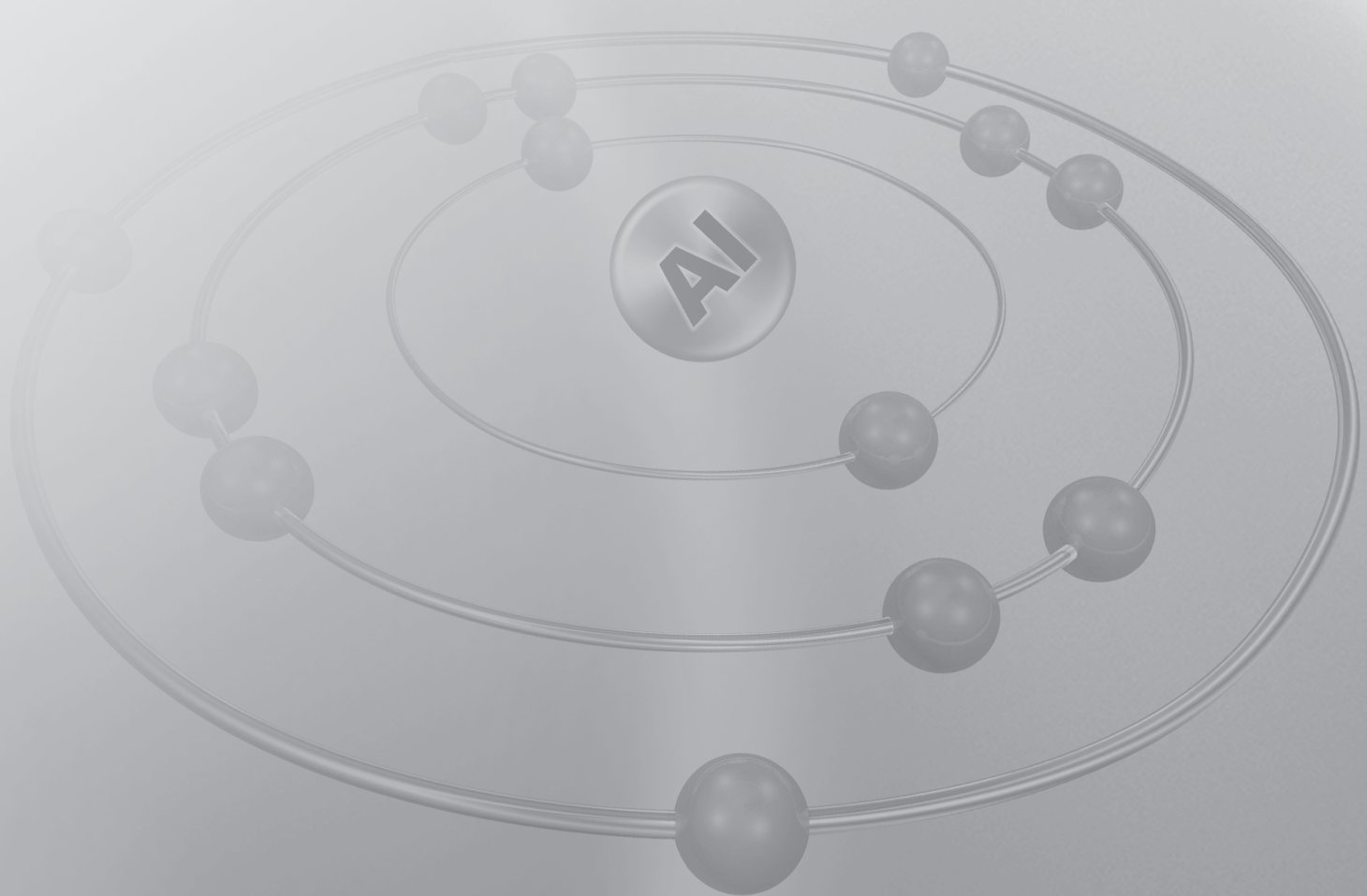
AlumiPlate

PURE ALUMINUM. THE ELEMENTAL COATING.™

Surface Finishing Solutions

Using AlumiPlate® Aluminum



USA Toll-Free 888-ALUMIPLATE | 888-258-6475 | INTERNATIONAL 763-786-3788
info@alumiplate.com | www.alumiplate.com
8960 Springbrook Drive, Suite 105, Minneapolis, MN 55433-5874

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 aluminized 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.

	AlumiPlate® Al	Cadmium	Organic Coatings	Zn / ZnNi / SnZn	IVD Al
Nominal Recommended Thickness	**0.0003"**	0.0003"	0.001-0.002"	0.0003"	0.0003"
SO_2 (G-85) Performance	**336+ hrs**	168 hrs	--	168 hrs (ZnNi)	--
Salt Spray (B-117) Performance	**1,000+ hrs**	1000 hrs	500 hrs	400-1000 hrs	500 hrs
RoHS and REACH Compliant	Yes	No	Yes	Partial	Yes
Drop-In Cad Replacement	**Yes**	--	No	No	No
No Re-Embrittlement nor 24 hr HE Bake	**Yes**	No	No	No	No
High Temperature Applicability	**300-400 C**	Up to 150 C	Up to 200 C	Up to 200 C	300-400 C
Sacrificial Protection	**Yes**	Yes	Partial	Yes	Yes
No galvanic reaction with Al parts	**Yes**	Yes	Partial	No	Yes
Complex Geometries and ID's	**Yes**	Yes	No	Yes	No
Tightly Adhering	**Yes**	Yes	No	Yes	No
Dense, thin and tough	**Yes**	Yes	No	Yes	No
Ductile, Formable and Stampable	**Yes**	Partial	No	No	No
Anodizable	**Yes**	No	No	No	No

Where Aluminum Plating Shines

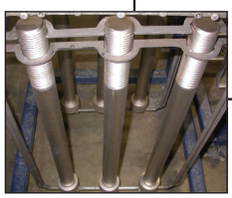
AEROSPACE

Application	Unique Value
Cadmium Replacement	Performance improvement Elimination of hazardous materials RoHS and REACH Compliant
High Strength Steels & Critical Flight-Safety Components	No embrittlement or re-embrittlement (HE, EAC, SCC) No fatigue debit No 23 hr "bake" required Best option for landing gear, pins, couplings
Electrical Connectors	Corrosion resistance with electrical conductivity Protects Al 6061, SST and composite connectors
Light Weight Materials	Enabler of high performance materials Enables replacement of Al 6061 with composites Protects Mg, Al-Be and Be
Galvanic Interactions	Galvanic compatibility with Al structures
IVD Al Replacement	Performance improvement Cost Reduction Meets MIL-DTL-83488D ("drop-in" replacement) Uniform coverage of ID's and complex geometries

Consumer Electronics and ICT

Application	Unique Value
Cell Phones & Laptops	Stunning color anodize finishes As-plated patterned finishes Protects Al and Mg from moisture and corrosion Enables use of innovative metals and non-metals
Wearable Technology (Glasses, watches and activity monitors)	Stunning color anodize finishes Protects composites from moisture and corrosion Bio-compatible
Audio and Video	Enables anodization of high end materials (Fe-Ni, SST)

High Strength Fasteners in Critical Applications



Application	Unique Value
High Strength Fasteners	Corrosion performance improvement Thin coating requires no undersizing of threads Matches existing torque-tension specifications No embrittlement or re-embrittlement (HE, EAC, SCC) Higher confidence in integrity of fatigue life No 23 hr "bake" required Replace SST with fewer and stronger steel fasteners

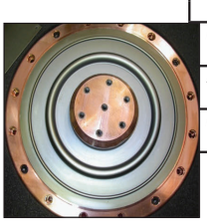
Coastal, Marine and Off-Shore

Application	Unique Value
Deck Hardware	Resistant to salt water environment Lower cost than stainless steel
Lighting and Cabin Fixtures	Highly salt corrosion resistant
Hull Fitting to Aluminum Structures	Eliminates corrosive galvanic cell
Hydraulic Fitting and Hoses	Lower cost than stainless steel Ductile and crimpable
Off-Shore Rig Decks	Resists UV degradation
Architectural Cosmetic Hardware	Protects Al and steel hardware in coastal zones Stunning color anodize finishes

Specialty Optics

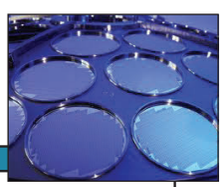
Application	Unique Value
Reflective Coating for Metal & Composite Mirrors	Diamond Turnable Excellent surface finish without polishing Low scatter and surface figure No bi-metallic distortion Best performing coating for cryogenic use No CTE mismatch with Al mirrors Lightweight coating option for AlBemet and Beryllium

Thermal, Heavy Equipment, Agricultural, Industrial



Application	Unique Value
Thermal Management	Anodized copper for electrical insulation Protects heat flow components from fluid corrosion
Heavy Equipment	Performance improvement for high strength fasteners Protection from salt and acid rain corrosion
Agricultural Equipment	Protection from fertilizer, urea and nitrates Crimpable and ductile
Industrial	Resistant to F, C, N, O Protection from corrosion even in highly polluting environments

Semiconductor & Solar



Application	Unique Value
Critical Etch Tools	Ultra high purity 99.99% Al Impurity & void-free barrier to diffusion contamination Optimizes baseline and high performance anodizes 2k/mil BV and >200 hrs HCl bubble
Metal Deposition	Resistant to hot fluorine gas High working temperature range Protects Fe-Ni and Al alloys from process gases
Chamber Components	Protects inner chamber components Protects chamber hardware (fasteners and straps) Enables innovative chamber body substrrates

The AlumiPlate® Aluminum Plating Process

If you are familiar with electroplating, you know the basics of the AlumiPlate plating process. Parts are cleaned, activated and Al plated in a series of fluid-filled processing tanks. What you may not know is that aluminum cannot be deposited from water-based solutions. AlumiPlate uses a non-aqueous electrolyte and soluble ultra-high purity aluminum anodes to electrodeposit pure Al. The process is 100% efficient and contains no free hydrogen. Unlike water-based plating processes, an exact amount of aluminum is deposited while eliminating hydrogen embrittlement.

The aluminum plating line is completely enclosed. There are neither free emissions nor worker exposures. The aluminum plating equipment is highly automated, monitoring and controlling key process and system variables for optimum plating results. Once an aluminum surface is applied, all common aluminum finishing steps can be performed, including conversion coatings, lubricants or even anodizing.

The entire process has been engineered and optimized to produce robust and repeatable results, without sacrificing safety. The AlumiPlate Al plating equipment can be scaled to support high volume applications. AlumiPlate is ready to discuss licensing, maintenance and support options with interested partners.

Your Needs, Our Expertise

AlumiPlate offers technical design and engineering assistance, applications engineering and sample processing, all aimed at providing targeted solutions that go beyond the plating. We believe in engineering a coating solution tailored to your application and requirements. AlumiPlate maintains its world-wide leadership in Al plating technology by investing in research and introducing new products to meet your challenging corrosion problems. We continuously collaborate with our customers to find solutions based on their materials, design, specification and cost objectives.

Pure Aluminum.
The Elemental Coating.™

Why protect your components with high purity aluminum? Purity means the highest corrosion protection.

AlumiPlate® Al offers surface finishing and materials engineers the ability to transform the surface of virtually any substrate into 99.99% pure aluminum. The coating has demonstrated unsurpassed anti-corrosion performance in countless laboratory tests and, more importantly, in real world applications.

Since 1997, electroplated aluminum has prevented attack in some of the toughest and most corrosive operating environments on Earth and places beyond. The coating has helped the incredibly engineered Curiosity Rover discover and study Mars.

Here on Earth, applications vary across a wide range of industries: from minimally invasive medical devices that extend and save lives, to semiconductor processing equipment for the electronic devices fueling the digital and social economy, to flight-safety-critical equipment in the most advanced military aircraft. And aluminum electroplating is at the center of energy research including fusion, high performance batteries and renewable energy, where the coating enables and facilitates the next generation of solutions to these global problems.

We care deeply about our place in the global neighborhood. AlumiPlate, Inc. is committed to a safer, healthier and less hazardous environment. The plating helps eliminate the hazardous materials and toxic legacy coatings restricted by domestic and global regulations. The plating process is enclosed and automated with the potential for zero emissions. The aluminum plating and its application process are truly benign and environmentally friendly.

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 400 °C THERMAL CAPABILITY

MALLEABLE AND HIGHLY DUCTILE

ELEMENTAL 99.99% PURE

WIDELY ADOPTED • HIGHEST PERFORMANCE • ENVIRONMENTALLY FRIENDLY

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