

CONSERVATION OF POLYCHROME WOOD - PRINCIPLES AND CASE STUDY

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Abstract

Polychrome wood artefacts represent a significantly valuable component of world cultural heritage, requiring thorough scientific investigation and specific conservation-restoration treatments. These are illustrated in this paper by the case study of an artisanal hanger, originating from Szecklerland, Romania. The study is focused on the analysis of initial conservation state and identification of the constituent materials and techniques, employing non invasive and micro-destructive scientific investigation methods, such as: photographic techniques, radiography, and microscopy of cros-sections through the painting layer. The conservation-restoration process of the hanger consisted in a series of treatments meant to preserve its authenticity, while highlighting its original beauty.

Key words: polychrome wood; scientific investigation; conservation; restoration; principles.

INTRODUCTION

The polychrome wood represents a distinct category of cultural heritage of universal value, which combine a range of artistic, technical and material expressions of human civilisation. The polychromy consists of one or more layers of paint, with or without a primer coat, which covers different elements entirely or partially in order to provide them a finishing or a decoration (García and Martínez 2001).

Polychromed wooden elements have been identified on all continents, except the Antarctic, among them being found altarpieces, furniture pieces, wood statues, decorative objects, etc. (Fig. 1).



Fig. 1.

Examples of polychromed wooden artefacts:

a - Polychrome wooden statue from Tartanedo Church, Guadalajara, Spain; b - Retablo de la Virgen del Rosario, 18th century, Tartanedo Church, Guadalajara, Spain; c – Transylvanian painted trunk, ASTRA National Museum Complex, Sibiu, Romania; d – Salt cellar (1889), Székely National Museum, Sf. Gheorghe, Romania

From the structural point of view, the polychrome wood is a composite with multi-layered structure, which reunites materials with different composition and behaviour, reacting in a specific way under variable environmental conditions. This generates in time multiple defects that may affect one or more compositional layers, their compatibility and mutual adhesion, as well as its whole structural integrity. Specific degradation and deterioration of the wooden substrate, from biological decay to cracks, fractures, loose joints, also occur as a function of wood properties and environmental conditions.

The study of polychrome elements involves: identification of different materials (pigments, binders, varnishes etc.), characterization of painting techniques, determination of historical context, dating, provenience and estimation of authenticity, the study of alterations, assessment of modifications (repainting, previous restorations etc.) (Cabr  *et al.* 2008).

Given the physical complexity of polychrome wood, the diversity of pictorial materials (binders and pigments type) (Timar 2003, Cabr  *et al.* 2008), as well as the variability of wooden support properties, such as swelling and shrinking, superficial properties depending on the species, sectioning mode and other factors (Cismaru 2003), an efficient conservation of these artefacts requires a complex scientific approach.

Scientific research represents an essential request in conservation and involves a broad range of non-destructive or (micro)-destructive methods. These include: special photographic techniques, such as UV reflectance imaging (highlighting refinishing and repainting), UV fluorescence photography (highlighting various materials) and infrared photography (highlighting the original drawing); X-rays investigation, such as radiography or tomography (highlighting internal structure and defects), XRF –X ray fluorescence (identification of chemical elements on the surface); microscopy from classical optical methods to AFM - atomic force microscopy (determination of surface topography) and SEM/EDX - scanning electron microscopy with energy dispersive X-ray spectroscopy; FTIR - Fourier transform infrared spectroscopy (identification of organic materials based on specific chemical structural features), etc. (Timar 2003, Barros 2009).

To ensure the safety of the polychrome wood, an efficient conservation imposes compliance to standardized procedures. First step in conservation of polychrome wood is a thorough examination to determine its structure, methods and materials used and evaluate its initial state of conservation. Documentation is necessary to record the initial condition through photography. Scientific investigation follows direct visual examination in order to correctly assess the real initial conservation state, determine the nature of materials and background the restoration concept. Before any effective restoration action, the paint layer must be protected by applying a foil of Japanese paper glued with fish glue. After securing the paint, the restoration process may be carried out by disinfection, consolidation of wood structure, cleaning the surface, reducing or removal of old varnishes, filling the areas of paint loss, colour integration and varnishing. A final documentation will provide information on all aspects of the applied treatments alongside preventive conservation measures (Timar 2003, Carlavilla 2008, Surt *et al.* 2012, Olaru 2014). However, each object is an individual special case and should be treated accordingly.

OBJECTIVE

The main objective of the present paper is to illustrate the application of the above presented general principles for a particular case study of polychrome wood object. The object under study was an artisanal wooden hanger originating from Szecklerland, Romania.

PRESENTATION OF THE OBJECT

The case study refers to an artisanal hanger of polychrome wood originating from Szecklerland. This is a furniture object very common in the traditional Romanian houses, with the function of hanging clothes or pieces of pottery. Based on the painting technique and painting materials, identified by chemical analysis, it is likely that the objects dates from the early 19th century. This assumption is based on the known information regarding the manufacture and usage along time, of different painting materials, especially pigments.

The painted hanger is made in fix construction by a carpenter. It is formed from twelve elements of fir wood: a wide rectangular board with two holes allowing its fixing along the wall, a narrow rectangular board joined to the first one through two strips, and eight hooks.

The front surface of the hanger is covered by an oil painting. The binder used in achieving the painting is the linseed oil, as resulted from the Gas chromatography - mass spectrometry (GC-MS) investigation (not presented in this paper). Each board is decorated on the center with floral and vegetal motifs (*Fig. 2*). The composition of the painting consists of: tulip flowers, as a symbol of fertility and pride, painted in shades of red and yellow, with the central petal longer and overshadowed with white; rose flowers, as a symbol of beauty and love; carnation and daisy flowers, as symbols of happiness; Pomegranate flower, as symbol of the cyclic evolution of the Universe, and lily-of-the-valley, as symbol of tenderness. The color palette consists of: reddish brown, red, white, yellow, dark green, blue and black.



Fig. 2.
Painted hanger, (L) 107 x (W) 15 cm

This type of floral composition appeared for the first time in Seklerland (Mereni and Aldea villages) and is representative for the Hungarian painted furniture. The best known representatives of this style and ornamentation are the furniture-making and furniture-painting Sütő family from Vârghiș village, a family of carpenters who preserved the tradition until today, and Pulu István from Racoșul de Sus, the one who had the opportunity to learn the craft from the Sütő family.

INITIAL CONSERVATION STATE

In terms of integrity and general condition, the analyzed hanger was in a quite good initial conservation state. Analysis of the wooden substrate revealed 15 knots on the surface of the wide board and 11 knots on the surface of the narrow board (Fig. 3.a.). Knowing that knots are always places where a former branch was linked to the cylinder of the trunk producing a ramification and a deflection of the grain direction, and their density per square meter is a quality criterion of wood, it can be said that the wood used in making the wooden hanger was of low quality.

There was no active biological attack on the object's surface (10 inactive galleries of boring insects on the entire surface), therefore the integrity and resistance of wooden support was not significantly affected and did not required consolidation.

Due to inadequate handling, ruptures occurred in the narrow board (Fig. 3.b.) and in one of the hooks (Fig. 3.c.). The cracks in the upper corners of the hanger are the result of the assembling with pegs that have fissured the wood in the direction of the grain (Fig. 3.d.).



Fig. 3.

Initial conservation state of the painted hanger:

a - representative knots on the backside of the wooden hanger; b - rupture in the narrow board; c - rupture of the peg; d - fissures in the wooden support

The surface of the hanger is covered by a painting layer, affected mostly by dirt, stains and inclusion of different materials, including plant parts stuck to the object, probably in a previous revarnishing (Fig. 4.a,b,c.). Crackling of painting layer and fissures in different patterns were the most clear sign of aging of painting layer (Fig. 4.d.). The areas most affected are represented by floral motifs in red and white, which presented opened fissures and color separation, while the remaining area consisted in a network of fine cracks, irregular, branched, with or without color separation.

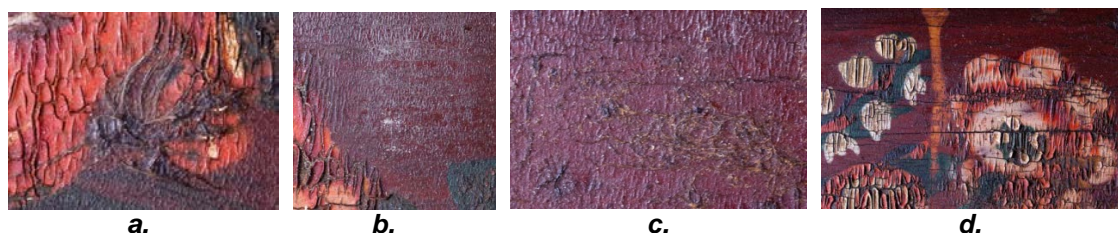


Fig. 4.

Accumulation of dirt on the painted surface:

a – area with branched cracks and plant parts stuck on the surface; b – area with dirt; c – plant parts and dirt; d – stains and opened fissures on the area painted with red and white colors

SCIENTIFIC INVESTIGATION

In order to examine the constituent materials and techniques used in the polychrome wooden hanger, non invasive and invasive examinations were carried out within the Department of Conservation and Restoration of Cultural Heritage UPV Valencia, Spain. These included: photographic techniques (involving visible and invisible radiation to the human eye), radiography, microscopic identification of wood species and investigation of cross-sections through the painting layer. Some of the examinations are presented below.

Using normal light photography, the initial conservation state of the polychromy was documented (Fig. 5.a.), while using the grazing light (Fig. 5.b.) the surface condition was better highlighted. IR photography (Fig. 5.c.), showed that there was no underdrawings, while the UV photography did not highlighted any previous interventions such as retouches, repainting, but evidenced on the painted surface small fluorescent crystals which at first sight were not visible in normal light (Fig. 5.d.). Regarding the varnish layer, the Gas chromatography - mass spectrometry (GC-MS) and the Energy-dispersive X-ray spectroscopy (not presented in this paper), revealed that the varnish layer consists of a very thin layer of linseed oil (10-25 μm), almost unnoticed.

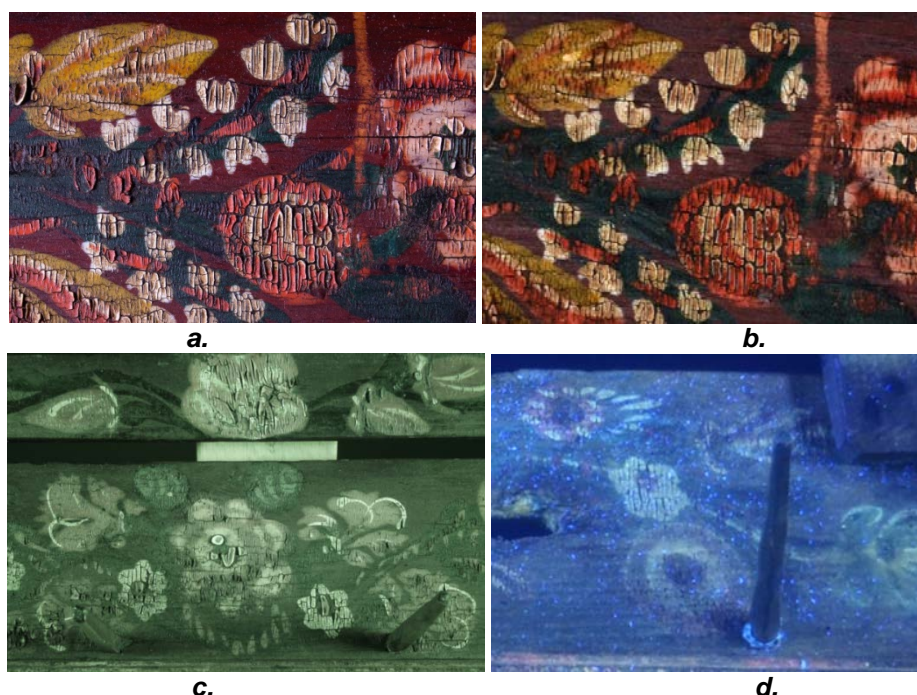


Fig. 5.

Investigation of the object by photographic techniques: a - Normal light photography; b - Grazing light photography; c - IR photography; d - UV photography

The radiographic images (Fig. 6), were obtained employing an equipment from the X-Ray Laboratory, Department of Conservation-Restoration, UPV Valencia, Spain. This was composed of a TRANSPORTIX 50 generator (General Electric Company), an X-ray tube with a rank of 20 kV to 110 kV, a CR MDT4.0T frame and a CR 30-X digitizer. The additional filtration was achieved with an aluminum sheet of 2 mm interposed between the tube and the object. To obtain the digital image, behind the object was mounted a patchwork of four boards of sensors of 35 x 45 cm. X-rays hit the sensor boards, which converted the signals generated into digital information, resulting the image on the computer screen. The data of radiography is: 45 kV voltage, 20 mA amperage, with a distance of 300 cm and a target exposure of 3".

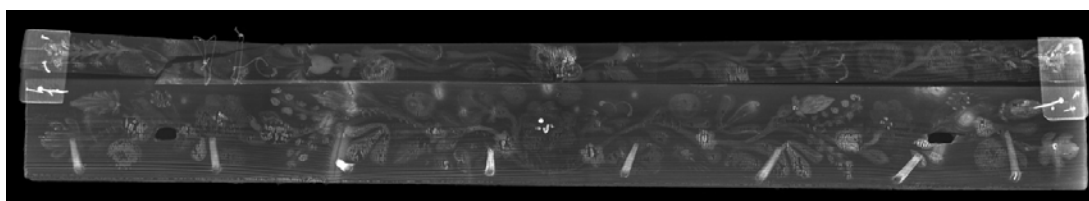


Fig. 6.


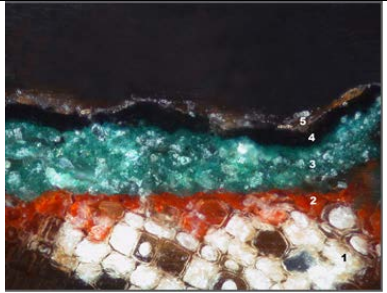

Radiographic investigation

Radiography highlighted details of the fastening system: joining with the main decorative board via 2 strips which are fixed by metal and wooden nails. Both, on the left and right side can be observed the conservation state of the metallic elements (deformations, ruptures, etc.). In addition it can be observed the direction of the wood grain and the structural defects (knots).

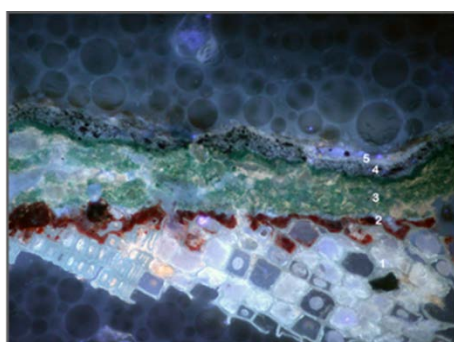
In order to analyze the multy layered structure and composition of the painting film three micro-samples were taken from different parts of the hanger surface and prepared for microscopic investigation as cross-sections. They were observed in both visible light (*Table 1*) and UV light (*Fig. 7*). Arte-Lab S.L. Laboratory from Madrid, Spain, was responsible for the identification of pigments and binders used on the surface of the hanger.

Table 1

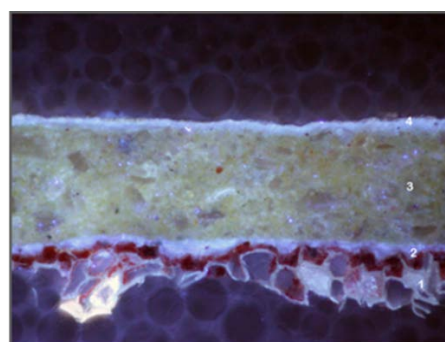
Microscopic images (visible light, 20X) of the cross-sectional samples (1, 2, 3), showing their multy-layered structure from the top varnish to the wooden substrate. Details of their thickness and/or composition is given under each picture

		
Sample 1	Sample 2	Sample 3
5 – varnish (translucent, 0-10 µm); 4 – painting layer (red, 130 µm: cinnabar, zinc oxide – l.p.*, earths – v.l.p., plaster – v.l.p.**); 3 – painting layer (549hite, 60-200 µm: zinc oxide, earths – v.l.p., plaster – v.l.p.); 2 – preparation layer (reddish-brown, 100-200 µm: red earths, barium sulfate – zinc oxide – v.l.p./plaster – v.l.p., bone black – v.l.p.); 1 – wooden support	5 – varnish (translucent: 25 µm); 4 – painting layer (black, 35 µm: carbón black, barium sulfate – v.l.p., earths – v.l.p.); 3 – painting layer (blue-green, 80 µm: Prussian blue, barium sulfate, plaster – l.p.); 2 – preparation layer (red, 20-40 µm: red earths, barium sulfate – zinc oxide – v.l.p.; bone black – v.l.p.; plaster – v.l.p.); 1 – wooden support.	4 – varnish (translucent, 15 µm); 3 – painting layer (yellow, 135 µm: yellow earths, barium sulfate – l.p.; 549hite lead – v.l.p.; plaster – v.l.p.); 2 – preparation layer (red, 35 µm: red earths, barium sulfate – zinc oxide – v.l.p., bone black – v.l.p., plaster – v.l.p.); 1 – wooden support.
Note: *l.p. = low percentage; **v.l.p. = very low percentage		

The pictures in *Fig. 7* demonstrate the effectiveness of UV light to cause fluorescence of certain materials from the structure of paint layer, contributing to a better visualization of its complex structure, especially for the transparent /colourless layers, difficult to clearly distinct in visible light.



Sample 2.a.



Sample 3.a.

Fig. 7.

Microscopic aspect (UV light, 20X) of cross-sections of paint layer, showing bright fluorescence of top varnish (samples 2.a., 3.a.) and existence of a fluorescent layer between the preparation layer no. 2 and the yellow paint layer no. 3 (sample 3.a.)

Optical microscopy corroborated with SEM-EDX (results not presented in this paper) concluded that the following pigments and fillers were employed in the polychromy of the analysed

artefact: plaster, vermilion, white lead, zinc oxide, barium sulfate, bone black, charcoal, Prussian blue, red earths, yellow earths and other earths.

These results correlated with the existing literature information related to their manufacturing and use (CAMEO: Conservation & Art Materials Encyclopedia - materials database developed by the Museum of Fine Arts, Boston), can provide valuable input for approximate dating of the object as from the early 19th century, because:

- white lead has been used from antiquity to mid 20th century;
- barium sulfate: the late 18th century;
- zinc oxide: the late 18th – 19th century;
- Prussian blue: approximately from the 1720s;
- bone black: 18th – 19th century;
- cinnabar: 19th century.

Other chemical tests identified animal glue residues and traces of wax on the surface of the samples, so it is likely that these materials have been employed/included in different finishes or for further maintenance interventions. Gas Chromatography - Mass Spectrometry (GC-MS), performed on samples 1 and 3 (results not included in this paper) demonstrated that linseed oil was employed as binder of the paint layers.

CONSERVATION TREATMENTS

The conservation-restoration process consisted in a series of operations carried out under the close supervision of specialists within the Polytechnic University of Valencia, `ASTRA` National Museum Complex and Transilvania University of Brasov. The main steps are presented below.

1. The preventive consolidation of the unstable paint layers was achieved by brushing fish-glue (6% concentration) and applying Japanese paper on the surface (*Fig. 8.a.*). The fish-glue was chosen because its good properties: elasticity, resistance, adhesion and compatibility with the original materials.
2. Mechanical cleaning of the superficial dirt by dusting with soft bristle brushes.
3. Mechanical consolidation of the wooden support by gluing rupture of the upper board (*Fig. 8.b.*) and of one hook with bone glue (water solution of 30%).



Fig. 8

Conservation treatments

a - preventive consolidation of the paint layer; b - consolidation of the wooden support; c - curative and preventive disinfection of the wooden support; d - cleaning the unpainted surfaces

4. Curative and preventive disinfection with a fungicidal-insecticide solution (*Xylaze*), by injecting the solution into the insect galleries from the back of the wooden support. The painted surfaces did not required disinfection (*Fig. 8.c.*).
5. Cleaning the unpainted surfaces (wet cleaning) with an aqueous solution (consisting of: 48% water, 48% ethylic alcohol, 3% detergent and 1% ammonia) by easy friction of the surface using cotton pads dipped in the solution (*Fig. 8.d.*).
6. The consolidation of the paint layers was made by impregnation with fish-glue (6% concentration) and application of Japanese paper on the surface, followed by hot-pressing with an electric spatula at 40-50°C over the Melinex film and cold pressing with sand bags (*Fig. 9.a.*). Cold press removes excess moisture by creating condensation. The Japanese paper is removed with cotton pads moistened in hot water followed by wiping with dry pads to avoid water penetration under the paint layer.
7. Cleaning and degreasing the loopholes with ethylic alcohol. Brushing the loopholes with glue and putty milk. Grouting in order to achieve chromatic integration (putty of chalk and fish-glue in proportion of 6% in successive layers at intervals of 24 hours). Smoothing the grouted areas by grinding with a cork and water (*Fig. 9.b,c,d.*).

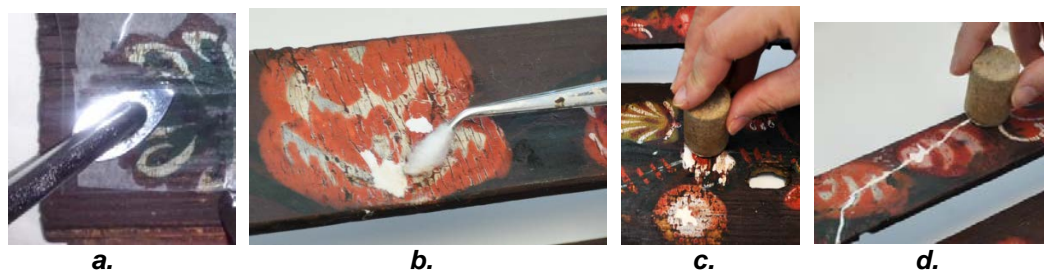


Fig. 9

a - consolidation of the paint layers; b,c,d – filling the loopholes with putty and smoothing them with cotton pads, cork and water

8. To remove dirt adhered to the painted surface, standard cleaning solutions, containing turpentine, ethylic alcohol, distilled water, ammonia, raw linseed oil or other combinations of solvents in diverse proportions, were tested for their efficiency. The solution employed was a standard cleaning solution consisting of: 70% water, 20% alcohol, 8% ammonia, 2% C2000 (Fig. 10.a,b.).



Fig. 10

a – painted area before cleaning; b – painted area after cleaning; c - chromatic integration of the missing area

9. Chromatic integration was done with water colors, in the rittoco and tratteggio technique, only on limited areas, where this was considered strictly necessary (Fig. 10 c.).

10. A protective varnish, based on dammar resin dissolved in turpentine (12%), was finally applied by brushing in a thin layer. The reverse side (not painted) was treated with a layer of bees wax in white spirit to ensure hydrophobation and equilibrated the behaviour of the two sides of the hanger boards.

CONCLUSIONS

Traditional painted furniture represents a very important part of the Romanian Cultural Heritage and a challenge for its scientific conservation. Scientific investigations are of great importance to understand the object as structure, original materials and techniques, and assist assessing of the initial conservation state and possibly dating. Photographic techniques, radiography and optical microscopy, alongside electron microscopy with EDX and GC-MS were the investigation techniques employed in the case study of a painted hanger, which was accordingly dated as from the beginning of the 19th century. The initial state of the hanger was pretty good for the wooden support, and bad for the painting layer. The conservation-restoration treatments ensured maintenance of its authenticity, while revealing its original beauty and ensuring its preservation in time.

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REFERENCES

- Barros García JM (2009) El estudio estratigráfico del patrimonio pictórico. Editorial UPV, Valencia.
- Carlavilla Asensio MP (2008) Análisis y métodos científicos aplicados al reconocimiento de los materiales empleados en los muebles dorados y policromados conservados en la Comunidad de Castilla La Mancha: la villa de Iniesta. PhD Thesis. Universidad Politécnica de Valencia. Valencia.

CAMEO: Conservation & Art Materials Encyclopedia. Online at:

http://cameo.mfa.org/wiki/Category:Materials_database

Cismaru M (2003) Fizica lemnului și a materialelor pe bază de lemn. Editura Universității Transilvania, Brașov.

García Ramos R, Ruiz de Arcaute Martínez E (2001) La escultura policromada. Criterios de intervención y técnicas de estudio. Arbor: ciencia, pensamiento y cultura 169:645-676.

Olaru VI (2014) Mobilierul pictat din sudul Transilvaniei secolele XV – XVIII. PhD Thesis. Universitatea Lucian Blaga din Sibiu. Sibiu.

Salvadó i Cabré N, Butí i Papiol S, Oriols i Pladevall N (2008) Presa de mostres de policromies. Metodologia. Generalitat de Catalunya. Departament de Cultura i Mitjans de Comunicació. Museu Documentació 1:5-30.

Surt P, Ocon N (2012) A Primer for the Materials, Methods and Techniques of Conservation. North Carolina Art Museum: 1-10.

Timar MC (2003) Restaurarea mobilei, teorie și practică. Editura Universității Transilvania, Brașov.