



MARIO BANDIERA
CONSERVATION SCIENTIST

Luogo di nascita: Siracusa (IT)

Data di nascita: 02-01-1986

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EDUCATION

03/2017 – 01/2022 **PhD in Conservation Science (Equipollenza Italiana ottenuta il 27 dicembre 2023)**

Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa (Lisbon, Pt) –
Research Unit VICARTE.

Supervisors:

Pof. Marcia Vilarigues, *Director of the Research Unit VICARTE - Vidro e Cerâmica para as Artes NOVA School of Science and Technology, Head of the Department of Conservation and Restoration, FCT-NOVA.*

Dr Marco Verità, collaborator of LAMA laboratory, IUAV University, Venice (Italy)

PhD thesis title: *Technological study and chemical-archaeometric characterization of Roman opaque red glass of 2nd century A.D. in the Gorga collection.*

PhD project:

The project was focused on the chemical characterization of pieces of Roman opaque red glass. They are pieces of *opus sectile* which decorated the rooms of *Lucius Verus* Villa 2nd century A.D. (the adoptive brother of Marco Aurelio). The samples were stored in Soprintendenza Archeologica di Roma, and they belonged to Gorga collection.

The research involved a depth literature review, chemical and mineralogical analyses of the collected samples. The obtained data were helpful:

-to shed light on the Roman glassmaking technology to produced different red hues of opaque red glass

-to identify the different recipes used, unveiling raw materials

- information about the production and trading model of coloured glass in the 2nd A.D.

The scientific investigation included international collaborations such as: C2MRF (Louvre, Paris, France), LAMA (Venice, Italy), Stazione Sperimentale del Vetro (Venice, Italy), IRAMAT (Orleans, France).

Laboratory reproduction helped to understand the technological aspect required for the manufacture of different red hues testing:

- different raw materials (such as distinct reducing and colouring agents)

- different base glass compositions
- several melting procedures such as: diverse melting temperature and time; redox furnaces atmosphere; specific heat treatments
- Testing different typology of furnaces such as laboratory electric furnace and wood-fired furnaces (Oficinas da ceramica e da terra (Montemor Novo – PT); Villa Borg, Germany) and comparing the obtained results.

The samples have been characterized by: colourimetric measurements; FORS, Raman spectroscopy, XRD, XRF, PIXE, analyses.

Furthermore, due to the lack of written historical source dated to the Roman age, the Venetian glassmaking manuscripts (13th-17th centuries) were deeply study.

Collaborations with the laboratories of C2RMF (Centre de recherches et restauration de musées de France), Glass factory Effe3 Murano (VE), Stazione sperimentale del Vetro, Campus Nuclear Tecnologico do Instituto Superior Tecnico de Lisboa, CENIMAT.

Additional research work performed during the PhD:

Research assistant in the framework of the project Artechne (Technique in the Arts: Concepts, Practice, Expertise, 1500-1950)

- Bibliographic research to individuate the recipes in Venetian Manuscript from the 13th-17th c. AD concerning the manufacture of copper-ruby enamels and copper-red glass.
- Assistant for the preparation of the raw materials according to the procedure indicated in the recipes; preparation of the batch and frit following the methodology individuated in the recipes.
- Responsible for the set up of the electric furnace to melt the glass; follow the procedure suggested in the recipes to produce opaque red glass and enamels; taking out and pouring the molten glass.
Reproduction of red enamels by using wood-fired furnaces in Oficinas da ceramica e da terra (Montemor novo – PT); Villa Borg in Germany.

Techniques: FORS, colorimetry, Raman spectroscopy, XRF, and optical microscopy (autonomy) interpretation of the FEG-SEM, XRD and LA-ICP-MS, PIXE analyses.

05/2019

Academic and funding award

Graduate student award in recognition of an outstanding paper contributed to the 2019 E-MRS spring meeting (27-31 May, 2019, Nice – FR-); Symposium BB; Cultural Heritage – Science, Materials and technology.

10/2012 - 4/2015

MSc (Science for Cultural Heritage Conservation)

University of Parma (Italy) – Department of Physic and Earth sciences.

Grade: 110/110 cum laude

Supervisors:

Prof Sandro Meli, Dipartimento di Scienze Chimiche, della Vita e della Sostenibilità Ambientale, University of Parma

Giovanni Michiara, GEOfaber (Parma, Italy)

MSc thesis title: *Studies of the mortars from the ex-furnace of Ghiare di Berceto' aimed at a conservation project in the field of industrial archaeology.*

Archival retrieval for historical reconstruction; sampling, petrographic study of thin sections by light microscopy, scanning electron microscope (SEM-EDS), XRD.

Additional work performed during the MSc:

10/2014 - 03/2015

Conservation Student Work Placement at GEOfaber (Parma, Italy) under the supervision of Giovanni Michiara

Structural diagnostic for historical buildings, including damage assessment due to cracks formation and propagation in the structure of the edifices; petrographic investigation on thin cross-section of mortars and plasters.

09/2006 - 1/2012 BSc (Technology for Cultural Heritage Conservation)

University of Parma (Italy)

Grade: 99/110

Supervisors: Prof Antonella Casoli Department of Chemistry, University of Parma (Italy)

BSc thesis title: *Characterisation of the organic binding medium of the altarpiece in San Peter Cathedral in Geneva painted by Konrad Witz in 1444.*

ADDITIONAL QUALIFICATIONS

- June 2018** Summer School/Research Seminar “*Il vetro nell’antichità*”, Comitato italiano AIHV, Sarzana (Italy), 16-17 June 2018
- January 2017** *Playing with light: from FORS to hyperspectral imaging for the conservation of cultural heritage* - internal workshop organized by Department of Conservation and Restoration, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa (Lisbon, Pt)
- September 2016** *IPERION CH.it 3rd Training Camp on Non-invasive Diagnostics*, organized by Opificio delle Pietre Dure together with CNR, INFN, ENEA, INSTM, Siracusa (Italy), 25 - 30 September 2016.
Some Museum of Palazzo Bellomo’s artworks were studied by non-invasive investigation as: scanning multispectral VIS-NIR reflectography and spectrophotometry analysis; radiographic system; colorimetry and Raman spectroscopy; Scanner XRF; 3D scanning.
- February 2016** *Training workshop for the use of a Jasco mod. FT/IR-4200 coupled to an IRT-500-16 microscope and corresponding Spectra Manager software* - Università IUAV, Venice (Italy), 12 February 2016
- August 2015** *Workshop on Archeological architecture conservation: cleaning and consolidation (theoretical discussion and practical application with a focus on metal, stone and wall paintings)* - Archeoclub, Venice (Italy), 18 - 23 August 2015

ADDITIONAL SKILLS

Languages	Italian (native speaker); English (fluent); Portuguese (fluent), Spanish (fluent)
IT skills	Proficient with Microsoft Office suite including Word, Excel and Power Point on both Microsoft and Apple operating software; software for data analysis, such as Omnic, Origin Pro, ArtTax, LabSpec 5, PyMca, INCA, Familiar with photo editing software, i.e. Photoshop CS5 and Lightroom.

PROFESSIONAL EXPERIENCE

May 2023 – August 2025

Collaborator to the scientific laboratory of Opificio delle Pietre Dure, Firenze (Italy).

Project *Change* “Humanities and cultural heritage as laboratories of innovation and creativity” spoke 7.

- Study the application of volatile binding media on cultural heritage.
- Collaboration in Laboratory activity: non-invasive analyses before restoration of artistic object (bronze, paints, ceramic, glaze, glass, paper, leather etc.) from museums (national and international), private collections by using handheld X-ray fluorescence (XGLAB Elio), mapping XRF, handheld FT-IR (Agilent) and bench FT-IR spectroscopy, Raman, Optical microscope, stereomicroscope, Eddy Current, FORS. For invasive analysis SEM-EDS.

The analyses are focused on the characterization of the material, the state of conservation, and of the degradation materials.

April 2022 – April 2023

ChromAz project (PTDC/HAR-HIS/1899/2020)

<https://chromazproject.com>

Postdoctoral Research

- Catalogue and characterise the colours and respective pigments that make up the Portuguese azulejo palette (from 16th to 18th century AD). Multi-analytical approach: μ -Raman, Optical Microscopy, DSC, FORS, UV-Vis-NIR, Colorimetry, SEM-EDS, and μ -XRD.
- Analyse the results under an international context of technology transfer to identify possible regional and/or chronological markers
- Unveil the historical recipes using reverse engineering and the study of historical sources to reconstruct the colour palettes. To perform experimental reconstructions, we will consider the literature review (including treatises, recipes, testimonies), published

archaeometric data. Historically-accurate reconstructions will be made at VICARTE, which possess all the necessary infrastructures (laboratories, kilns, safety equipment) to successfully undertake this task.

Collaboration with: UPC – BarcelonaTech, LNEC, LIBPhys,

July 2021 – March 2022

VICARTE (UIDP/00729/2020 – 01)

Research fellow for master degree.

Laboratory Synthesis of pigments used in glazed ceramic.

Bibliographic research about Portuguese azulejos.

Laboratory reproduction of glass.

Preliminary analytical investigation through optical microscope and Raman spectroscopy.

September 2016 - February 2017

Fondazione Magnani Rocca

<https://www.magnanirocca.it>

Volunteer

Tour guide group and educator for school groups:

Art history classes for kids 6-10yo, focused on artists presented in the

Museum's permanent collection (i.e. Monet, Morandi, Burri and many more)

February 2016 - September 2016

Archeoclub d'Italia, Venice (Italy)

<https://archeove.com>

Line manager: Gerolamo Fazzini

Volunteer Conservation Assistant

Restoration and maintenance of architectural structures on the island of Lazzaretto Nuovo and Lazzaretto Vecchio:

- Archaeological excavation in the area of Lazzaretto Novo, Venice Lagoon.
- Cleaning and cataloguing of the uncovered items (i.e. glass, ceramic, metals, ivory, etc.)
- Assessment of the state of conservation of the excavated objects, and of those stored in the Lazzaretto's storage
- Preparation of objects for display in the Lazzaretto MUSEUM and for loans
- Assistance in the consolidation treatment of a 16th century AD Venetian cannon

Educator and guide in archaeology summer camp

Tour guide for groups and school groups

February 2016 - September 2016

LAMA (Laboratorio di analisi materiali antichi),

Università IUAV, Venice (Italy)

<http://www.iuav.it/SISTEMA-DE/Laboratori3>

Line manager: Prof. Fabrizio Antonelli, Prof. Lorenzo Lazzarini

Intern and Lab assistant

Research on the impact of various consolidants for materials construction used in historical Venetian monuments and buildings.

- Sampling and preparation for analysis.
- Analysis of samples with Optical Microscopy, FTIR spectroscopy, EDX, XRD,
- Interpretation of the results within context and preparation of analysis reports
- Support with analysis of 13-16th century Venetian enamels via portable XRF in collaboration with Museo del Vetro (Murano, Venice , Italy).
- Study of the degradation on marbles used in historical Venetian buildings.

2015 - 2016

Manifattura Urbana (Parma, Italy)

*Guest Lecturer, Assistant in Conservation Workshops
And coordinator for cultural activities.*

LIST OF PUBLICATIONS

Peer-reviewed
journal articles

Mario Bandiera, Umberto Veronesi, Marta Manso, Alexandre Pais, Lurdes Esteves, Andreia Ruivo, Márcia Vilarigues, Susana Coentro. *Unveiling the colours of the 17th-18th century azulejos using a multi-analytical non-invasive approach.* (Cultural Heritage) (Accepted)

Marco Verità, Patrice Lehuédé, Sandro Zecchin, Mario Bandiera. *Renaissance Venetian Filigree glass: a successful invention investigated through the analyses of archaeological samples.* Journal of Archaeological Science, Report. (accepted)

Umberto Veronesi, Mario Bandiera, Marta Manso, Andreia Ruivo, Márcia Vilarigues, Susana Coentro. *Naples yellow: Experimental re-working of historical recipes and the influence of the glazing process in the in situ analysis of historical artwork.* Boletín de la Sociedad española de cerámica y vidrio XXX (2023) xxx-xxx. <https://doi.org/10.1016/j.bsecv.2023.01.006>.

Márcia Vilarigues, Andreia Ruivo, Thijs Hagendijk, Mario Bandiera, Mathilda Coutinho, Luis C. Alves, Sven Dupré. *Red glass at Kunkels' Ars Vitruvia Experimentalis: the importance of temperature,* in International Journal of Applied Glass Science, august 2022 <https://doi.org/10.1111/ijag.16605>

Bandiera M., Verità M, Zecchin S, Vilarigues M. *Some secrets of Renaissance Venetian opaque red glass revealed by analyses and glassmaking treatises.* Glass Technology: Europ. J. of Glass Science and Technology, Part A. 2021, Vol62(1):24-33.

Bandiera M, Verità M, Lehuédé P, Vilarigues M. *The technology of copper-based red glass sectilia from the 2nd century AD Lucius Verus villa in Rome.* Minerals. 2020,10. DOI: [10.3390/min10100875](https://doi.org/10.3390/min10100875)

Bandiera M, Léhuédé P, Verità M, Alves L, Biron I, Vilarigues M. *Nanotechnology in Roman Opaque Red Glass from the 2nd Century AD. Archaeometric Investigation in Red Sectilia from the Decoration of the Lucius Verus Villa in Rome.* Heritage 2019, 2(3), 2597-2611. DOI: [10.3390/heritage2030159](https://doi.org/10.3390/heritage2030159)

- Conference proceedings Bernardi G., Verità M., Bandiera M. *Il mosaico con la vergine theotokos del museo civico medievale di bologna: nuovi studi*. In *Atti XXVIII colloquio AISCOM 2-4 marzo 2022, Udine*, 663-674.
- Bandiera M., Verità M., Gratuze B., Saguì L., Vilarigues M. *Chemical characterization of 2nd century AD opaque red glass sectilia from the Lucius Verus villa in Rome. Different recipes for different red hues*. In 20th Congress of AIHV 2022, September, Lisbon. In press
- Bandiera M, Verità M, Zecchin S, Villarigues M. *Il vetro rosso opaco veneziano attraverso ricettari e analisi di tessere musive*. Atti delle XX Giornate di Studio del Vetro, Comitato Italiano AIHV, 2022.
- Bandiera M, Verità M, Zecchin S, Villarigues M. *Riproduzioni in laboratorio del vetro rosso bruno opaco*. Atti delle XX Giornate di Studio del Vetro, Comitato Italiano AIHV, 2022.
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- Manuscripts submission preparation: in / Bandiera Mario, Verità Marco, Luis Cercquiera, Teresa Palomar, Patrice Lehuède, Marie Godet, Marcia Vilarigues; *The colour control of the ancient red brown glass. Laboratory reproduction*. (Minerals)

CONFERENCE PAPERS AND POSTERS

- Oral contribution Mario Bandiera, Umberto Veronesi, Marta Manso, Alexandre Pais, Lurdes Esteves, Andreia Ruivo, Márcia Vilarigues, Susana Coentro. *The colours of Portuguese azulejos. A multi-analytical characterisation of decorated tiles and the replication of historical pigment recipes*”, and a Poster, title: “How was it made? Studying the technology of Portuguese faience from the 16th to the 18th century. Conference European Meeting Ancient Ceramic (EMAC Pisa, 14-16th June, 2023).
- Mario Bandiera, Umberto Veronesi, Marta Manso, Alexandre Pais, Lurdes Esteves, Andreia Ruivo, Márcia Vilarigues, Susana Coentro. *Unveiling the colours of the 17th-18th century azulejos using a multi-analytical non-invasive approach* at the international conference on analytical techniques in art and cultural heritage – Technart 2023, held in Lisbon (Portugal), from 7 to 12 May 2023
- Bandiera M., Verità M., Saguì L., Vilarigues M.; *Archaeometric investigation on the opaque red glass sectilia from the villa of Lucius Verus (2nd century AD) in Rome*, Session 187: The Network Former: Trade and Exchange of Glass in Antiquity. 28th EAA Annual Meeting in Budapest, Hungary 31 August - 3 September 2022.
- Bandiera M., Verità M., Saguì L., Vilarigues M. *The production of opaque red glass during the 2nd century AD in Rome. Archaeometric study of the red glass sectilia from the villa of Lucius Verus*. Congresso Tematico AIAr Padova, 29 giugno-1 luglio 2022.
- M. Bandiera, M. Verità, B. Gratuze, M. Vilarigues *Chemical characterization of 2nd century AD opaque red glass sectilia from the Lucius Verus villa in Rome. Different recipes for different red hues*. 22nd Congress of the Association Internationale pour l'Histoire du Verre 13-17 September 2021.
- M. Bandiera, P. Lehuédé, M. Verità, I. Biron, M. Vilarigues, “*The nano-technology in Roman opaque red glass from the 2nd century AD. Archaeometric investigation in red*

sectilia from decoration of the Lucius Verus Villa in Rome”, European Materials Research Society Conference, Nizza 27-31 May 2019.

M. Bandiera, M. Verità, S. Zecchin, M. Vilarigues, “*Il vetro rosso opaco veneziano attraverso ricettari e analisi*”, XX Giornate Nazionali di Studio sul Vetro Ravenna, 18-19 May 2019, Italian Committee AIHV.

M. Bandiera, M. Vilarigues, M. Verità, L. Saguì “*Technological study and chemical-archaeometric characterization of Roman opaque red glass of 2nd century A.D. in the Gorga Collection*”, V congresso Hispano-Luso de Ceramica e Vidrio, LVI Congresso Nazionale SECV, Barcelona 8-11 October 2018.

M. Bandiera, M. Vilarigues, M. Verità, L. Saguì “*Technological study and chemical-archaeometric characterization of Roman opaque red glass of 2nd century A.D. in the Gorga Collection*”, in the summer school “*Corso di formazione specialistica: Il vetro nell’Antichità*”, Sarzana – Luni (SP), 16-17 June 2018” Comitato Italiano del AIHV (Italy)

Poster presentation

Susana Coentro, Mario Bandiera, Umberto Veronesi, Alexandre N. Pais 3, Anabela Castro, Sofia Pires, Inês Coutinho, Maria João Cândido, Sílvia Pereira, João M. Mimoso. *How was it made? Study the technology of the ancient Portuguese faience from the 16th to the 18th century*. Conference European Meeting Ancient Ceramic (EMAC Pisa, 14-16th June, 2023)

Umberto Veronesi, Mario Bandiera, Marta Manso, Andreia Ruivo, Márcia Vilarigues, Susana Coentro. *What colour is it? Experimental, replications and the quest for yellow in Portuguese azulejos. The 9th Interim Meeting of the Art Technological Source Research Working group “Work in Progress: The artists’ gestures and skills explored through art technological source research”* in Paris at INHA (Institute National pour l’Histoire de l’Art), rue Vivienne, 75002 Paris from 24th to 25th of November.

Bandiera, M., Verità, M., Lehuédé, P., Cerqueira, L.A., Pinto, J, Saguì, L., Vilarigues, M. *Archaeometric study on the production technology of opaque red glass sectilia from the 2nd century AD Lucius Verus villa in Rome*. In 43rd International Symposium on Archaeometry Lisbon, 16th – 20th May 2022.

Mario Bandiera, Marcia Vilarigues, Marco Verità, Alves Luis, Lucia Saguì, “*Roman opaque red glass, considerations and improvements on the application of PIXE analyses on archaeological glass*”. 16th International Conference on Particle Induced X-Ray Emission, 24-29 of March 2019. Cultural and Congress Center of Caldas da Rainha.

M. Bandiera, M. Vilarigues, M. Verità, L. Saguì, “*Roman opaque red glass from the Lucius Verus Villa, 2nd century AD. The secret of colour*”, Poster session of the X^o Congresso Nazionale AIAR, 12-14 February 2018 Torino (Italy).

M. Bandiera, M. Verità, S. Zecchin, M. Vilarigues, “*Riproduzioni in laboratorio del vetro rosso opaco*”, XX Giornate Nazionali di Studio sul Vetro Ravenna, 18-19 May 2019, Italian Committee AIHV.

REFERENCES

PhD Andrea Cagnini,
Direttore del settore indagini non invasive del laboratorio scientifico dell'Opificio delle Pietre Dure di
Firenze.

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LAMA Laboratory for Analysis of Ancient Materials - IUAV University
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Professor Márcia Vilarigues
Head of the Department of Conservation and Restoration (www.dcr.fct.unl.pt) and Director of the Research
Unit VICARTE - Vidro e Cerâmica para as Artes (www.vicarte.org)
Fellow Society of Glass Technology (www.sgt.org)
Vice-president of the Association internationale pour l'histoire du verre (www.aihv.org)
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