

Scientific Analysis of Fine Art Report #1417: Identification of aluminum paint on aluminum aircraft fuselage

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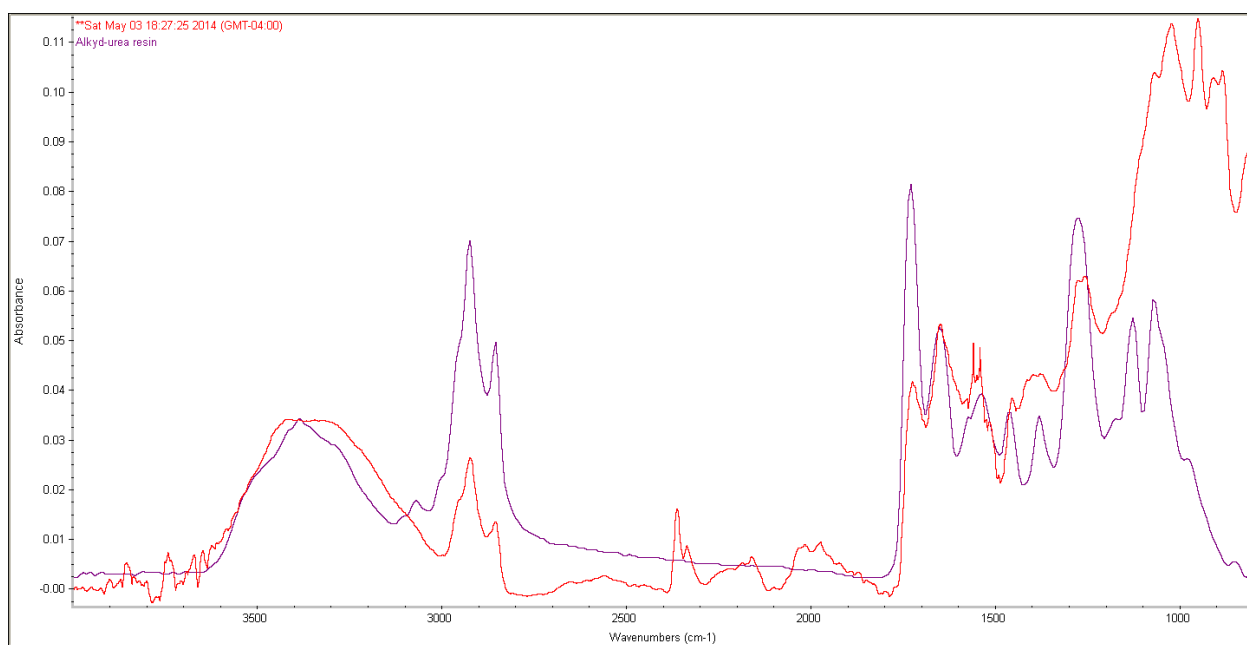
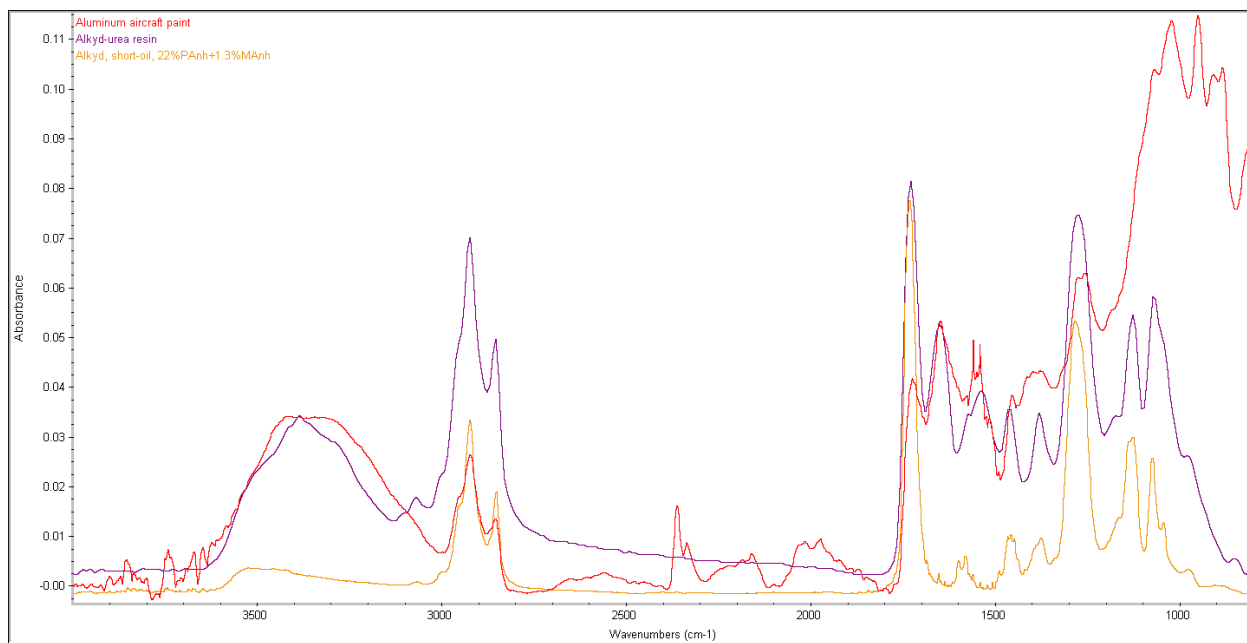
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Object Description, Reason for Analysis: The two objects submitted for analysis were both fragments of aircraft fuselage dating to the 1930s. One piece was a reference sample removed from a known 1930s plane, collected during a time when the interior of an aircraft would have been painted with an aluminum paint. The second piece was a fragment of a plane recovered from the vicinity of Kiribati, and thought to be a potential fragment of the fuselage of Amelia Earhart's downed aircraft.

Experimental Method: Molecular analysis (to identify the paint binder) using Fourier transform infrared spectroscopy (FTIR) was performed using a Thermo 6700 bench and a Continuum microscope. The microgram-sized samples were removed from both objects with a size 11 scalpel blade, flattened with a steel roller onto a diamond half cell, and 128 scans were collected at a 4 cm^{-1} spectral resolution over a $4000\text{-}650\text{ cm}^{-1}$ spectral range.

Samples from both components were also mounted in cross-section in Buehler epoxy resin for metallographic examination. These samples were then coarse polished using 240 to 600 grit silicon carbide sandpapers, and then fine polished using 6 micron diamond powder in aqueous suspension.

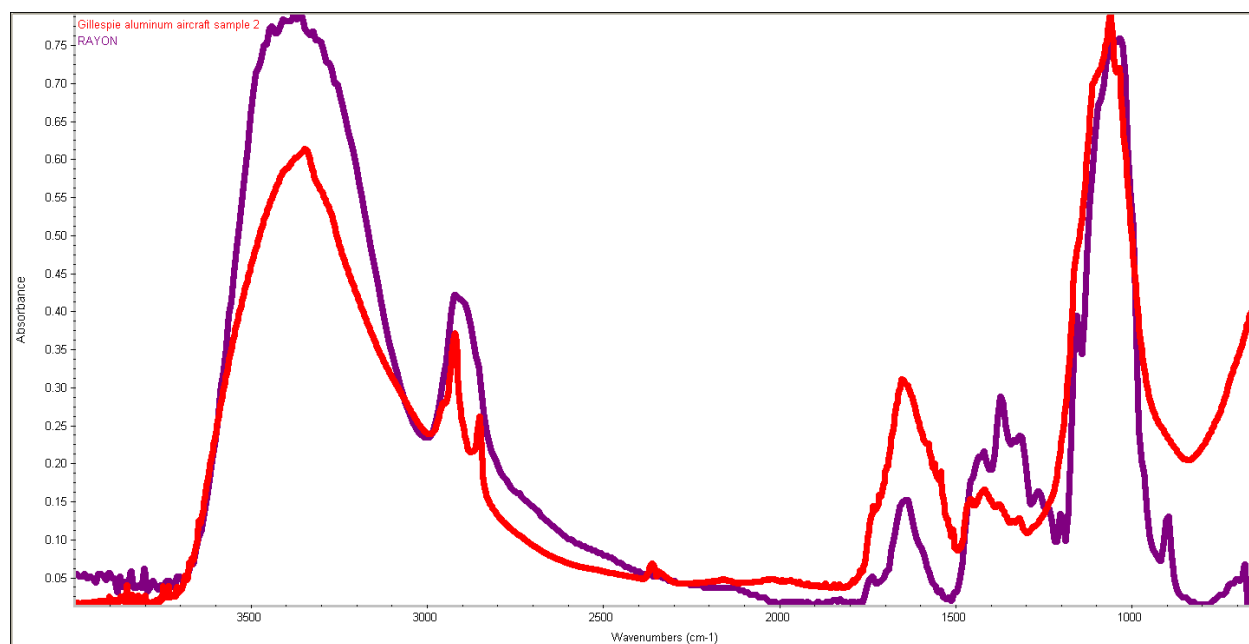
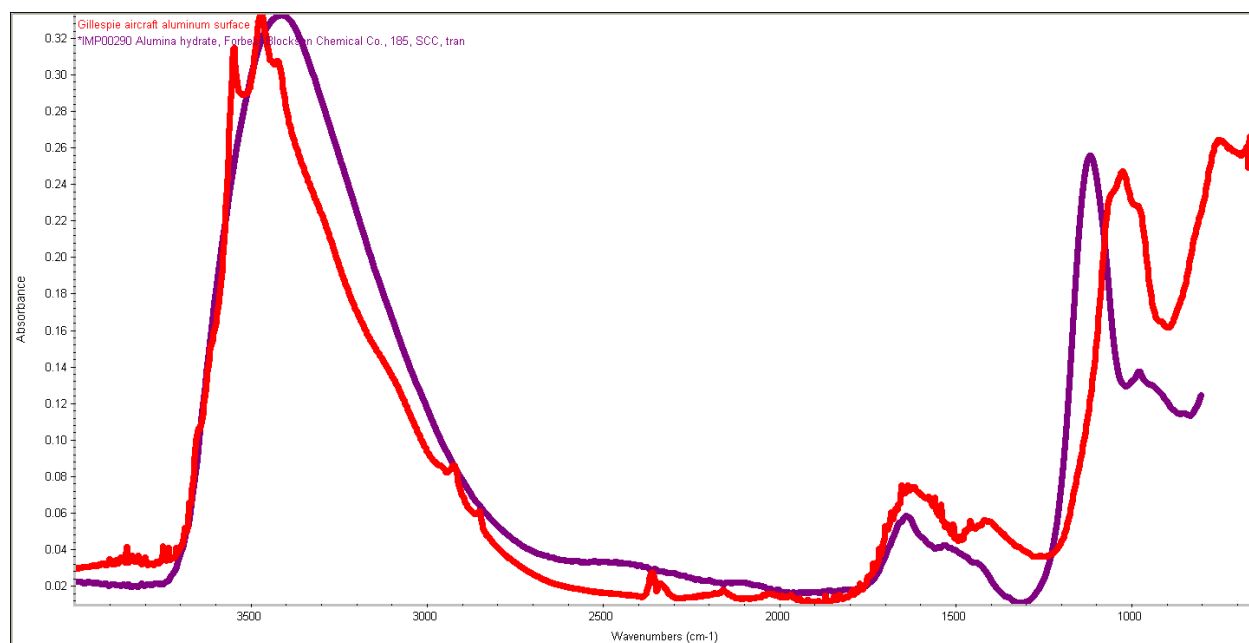
Results and Discussion: The first two infrared spectra shown below are from the "reference" aluminum fuselage, known to date from the 1930s and having been coated on the interior with aluminum paint. The molecular analysis will not reveal the aluminum pigment, only the organic binder holding the pigment together.

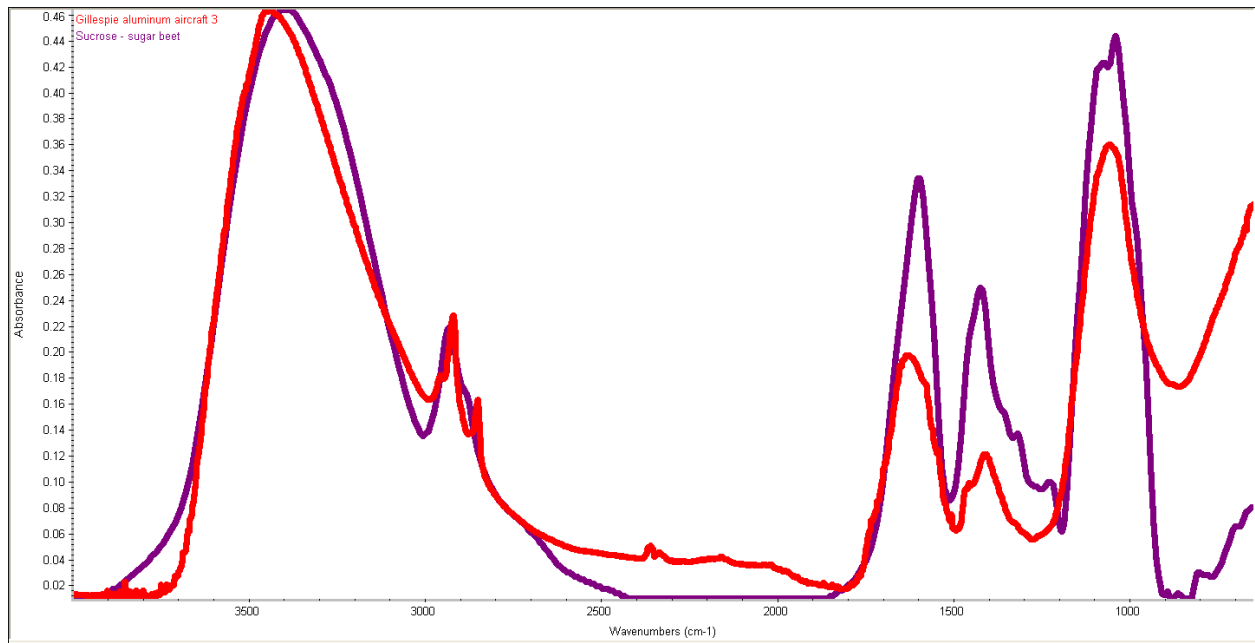


Note that in both samples the aircraft paint fragment reveals that the paint binder is an alkyd resin. Alkyd resins are synthetic drying oils that were invented in 1901, patented by General Electric in 1914, and commercialized by GE in 1926 (see MFA Boston, CAMEO database, Encyclopedia of artists' materials, Alkyd resins). There appears to be a second component of the paint with peaks below 1000 cm-1. This may correspond to aluminum hydroxides formed in the paint over time.

The next three spectra are from the fragment of fuselage thought to relate to Amelia Earhart's plane. The topmost spectrum is closely related to hydrated aluminum oxide (although not an exact match). Aluminum corrosion products such as hydroxides and chlorides are not unexpected for an aluminum object exposed to

seawater for many years. The second and third spectra show cellulose-based materials, likely plant matter. This material is undoubtedly adhered to the aircraft fuselage fragment by being entrained within the encrustations on the surface of the fragment. These encrustations are largely oxidized aluminum minerals. As a result, the findings can be interpreted as plant matter that has become trapped in the mineralized/oxidized surface of the archaeological aluminum fragment.





Cross-section microscopy of the polished cross-sections of the two aircraft fragments did not reveal significant data, only highlighting the areas of mineralization/corrosion in the archaeological fragment which can already be observed using low power magnification.

Conclusions: In light of these analyses the original aluminum paint coating applied to the aircrafts in the 1930s was an alkyd resin. However, this resin could not be identified on the archaeological fragment.