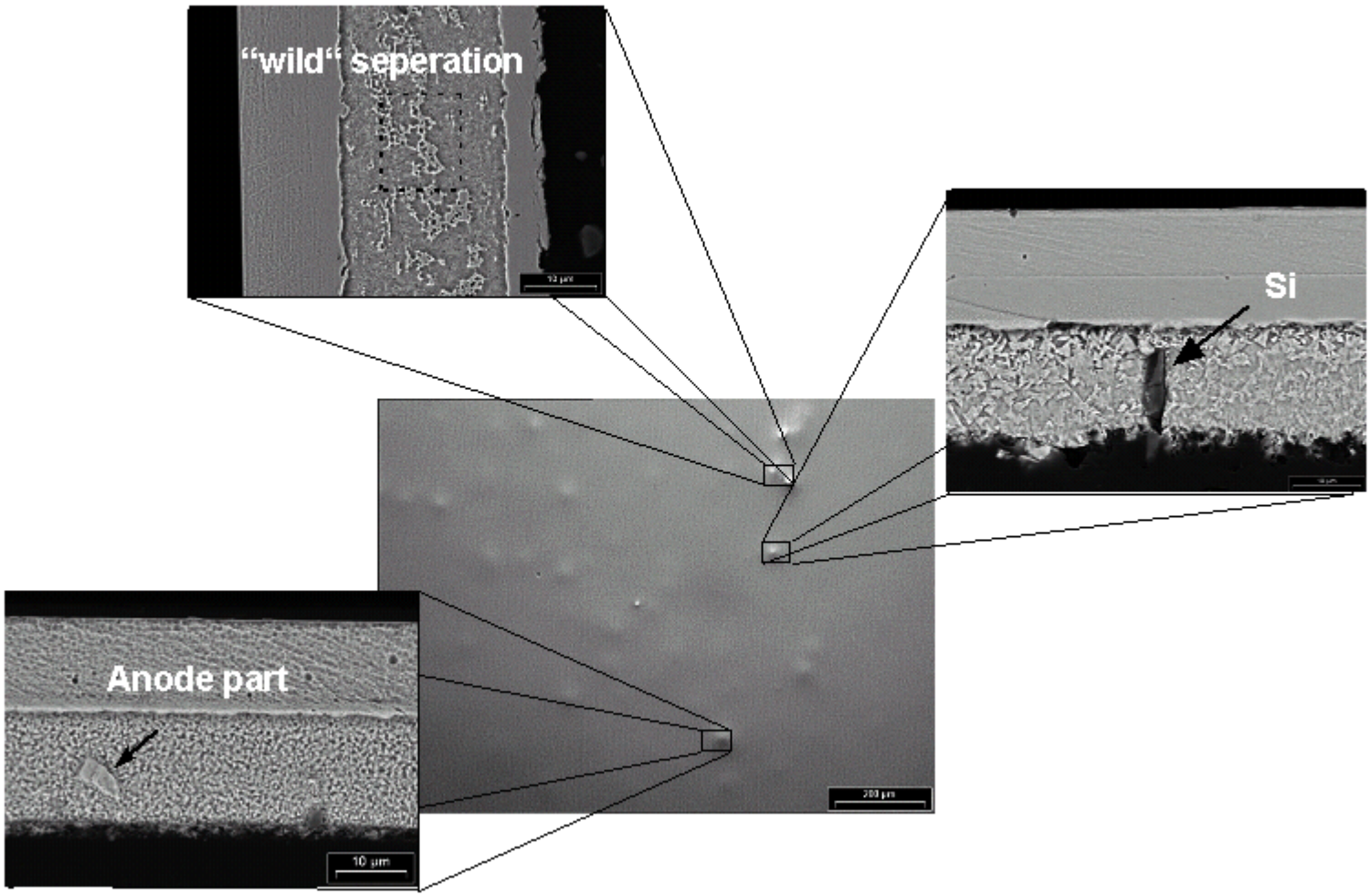
Failure Caused by the pollution of Cu Bath



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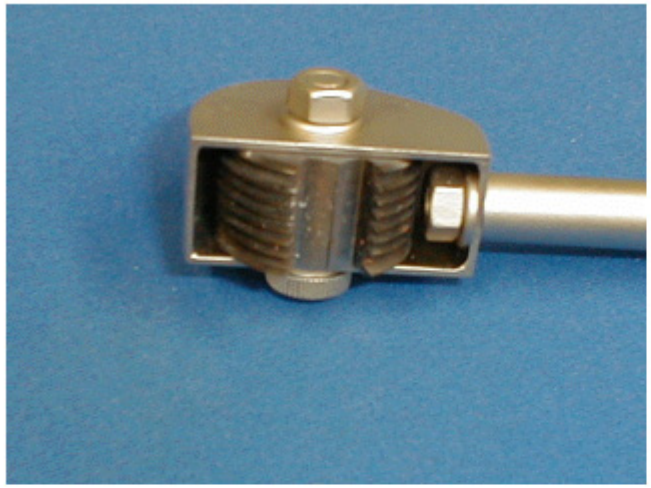
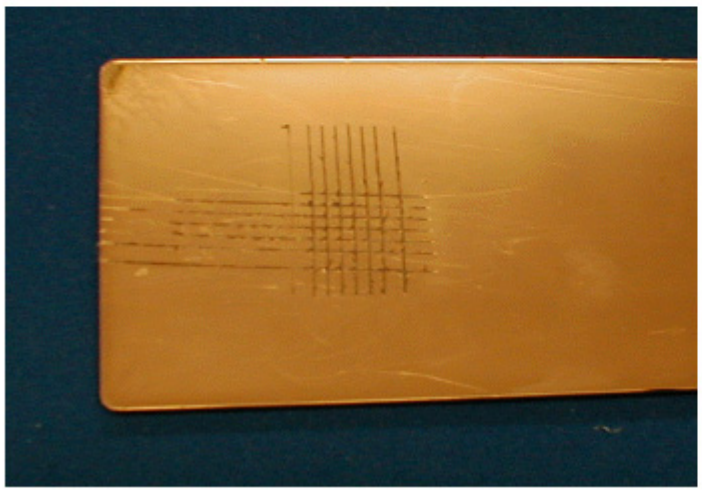
Cross Hatch Test





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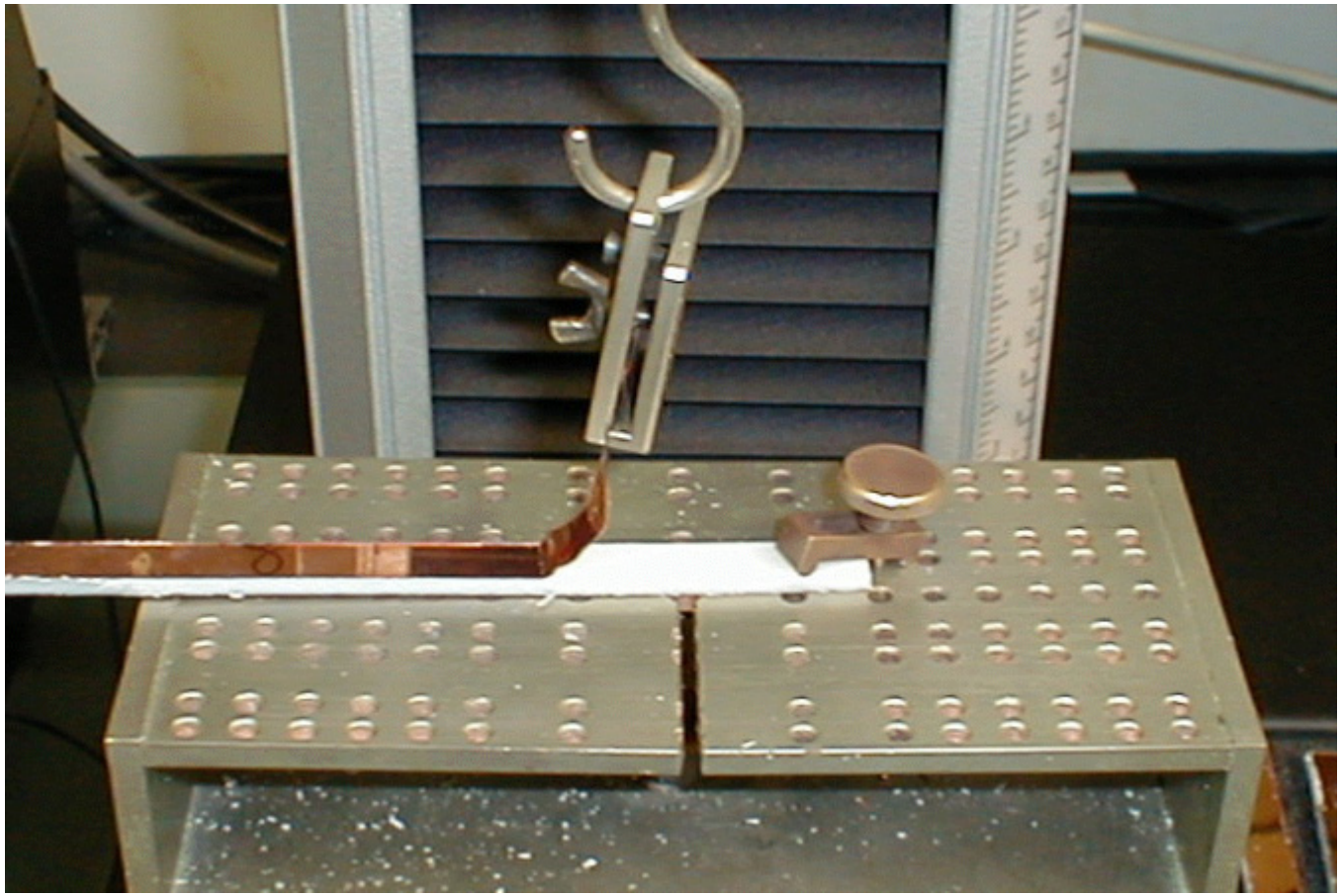
Adhesion Test

Adhesion Test



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Thank You.