

Scientific Investigation of Historic Asian Lacquer Works of Art

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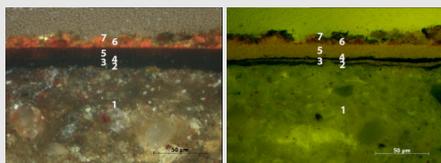
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From the sixteenth century onwards collecting Asian artefacts has been fashionable among European aristocratic houses since the Portuguese and later the Dutch and the English obtained a monopoly for trading with China and Japan, where lacquer has been used for thousands of years as a durable and beautiful coating material. As European imitations and replicas were produced later, it has always been fundamental for assigning the provenance of these objects to accurately define not only the coating technique, but also the composition of the surface varnishes and lacquers as well. According to the provenance, the objects can be divided into three groups: Japanese, Chinese, and European origin, respectively. Examinations of the lacquer objects revealed that in addition to Asian lacquers a variety of other materials were used to obtain a durable lacquer layer. Diverse drying oils, proteinaceous or polysaccharide based materials applied as organic binding media – together with various substrates and pigments – were identified when studying the grounds, lacquer layers or upper coatings. Combining optical microscopy and GC/MS is an appropriate analytical approach to detect and identify such complex organic mixtures.

Japanese lacquer object

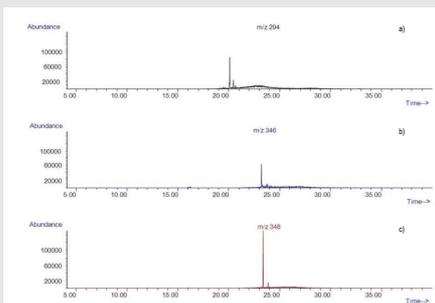


Namban lacquer cabinet (KK_5421), Kunstkammer Vienna (left) and a detail of the top side of the cabinet (right)



Layer	Name	Description
7	gold	layer of gold powder (particles)
6	red size	red layer, dark and brighter red particles, inhomogeneous, iron oxide (XRF)
5	upper lacquer	thin layer, UV-fluorescence like milk coffee
4	black outline	dark thin layer, carbonic
3	lower lacquer	thin layer, UV-fluorescence like milk coffee
2	black outline	dark thin layer, carbonic
1	ground	thick tan-grey ground layer with coarse particles (white, yellow, red and black), claylike

Cross-section of a sample from the Namban lacquer cabinet showing the stratigraphy of the ground, lacquer layers and golden decoration



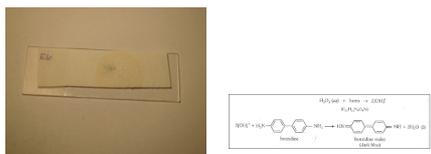
The ion extracted pyrogram (m/z 294, 346, 348) of the lacquer layers
Note: pyrolytic products of urushiol: (a) m/z 294: Mazzeic acid methyl ester, (b) m/z 346: C15-1 - catechol methylated, (c) m/z 348: C15 - catechol methylated

The Japanese Namban cabinet KK_5421 at the Kunsthistorisches Museum Vienna, dated 1580-1607/11, is a typical Namban lacquer work with flat gold and silver makie and mother-of-pearl inlay on a black-lacquered ground with designs of plants, flowers and animals and gilded copper fittings. Its wooden base is probably – according to the smell – a Japanese cypress. Its conservation for the re-opening of the Kunstkammer collection in the Kunsthistorisches Museum included cleaning and consolidation with muguri-urushi, improvement of the old filling and retouching of the split on the backside with both Japanese and western materials, and the aesthetic integration of the big lacquer losses. In parallel with the conservation the analyses were performed to obtain new information about the stratigraphy and the structure of the layers to determine the composition of the lacquer and the binder of the ground.

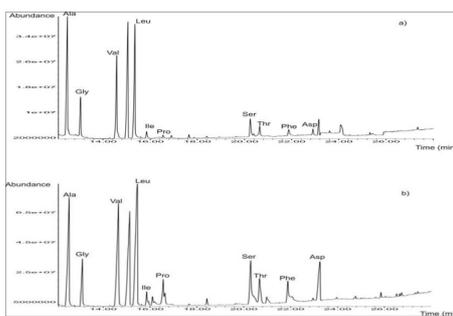
Chinese lacquer object



Chinese lacquer tea box, Canton (9952), private collection (left) and a detail of the top side of the box (right)



Enzymatic reaction with hydrogen peroxide (H₂O₂) and benzidine (positive test gives a blue coloration)
Reference: Odegaard, N., Carroll, S. and Zimmt, W.S. 2005. *Material characterization tests for objects of art and archaeology*. London: Archetype Publications Ltd.



Total ion chromatograms of the ground layer (a) and a pig blood reference standard (b)
Note: amino acids from pig blood (Alanine, Glycine, Valine, Leucine, Isoleucine, Proline, Serine, Threonine, Phe-phenylalanine, Asparaginic acid)

The Tea box (9952), belonging to a private collection in Austria, is a typical Canton lacquer object from the 19th century (1820 – 1850, Qing dynasty). The box with lid contains another box made of tin, in which the tea was stored. The black lacquer surface of the outer wooden box is decorated with very fine gold and silver paintings (miaojin), depicting scenes with persons drinking, tasting and trading tea. The foundation layer taken from the edge of the top side of the Chinese lacquer tea box was analysed by both microchemical test and GC/MS. The sample was firstly treated with hydrogen peroxide and benzidine, the positive presence of blood was indicated by a blue coloration appearance. The comparison of chromatographic profiles of amino acids obtained by hydrolysis of a blood reference standard and the sample proved that the ground contains blood, and according to the literature and traditional recipes, pig blood was commonly used by Chinese lacquer artists. The investigations served to identify the materials and to plan the conservation measures.

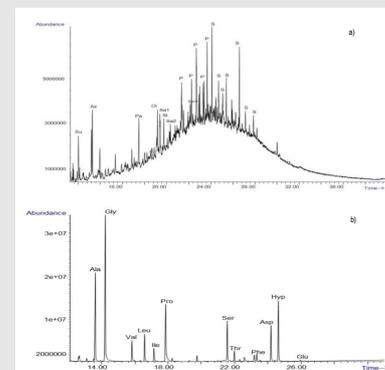
European furniture with incorporated Japanese lacquer plate



Jacques Dubois cabinet (M 73/1), private collection (left) with incorporated Japanese panel and detail of Japanese panel (right)

Microchemical test	Proteins Detection of pyrrol with dimethylamino-benzaldehyde	Polysaccharides Detection of coloured Schiff bases with oxalic acid
ground layer	positive	negative

Microchemical tests
Reference: Schramm, H. P. and Heing, B. 1995. *Historische Malmaterialien und ihre Identifizierung*. Stuttgart: Ferdinand Enke Verlag



Total ion chromatogram of the coating from the Jacques Dubois cabinet (M 73/1) (a) and ground layer (b)
Note: fatty acids from drying oil (Stearic acid, Azelaic acid, Palmitic acid, Oleic acid, Stearic acid), Pin resin diterpenes, sandarac components (Sal-Histadi, Sa2-methyl sandaracopimarate, Sa3-methyl hydroxy-sandaracopimarate), S-shallic acids
Amino acids from animal glue (Ala-alanine, Glycine, Val-valine, Leu-leucine, Ile-isoleucine, Phe-phenylalanine, Thr-threonine, Phe-phenylalanine, Asp-aspartic acid, Hyp-hydroxyproline, Glu-glutamic acid)

Another exceptional piece from the same private collection is a French cabinet (M73/1) made by Jacques Dubois in Paris, around 1760. A Japanese lacquer panel is inserted in the front door. The door panels are Japanese export lacquer, produced between 1640 and 1690, and have been thinned down, bent and transferred to the new corner cabinet which was varnished. The decoration is executed with takamakie and hiramakie techniques, using different gold and silver powders and small kirikane plates, depicting a landscape with huts and trees. The analyses aimed to identify the composition of the ground layer to support the choice of consolidation materials as well as the composition of the varnish over the lacquer to be able to decide about the surface treatment. GC/MS investigations of the ground layer showed that it is based on animal glue. The European varnish is composed of drying oil, shellac, sandarac resin and pine resin.