

Aluminum SiO₂ Coated Optical Mirror Deterioration with Epoxy Resin

Wilhelm, Shayla (School: Portville Central School)

Optical telescope mirrors used in aerospace imaging typically contain aluminum or silver protective coatings. Mirror life time is about three to five years, as corrosion severely degrades these coatings. Archetypal corrosion factors- oxygen, water, and volatile gases- significantly affect mirror functionality. For instance, sulfur dioxide has been documented to corrode aluminum as it forms sulfuric acid in the presence of moisture. Because mirror degradation is a rising problem for materials scientists, it begs the question whether an alternative coating material exists. Procedures consisted of an initial density and surface area measurement for two identical optical mirrors. A small volume of epoxy was mixed with a hardener catalyst in a 1:1 ratio and cured. The epoxy-resin coating was applied to the surface of one optical mirror and allowed to dry for 24 hours. Both optical mirrors were individually subjected to 10ppm sulfur dioxide gas for 29 days, simulating the wear of atmospheric sulfur on aluminum. Gas Chromatograph analysis of the SO₂ was performed to show additional corrosive agents. After cleaning both mirrors with isopropyl alcohol, the non-coated mirror had lost 0.001g of mass indicating oxidation of the aluminum. Conversely, the resin-coated mirror had lost no mass, showing no sign of corrosion. Refractive index of the epoxy-resin was calculated using Snell's Law. Data also included angles of reflection and refraction through coating mediums using a monochromatic laser (5.09x10¹⁴ Hz). Although corrosion was overcome with the application of a resin coating, the optical clarity of the mirror was partially compromised. Instead of applying the resin by pouring, as done so currently in industry, alternative coating methods exist such as atomic layer deposition.

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