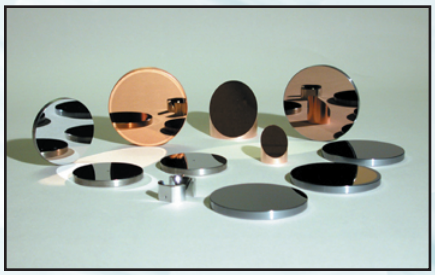
Electroplated High Purity Aluminum:

provides an unsurpassed reflective surface for high performance multi spectral, high thermal stability mirrors in critical applications.



In mirror applications calling for light-weight, excellent surface finish, low scatter, and thermally stable performance, diamond turned electroplated high purity aluminum offers a superior alternative to diamond turned aluminum alloys and polished nickel surfaces. Diamond turned metal mirrors used in high-end optical platforms for space borne, ground-based, infrared (IR), visible spectrum, and multi- spectral applications can immediately benefit from the electroplated aluminum coating.

As a superior alternative to polishing, electroplated aluminum can be diamond machined to a surface as smooth as 13 Angstroms (Å) rms without the need for post-machining polishing. Directly after diamond turning, an electroplated aluminum surface is ready for use and provides better optical finishes than other mirror substrate materials. The diamond turned geometry offers more predictable processing results than can be achieved by post polishing of the mirror surface.

The many attractive properties of electroplated high purity aluminum in optical mirror applications include:

Reduced Bi-Metallic Figure Distortion

High purity aluminum plated on 6061-T6 aluminum substrate mirrors is not susceptible to bi-metallic surface figure distortion in cryogenic or broad operating temperature ranges. As illustrated in the table, the linear CTE (coefficient of thermal expansion) of AlumiPlate® aluminum is very close to that of 6061 aluminum alloy mirror substrates. Adding to stability, the coating is soft, ductile and free of internal stresses that may warp the substrate during a variety of storage or operating conditions.

Coefficient of Thermal Expansion µm/m°C		
AlumiPlate® Aluminum	Aluminum 6061-T6	Electroless Nickel
24.4	**23.6**	**13-14.5**

Using high purity aluminum as the reflective material in these applications will minimize the figure loss that can occur due to bi-metallic bending with other platings on 6061, the most common being electroless nickel plating.

Improved Surface Finish eliminates the need for post-polishing

The AlumiPlate electrodeposited aluminum layer is high purity (99.9+%) aluminum which can be diamond machined to a greater than 2x improved surface finish compared to bare or nickel-plated Al 6061 mirrors. Because electroplated aluminum has no alloying elements, there is a greatly reduced chance of comet-tails, pull-outs, surface pitting, plowing or damage of diamond cutting tools during the turning process. Electroplated aluminum makes the entire optical manufacturing process more robust by eliminating the need for labor-intensive and non-repeatable hand polishing after machining.

AlumiPlate INCORPORATED

Phone: 888 258 6475 (1-888-ALUMIPLATE)

8960 Springbrook Dr.
Minneapolis, MN 55433-5874
U.S.A.

Fax: 763.786.8518

info@Alumiplate.com

www.alumiplate.com

Geometry	On/Off-Axis	Focal Length	Diameter (Inches)	Machine	rms Surface Roughness Al 6061-T6	rms Surface Roughness Electroplated Al
Spherical	On-Axis	100 mcc	2.0	Nanoform 600	52 Å	***18 Å***
Spherical	On-Axis	100 mcc	2.0	Precitech 2400 HS	43 Å	***13 Å***
Parabolic	5″ Off-Axis	14.6″ FL	3.0	Nanoform 600	96 Å	***36 Å***
Plano	Flycut	Plano	2.0	Precitech 1200	54 Å	***<30 Å***

The chart above indicates the surface roughness results that have been achieved when diamond turning the aluminum electrodeposited layer versus a diamond turned aluminum alloy substrate.

Superior Scatter, An Order Of Magnitude Better Than Al 6061 Mirrors

NASA has conducted extensive tests comparing reflective surface properties of various high-end surface treatments and has determined that the diamond turned high purity electroplated aluminum layer offers significant performance advantages over other alternatives in the aerospace environment. NASA found diamond turned surface roughness ranges of 15-30 Å rms for electroplated aluminum, significantly better than the 30-70 Å rms finish for diamond turned bare Al 6061. More importantly electroplated aluminum provided nearly an order of magnitude lower scatter for a large range of angles.

Enabling Use of High Performance Optical Substrates

Electroplated aluminum offers a significant optical performance and weight advantage over nickel coatings on exotic substrates such as beryllium or composites. Space borne, scanning and spinning mirror designs benefit from the use of these lighter, stiffer and more thermally stable substrates. These substrate advantages are negated by using a heavy nickel layer.

Achieve Uniform, Pure, Black Anodize Finishes Over Any Optical Substrate

Electroplated aluminum offers the ability to anodize any optical substrate with an optically flat, non out-gassing, absorptive, black coating. Unlike aluminum alloys, anodized high purity electroplated aluminum can be dyed and sealed with a uniform, blotch-free, cosmetically pleasing black finish for applications requiring maximum absorption of stray radiation.

Electroplated high purity aluminum is becoming accepted as the new standard of high performance optical reflective surface materials, as evidenced by results achieved by these leading industry authorities:

II-VI Incorporated, a pioneer and leading supplier of high end engineered optics products, has achieved an outstanding 18 Å rms diamond turned surface finish on a 2 inch diameter 6061-T6 spherical mirror plated with 0.005" (5 mils) of high purity aluminum. II-VI also diamond turned 36 Å rms surface finishes onto an aluminum plated 3 inch diameter, 5 inch off-axis parabolic mirror.

Precitech, a premier diamond machine tool manufacturer, achieved a 20 Å rms diamond turned surface finish on a 3" diameter convex spherical mirror and a 13 Å rms finish on 2" plano witness samples.

The technology for electroplating aluminum is well established and commercially available. The coating has been specified for multiple optical programs, including all Raytheon Global Hawk Program metal mirrors. Aluminum electroplated optics have been in service for over 5 years in a variety of scientific and defense applications. Multiple sources for diamond machining are available.

Contact your optical component manufacturer and ask for electroplated aluminum for your metal mirror application.