

Complementary imaging and characterization methodology of polychrome composites in gilded woodcarving using Micro-CT, SEM-EDX and OM

M. F. C. Pereira^{*}, A. M. Maurício^{*}, I. C. A. Sandu^{**}, R. Veiga^{***}, A. Le Gac^{***}, N. Leal^{****}

^{*}CERENA/CEPGIST, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal

^{**}REQUIMTE and Departamento de Conservação e Restauro, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

^{***} Departamento de Conservação e Restauro, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

^{****} CICEGe, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

email: mfc@tecnico.ulisboa.pt

The work presents an innovative complementary methodology for characterizing polychrome composites from gilded woodcarving using three imaging techniques, two of them based on X-ray, Micro-CT (μ CT) and SEM-EDX, and on the Optical Microscopy (OM). The work is part of a 3-year research project entitled “*Gilt-Teller: an interdisciplinary multi-scale study of gilding technique and materials in Portugal, 1500-1800*”, funded by the Foundation for Science and Technology in Portugal [1].

Gilded woodcarving (known as “*talha dourada*” in Portugal) structures are complex and made of heterogeneous materials [2,3], therefore their study needs a multi-technique and multi-layer approach in order to answer to several issues related with the nature of the materials and techniques used in the past, such as: differentiation between *gesso grosso* and *gesso matte* in the structure and composition of the ground layers; differentiation between ground, bole layers and metal leaf and their elemental characterization; identification and mapping of inorganic phases in the whole composite; identification of organic phases; description of the conservation state of the composite, etc.

The μ CT technique is especially useful to visualize and compare the inner structure and texture of gilded samples [4]. The main advantage of this non-destructive imaging technique is the fact that allows obtaining of a great number (hundreds or thousands) of sections/slices of a very small sample throughout its entire volume, allowing 3D static and dynamic visualization of the morphology and microstructure (Fig.1). This technique allows to detect heterogeneous phases inside the sample’s volume, such as the grounds or paint layers. It also allows to analyze the characteristics related to physical degradation, such as fissures, cracks or lack of adhesion between layers [5]. In this way μ CT can complement the EDX surface elemental mapping and also the BSE images obtained from SEM and also the OM imaging, based in a limited number of cross-sections (Fig.2). μ CT is particularly recommended for wooden support characterization and conservation studies, expanding the classical approach based in a destructive and limited cross-section analysis.

Few case studies had been used to exemplify the application and advantages of this methodology. The samples were selected from different altarpieces with gilded decorations and sculptures in “*estofado*” technique from the Portuguese Baroque ecclesiastic heritage. One sample from a reliquary bust (*Museu Nacional Machado de Castro-MNMC*, Coimbra - Portugal) is also included in this study.

The authors acknowledge FCT financing for PEst-OE/CTE/UI0098/2011, PEst-C/EQB/LA0006/2011 and PTDC/EAT-EAT/116700/2010, and Ana Alcoforado and Pedro Ferrão from MNMC, Coimbra (Portugal).

[1]. <http://sites.fct.unl.pt/gilt-teller/>

[2]. Sandu I.C.A. *et al.*, *International Journal of Conservation Science*, **1**, 47-62, 2010.

[3]. Sandu I.C.A. *et al.*, *Surface and Interface Analysis, S.I. - Cultural Heritage*, **43**, 1134-1151, 2011.

[4]. Van de Castele *et al.*; 9th International Conference on NDT of Art, Jerusalem - Israel, 25-30 May 2008.

[5]. Pereira M.F.C. *et al.*, InArt2013, 1st Int. Conf. on Innovation in Art Research and Technology, Évora, 10-13th of July 2013



Fig. 1 – Sculpture of St. Joseph, XVI century, Museum of Aveiro. Collecting a gilded polychrome sample PT-SSJ_MA (Gilt Teller Project) in the lower part of the mantle. Microtomographic images (gray images) showing 3D views in partial transparent mode, and two selected radiographs (left bottom).

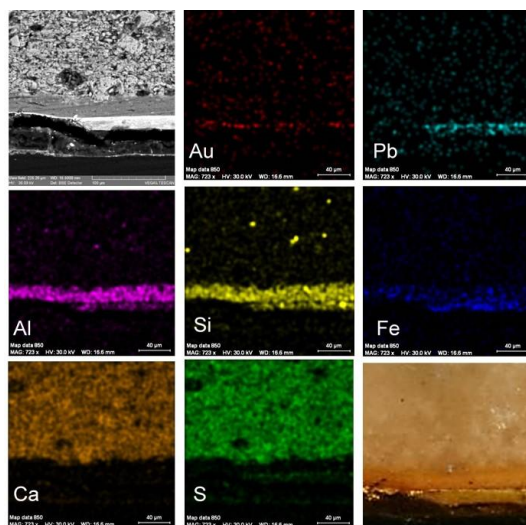


Fig. 2 – Stratigraphy and composition of the PT-SSJ_MA sample determined by SEM-EDX and other complementary techniques: gypsum and anhydrite (Ca, S) ground, and gilding layers including ochre bole (Si, Al, Fe) and gold leaf (Au/Cu/Ag).