Why coat with high purity aluminum?

Purity means protection. Imagine being able to combine the physical properties of any basis metal with a coating as impermeable to the elements as pure aluminum. Surface finishing and materials professionals have long known the desirable physical properties of high purity aluminum. It has not been until recently that an electrodeposited aluminum coating has become commercially available and economically attractive, and has offered designers the ability to capture the surface properties of high purity aluminum on virtually any substrate.

By using aluminum that is more than 99.9% pure, any conductive surface can be coated with outstanding results. High-purity aluminum can be anodized, and its high electrical and thermal conductivity and excellent reflectivity are useful in many high-tech applications.

AlumiPlate, Inc. is committed to a healthier, safer, less toxic environment by helping manufacturers eliminate the use of hazardous materials. Our environmentally safe processes produce products that meet the highest quality standards but contain no toxic materials.

Surface Finishing Solutions
Using High-Purity Aluminum

8960 Springbrook Drive, Suite 105
Minneapolis, Minnesota 55433-5874
info@alumiplate.com
www.alumiplate.com

The AlumiPlate® Aluminum Coating
FREE OF ALLOYS AND CONTAMINANTS
SACRIFICIAL
GALVANIC
SELF-HEALING
ENVIRONMENTALLY FRIENDLY & RoHS COMPLIANT
UNEQUALLED CORROSION RESISTANCE
OPTIMAL ANODIZE FOR ANY MATERIAL
ALLAYS HYDROGEN EMBRITTLEMENT CONCERNS
UP TO 350 °C THERMAL CAPABILITY
MALLEABLE AND HIGHLY DUCTILE
ELEMENTAL 13  99.99% PURE
Electroplating with High Purity Aluminum

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Achieve the properties of High Purity Aluminum on virtually any surface.

**Corrosion Resistance.** Our pure aluminum layer offers unsurpassed resistance to corrosion with a layer only 8 μm (0.0003") thick. The plating combines the dense structure of pure aluminum with a spontaneously formed tenacious and impervious oxide surface acting as a barrier layer. High purity aluminum is sacrificially protective to nearly any basis metal, even when abrasions or scratches expose the substrate. The combination of a barrier layer and sacrificial anodic protection is unique to the AlumiPlate® Al plating, yielding the highest possible corrosion resistance. Aluminum electroplated parts can withstand in excess of 1,000 hours of salt spray testing per ASTM B-117 salt, with only a thin 8 μm coating; 12 μm coatings of electroplated aluminum can withstand 336 hours of sulfur dioxide testing per ASTM-G87. In test after test of accelerated corrosion, electroplated aluminum consistently outperforms cadmium, nickel, zinc, tin, zinc-nickel, tin-zinc and other specialty metallic and organic coatings.

**Low Risk of Hydrogen Embrittlement.** The AlumiPlate electrolyte contains no free hydrogen, therefore high strength steel parts do not require hydrogen embrittlement relief. Additionally, electroplated Al prevents re-embrittlement of plated parts installed in the field. Extensive testing by aerospace OEM's and DoD agencies confirms that AlumiPlate aluminum minimizes hydrogen embrittlement, environmentally assisted cracking and stress corrosion cracking. Pure AlumiPlate aluminum is the best anti-corrosion plating for steel aircraft landing gear, flying surface actuators and helicopter driveline components.

**Ultra-High Purity.** AlumiPlate electroplated aluminum is 99.99% pure and free of impurities, contaminants or voids. The Aluminum layer protects process equipment sensitive to impurities that can diffuse from the substrate. Very thick layers can be deposited (there is no thickness limit), making electroplated Al the only commercially available thick, dense, highly pure aluminum coating.

**Environmentally Superior.** Pure Al is non-toxic, poses little threat to the environment and can be easily handled and disposed. It is recognized as the best performing alternative to reduce and eliminate hazardous coatings, such as cadmium and hexavalent chromate.

**High Temperature Capability.** With a functional temperature range of up to 1000 °F, aluminum can be used in many applications where cadmium, zinc, zinc-nickel, tin, tin-nickel, and organics cannot.

**Anodizeable.** Because of its purity and lack of voids, the layer offers the ideal pure aluminum surface. The AlumiPlate™ Bond Layer allows for easy and complete anodization of the plating over most aluminum alloys. Anodized electroplated Al is superior to anodized Al 6061. Anodized finishes with stunning color retention and patterns are possible for cosmetic applications. Functional components benefit from the improved performance of anodized electroplated Al, with higher breakdown voltage (greater Kv per mil), higher corrosion resistance (more hours of HCl bubble test), and purity rivaling a pure sapphire surface.

**Electrical Conductivity.** Because aluminum is electrically conductive, it is ideal for electrical applications across many industries. Metallic and composite electrical connectors can be protected from corrosion while retaining high conductivity.

**Ductility.** Electroplated aluminum is highly ductile, allowing for post-plating forming or crimping operations on the plated part. It does not spall, separate or flake even on parts that flex such as springs or straps.

**Thermal Conductivity and Insulation.** The thermal conductivity properties of the aluminum layer prove valuable in many heat removing applications. The anodized coating can provide extraordinary electrical insulation. Copper components can be preferentially plated and anodized for applications requiring high thermal conductivity and high electrical resistance.
Comparison to other “High Performance” Coatings

When compared with other high performance coatings, high purity aluminum offers a better solution to corrosion. Its properties enable more manufacturing options. The aluminum plating process is not restricted by line-of-sight limitations nor suffers from compositional variations of other techniques. Electroplated aluminum can be applied on substrates from titanium to composites and even metallized ceramics, offering improved protection for components presently coated with underperforming options.

Where Aluminum plating shines

<table>
<thead>
<tr>
<th>Application</th>
<th>Cadmium</th>
<th>Organic Coatings</th>
<th>Ni, Zn, ZnNi, Sn, SnZn</th>
<th>IVD Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Recommended Thickness</td>
<td>0.0003”</td>
<td>0.0003”</td>
<td>0.001”</td>
<td>0.0003”</td>
</tr>
<tr>
<td>Salt Spray (B-117) Performance</td>
<td>1000+ hrs</td>
<td>1000 hrs</td>
<td>500 hrs</td>
<td>400-1000 hrs</td>
</tr>
<tr>
<td>Non-Embrittling</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Fully Dense and Pore Free</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sacrificial Protection</td>
<td>Yes</td>
<td>Yes</td>
<td>Partial</td>
<td>Yes</td>
</tr>
<tr>
<td>No galvanic reaction with AI parts</td>
<td>Yes</td>
<td>Yes</td>
<td>Partial</td>
<td>No</td>
</tr>
<tr>
<td>Complex Geometries and ID’s</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Tightly Adhering</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Environmentally Friendly</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>High Temp. Applicability</td>
<td>Up to 1000°F</td>
<td>Up to 500°F</td>
<td>Up to 500°F</td>
<td>Up to 500°F</td>
</tr>
<tr>
<td>Drop-In Cad Replacement</td>
<td>Yes</td>
<td>–</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>No peening required</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ductile, Formable and Stamplable</td>
<td>Yes</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Low Process Temperature</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Anodizeable</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Aerospace

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium Replacement</td>
<td>Performance improvement</td>
</tr>
<tr>
<td>Electrical Connectors</td>
<td>Corrosion resistance with electrical conductivity</td>
</tr>
<tr>
<td>Light Weight Materials</td>
<td>Enabler of high performance materials</td>
</tr>
<tr>
<td>Galvanic Interactions</td>
<td>Galvanic compatibility with AI structures</td>
</tr>
<tr>
<td>IVD AI Replacement</td>
<td>Performance improvement</td>
</tr>
</tbody>
</table>

High Strength Fasteners in Critical Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Management</td>
<td>Ammonized copper for electrical insulation</td>
</tr>
<tr>
<td>Heavy Equipment</td>
<td>Performance improvement for high strength fasteners</td>
</tr>
<tr>
<td>Agricultural Equipment</td>
<td>Protection from salt and acid rain corrosion</td>
</tr>
<tr>
<td>Industrial</td>
<td>Protection from fertilizer, urea and nitrites</td>
</tr>
</tbody>
</table>

Consumer Electronics and ICT

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Phones &amp; Laptops</td>
<td>Stunning color anodize finishes</td>
</tr>
<tr>
<td>Wearable Technology (Glasses, watches and activity monitors)</td>
<td>Stunning color anodize finishes</td>
</tr>
<tr>
<td>Audio and Video</td>
<td>Enables anodization of high end materials (Fe-Ni, S31)</td>
</tr>
</tbody>
</table>

Specialty Optics

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective Coating for Metal &amp; Composite Mirrors</td>
<td>Diamond Turnable</td>
</tr>
</tbody>
</table>

Semiconductor & Solar

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Etch Tools</td>
<td>Ultra high purity 99.99% AI</td>
</tr>
<tr>
<td>Metal Deposition</td>
<td>Resistant to hot fluorine gas</td>
</tr>
<tr>
<td>Chamber Components</td>
<td>Protects inner chamber components</td>
</tr>
</tbody>
</table>

Coastal, Marine and Off-Shore

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck Hardware</td>
<td>Resistant to salt water environment</td>
</tr>
<tr>
<td>Lighting and Cabin Fixtures</td>
<td>Highly salt corrosion resistant</td>
</tr>
<tr>
<td>Hull Fitting to Aluminum Structures</td>
<td>Eliminates corrosive galvanic cell</td>
</tr>
<tr>
<td>Hydraulic Fitting and Hoses</td>
<td>Lower cost than stainless steel</td>
</tr>
<tr>
<td>Off-Shore Rig Decks</td>
<td>Resists UV degradation</td>
</tr>
<tr>
<td>Architectural Cosmetic Hardware</td>
<td>Protects AI and steel hardware in coastal zones</td>
</tr>
</tbody>
</table>

Thermal, Heavy Equipment, Agricultural, Industrial

<table>
<thead>
<tr>
<th>Application</th>
<th>Unique Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Management</td>
<td>Protects heat flow components from fluid corrosion</td>
</tr>
<tr>
<td>Heavy Equipment</td>
<td>Protection from corrosion even in highly polluting environments</td>
</tr>
<tr>
<td>Agricultural Equipment</td>
<td>Protection from fertilizer, urea and nitrites</td>
</tr>
<tr>
<td>Industrial</td>
<td>Protection from corrosion even in highly polluting environments</td>
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</table>
The AlumiPlate® Al Plating Process

If you know plating, you know the basics of the AlumiPlate process. A series of fluid filled processing tanks that activate component surfaces and electrodeposit high purity aluminum. What you may not know is that aluminum cannot be deposited from a water-based solution. AlumiPlate uses a non-aqueous electrolyte and soluble aluminum anodes in a process that is 100% efficient and contains no free hydrogen. You get an exact amount of aluminum deposited with no hydrogen embrittlement.

The plating line is completely enclosed; there are neither free emissions nor worker exposures. The AlumiPlate line is highly automated to meet the strictest quality standards for consistent performance. Once an aluminum surface is applied, any desired final finishing steps may be performed, including conversion coatings, lubricants or even anodizing!

Your Needs, Our Expertise

AlumiPlate offers technical design and engineering assistance, sample processing and application engineering, all aimed at providing targeted solutions that go beyond mere plating. We believe in uncovering solutions that are tailored to your specific application, based on materials, design and objectives. Ask us, we’ve been there!
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