**ICOM-CC**
**Scientific Research Working Group**

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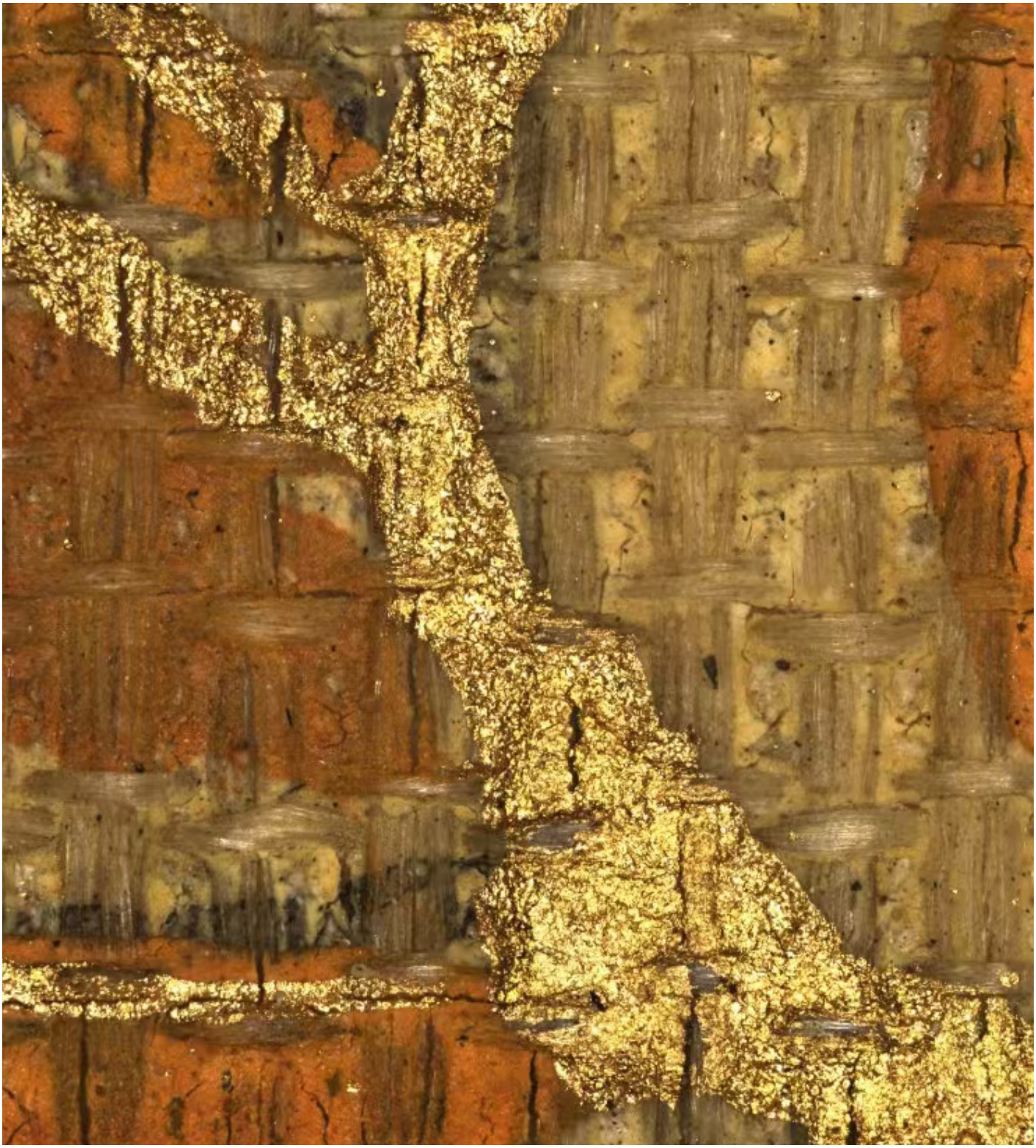
# NEWSLETTER



© An Gu
*Microscopic image of the gold lines in a Chinese painting by the court painter Leng Mwei, 18th Century*

# SCIENTIFIC RESEARCH

**Coordinator:**
*Lei Yong*

**Assistant Coordinators:**
*Jocelyn Alcantara-Garcia\ Ashley A. Freeman\ Manako Tanaka\ Rosanna Kuon\Hana Lukesova\Joy Mazurek*

## Working Group Aims

The Scientific Research Working Group is a venue to discuss in detail new research technologies and methodologies across many types of materials and collections. Application of methods and techniques for specific materials or objects are considered in the appropriate ICOM-CC working group. The areas of interest of the Scientific Research Working Group include: material degradation studies; non-invasive analysis and characterization; portable instrumentation, sensors and dosimeters; scientific methods for dating, provenancing and authentication; and statistics, modeling and chemometrics for cultural heritage. By exploring heritage materials, their construction, and mechanisms of deterioration, we aim to improve the conservation of moveable and immoveable heritage..

## Working Group [Scientific Research]

Working Group Triennial programme

- Organize an international seminar collaborated with some other working group.
- Organize a series of online seminar, to show case studies in Neutron Heritage Science.

## Activities for 2025

- Online session PERCEIVE: A new approach to the simulation of color change in paintings and works of art on paper -10 and 21 March 2025, Graphic Documents  Paintings, Scientific Research
- ICOM-CC Scientific Research Working Group Online session: Neutron in Heritage Science, 12 April 2025
- Encourage more professionals to become members of the committee and all the groups.

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# Lei Yong

Meet the Coordinator

Dr. LEI Yong holds a Bachelor's degree in History from Northwest University (Xi'an, China), a Master's degree in History from the School of Archaeology and Museology at Peking University, and a Doctorate in Science from the Institute of High Energy Physics, Chinese Academy of Sciences. His doctoral research primarily employed Instrumental Neutron Activation Analysis (INAA) to determine the trace elemental composition of Tang Sancai (three-colored glazed pottery of the Tang Dynasty) ceramic bodies unearthed from kiln sites, tombs, and architectural remains, for the purpose of provenance studies.

Since 2004, he has been engaged in the conservation and scientific research of cultural heritage at the Palace Museum in Beijing. He currently serves as Director of the Department of Conservation Science and Technology and is a Senior Research Fellow. His work focuses on the conservation and scientific analysis of a wide range of cultural artifacts, including paintings and calligraphy, ancient ceramics, lacquerware, and textiles. Through both research and scientific leadership, he has significantly enhanced the Palace Museum's heritage science capabilities and contributed to the development of innovative methodologies—particularly in materials characterization and non-destructive analysis systems tailored to Chinese cultural relics.

By leveraging advanced scientific techniques such as synchrotron radiation and computational chemistry, Dr. Lei has conducted systematic investigations into the composition and microstructure of ancient Chinese high-temperature iron- and copper-based glazes at the microscopic level. In collaboration with the Shanghai Advanced Research Institute of the Chinese Academy of Sciences (Shanghai Synchrotron Radiation Facility) and Peking University, he has carried out comprehensive studies on the synthesis mechanisms and phase purity of iron oxide crystals ($\varepsilon$-$Fe_2O_3$) in glazes spanning from the Tang to the Qing dynasties. He has also clarified the raw material sources, firing challenges, and reasons for subsequent scarcity of colorants used in early Ming dynasty underglaze red porcelain.

As Director of the Key Laboratory for the Conservation of Calligraphy and Painting under the Ministry of Culture and Tourism, he has led efforts to establish non-destructive, systematic analytical methods specifically adapted to Chinese painting and calligraphy. He served as principal investigator for a major national R&D project entitled Research on the Value Recognition and Key Technologies for the Conservation of Organic Movable Cultural Heritage, which focused on materials such as paper, textiles, and lacquerware. The project played a key role in building systematic analytical methods and databases, providing critical new insights for heritage science.

Dr. Lei currently serves as the Coordinator of the Scientific Research Working Group of the International Council of Museums Committee for Conservation (ICOM-CC) and is a Fellow of the International Institute for Conservation of Historic and Artistic Works (IIC). He continues to promote the advancement of scientific analysis techniques in cultural heritage and actively fosters international collaboration and knowledge exchange in the field of heritage science.

# Ashley A. Freeman

Meet the Assistant Coordinators

Dr. Ashley A. Freeman is an Associate Scientist at the Getty Conservation Institute, where she is part of the Preventive Conservation research team. Her work focuses on understanding how cultural heritage materials respond to environmental fluctuations by monitoring mechanical changes and measuring physical properties. She employs a range of scientific techniques, from directly applying acoustic emission to heritage objects to small-scale testing methods such as nanoindentation. Freeman's research primarily examines how wood and other hygroscopic materials react to environmental changes, as well as the characterization and analysis of modern paints and polymer-based materials.

Her academic background combines chemistry, conservation science, and engineering. She holds a BA in Chemistry from Monmouth College (Illinois), a study certificate in restoration and conservation from Lorenzo de' Medici (Italy), Master's degrees in Chemistry from Loyola University Chicago and in Conservation Science from Queen's University (Canada), and a PhD in Engineering from the Norwegian University of Science and Technology. This interdisciplinary training allows her to approach conservation challenges from both scientific and practical perspectives.

Freeman has been involved with the Getty in various capacities over the years. She first joined as a Graduate Intern in 2015–2016, followed by a position as a Research Lab Associate from 2016 to 2018. From 2022 to 2023, she worked at the Los Angeles County Museum of Art as an Andrew W. Mellon Postdoctoral Research Fellow in Conservation Science before returning to the Getty in 2023.
Since 2017, she has served as Assistant Coordinator for the ICOM-CC Scientific Research Working Group (SRWG), supporting initiatives that foster collaboration and knowledge exchange among cultural heritage professionals.

At the GCI, Freeman contributes to the Managing Collection Environments initiative[1], which focuses on the environmental management of cultural heritage, and the Modern Paints project[2], which involves the characterization and analysis of contemporary paint materials.

1- Managing Collection Environments Initiative: https://www.getty.edu/projects/managing-collection-environments-initiative/

2- Modern Paints Project: https://www.getty.edu/projects/modern-paints/

# Hana Lukesova

Meet the Assistant Coordinators

Hana Lukesova is a Senior Conservator at the University Museum of Bergen in Norway. A significant milestone in her professional journey was a study at the renowned Abegg Foundation and the Bern University of Applied Sciences in Switzerland, where she deepened her expertise in Textile Conservation. This institution, recognised for its excellence in curating and conservation of archaeological and historical textiles, expanded her understanding of intricate conservation techniques as well as methodologies applicable to diverse cultural heritage objects. Later, she received her PhD on the topic "Fibres in Heritage Objects. Identification and Characterisation by Imaging Techniques" in the department of Physics and Technology at the University of Bergen. Her aim lies in bridging various research fields from humanities and natural sciences and strengthening the position of the conservation profession.

She has been captivated by the diverse world of organic materials – especially textile fibres, their physical properties, and processing techniques, as well as their application for creation of various objects and artistic craftsmanship. She has long worked on the cutting edge of Conservation, Heritage Science, Art History and Archaeology.

Coming originally from the Czech Republic, she has experienced conservation practice in different European countries. She gained conservation experiences at the Prague Castle and further training in Germany, which reinforced her understanding of various conservation methodologies of fragile materials that define cultural identity across different periods and regions.

Her interdisciplinary background, which bridges art, heritage science, and conservation brings a diverse skill set and makes her well-suited for assisting in ICOM-CC Research Group. Collaboration is a key aspect of her work. As a researcher, she has contributed to pioneering studies on material analysis, methodological advancements, and textile conservation, published in leading journals. She has also played a vital role in international research networks, serving as a committee member in COST Action EuroWeb "Europe Through Textiles. Network for an integrated and interdisciplinary Humanities" and the follow up innovation project "Building a Heritage-Based Knowledge Hub to Empower the Green Transition in Textiles and Fashion, HERITEX-HUB." She has been co-hosting the community ComTex, joining archaeologists and conservators at the European Association of Archaeologists EAA. She has been the Norwegian vice representative on the E-RIHS enlargement board and is participating in large-scale heritage science projects. Through teaching, supervising students, mentoring early-career professionals, editorial work as well as external project evaluation, she fosters an open and collaborative environment for knowledge exchange in conservation and heritage science. Her work continues to advance interdisciplinary cooperation, integrating scientific innovation with traditional knowledge to further the conservation field.

She is excited to be part of the ICOM-CC team contributing to the Scientific Research Group. She especially looks forward to the Triennial Conference, meeting colleagues across the world and different specialisations. As a member of the conference National Organising Group, she is excited about the rich program of pre- and post-tours stretching from the far North to the South of Norway and hopes to meet colleagues in Bergen before the conference starts.

# Jocelyn Alcántara-García

Meet the Assistant Coordinators

Prof. Jocelyn Alcántara-García (she/her/ella), Ph.D. specializes in using scientific methodologies and multi-disciplinary collaborations to better understand material culture. At present, she is working on Spanish illuminated manuscripts, textiles, and waterlogged archeological wood, actively collaborating with chemometricians, conservators, and historians. In addition, in 2024 she began collaborating with industrial partners because she trusts that the past can inform the future.

She joined the University of Delaware's (UD) Department of Art Conservation in the fall of 2014 after working for about five years in interdisciplinary projects – predominantly in Mexico, where she was born. Since 2023, she has a joint appointment with the Department of Chemistry and Biochemistry at the same institution. Jocelyn studied Conservation for two years at the National School of Conservation, Restoration and Museography (ENCRyM) and received a B. S. and a Ph. D. in (Inorganic) Chemistry from the National Autonomous University of Mexico (UNAM). Prior to joining UD, she was at the Brno University of Technology in the Czech Republic (VUT, internship in polymers), the National Museum of Contemporary Art Reina Sofia (MNCARS conservation science fellow, Spanish Ministry of Culture), and completed postdoctoral research at Johns Hopkins University (JHU) as an Andrew W. Mellon Postdoctoral Fellow. Jocelyn is both a Phi Kappa Phi and Sigma Xi member.

Her research interests revolve around material culture and are divided into three broad categories, mostly involving textiles and/or archival materials:

- forensic analysis
- reverse engineering and degradation mechanisms
- innovative approaches to nondestructively study cultural heritage.

Besides her research roles, she is active in creating new pedagogies to attract and retain people to STEM fields. She enjoys serving in editorial roles, including as an associate editor to Studies in Conservation, and as a guest editor to the special issue of ChemPlusChem "The Chemical Arts: Chemistry for Characterization, Interpretation, and Management of Cultural Heritage."

Jocelyn joined ICOM-CC first when she realized that she visited enough museums around the globe to pay for a membership. A few years later, she saw that her skillset as a scientist with some conservation experience and teaching, could serve the association if more active. Her opportunity to use these skills came when she joined as an assistant coordinator to the scientific research working group. Her first term coincided with the last term of our previous coordinator – Lynn Lee. Selecting and then editing abstracts and papers culminated in chairing one session at the Triennial in Valencia. She very much looks forward to continuing serving our profession, welcoming new members, and encouraging all to join ICOM-CC.

***«IT IS NOT JUST MUSEUM ENTRANCES! »***

# Joy Mazurek

Meet the Assistant Coordinators

Joy Mazurek has worked for over 25 years within the materials characterization laboratory in the scientific department at the GCI to advance scientific research in heritage conservation. She obtained her MS in biology, with emphasis in microbiology from California State University Northridge, and has used her background in biology to characterize the chemical biomarkers found on artwork and wooden building materials due to microbial degradation.

She specializes in the analysis of organic materials found in a range of artist materials, from ancient to modern, including past treatments, coatings, plastics, and binding media. She utilizes analytical techniques like GC-MS, FTIR, Ion Chromatography, and Size Exclusion Chromatography. She is currently active in the Getty's Preservation of Plastics project *(https://www.getty.edu/projects/preservation-of-plastics/)* that aims to find sustainable treatment protocols and preservation solutions for three dimensional plastic artworks.

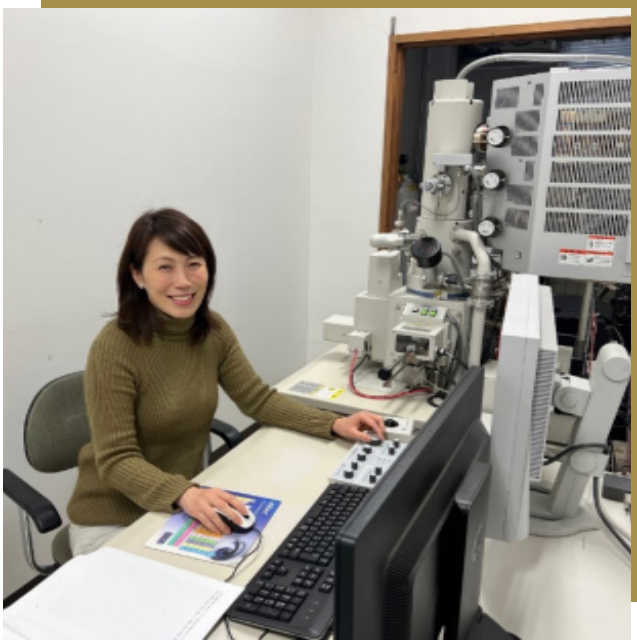
She is actively involved with international projects including:

- Sticking Stones *(https://www.uis.no/en/museum-of-archaeology/research/sticking-stones-rediscovering-medieval-wood-tar-adhesives-for-stone)*,
  A project that characterizes tar adhesives used in medieval churches in Europe.

- In Bloom project *(https://sites.fct.unl.pt/inbloom)*
  A project that investigates the impact of different treatments to remove blooming on polyurethane-coated fabrics used in fashion and design collections.

# Manako Tanaka

Meet the Assistant Coordinators



Dr. Manako Tanaka is an associate professor at the Graduate School of Fine Arts, Tokyo University of the Arts. She obtained her Ph.D. in the conservation of cultural properties from Tokyo University of the Arts. She specializes in conservation science, with a primary focus on material science research on metal artifacts such as Japanese swords and matchlock guns, as well as coloring materials. In recent years, she has been actively engaged in the non-destructive study of cultural properties using synchrotron radiation, neutrons, and muons. She is also diligently involved in interdisciplinary research on the conservation of modern and contemporary art.

Dr. Tanaka serves as an Associate Coordinator (ACO) of the ICOM-CC Scientific Research Working Group and is also a committee member for numerous international and national conferences in her field of expertise. Her roles include serving as a Standing Committee member of the International Conference on the Beginnings of the Use of Metals and Alloys (BUMA), a Commission Member of the Archaeometry of Prehistoric and Protohistoric Inorganic Artifacts, Materials, and Technologies Commission of UISPP, a Public Relations and External Affairs Secretary of the Specific Synchrotron Radiation Facilities Users Community (SpRUC), and the Representative of the SpRUC Cultural Heritage Research Group. She is excited to contribute to global activities as an ACO of the Scientific Research Working Group of ICOM-CC and looks forward to deepening her exchanges with experts in the field.

# Rosanna Kuon A.

Meet the Assistant Coordinators

She is the co-founder and an Associate Researcher at the Center for Research and Conservation of Heritage at the University of Engineering and Technology (UTEC) in Peru. As a conservator and restorer, she works as part of an interdisciplinary team dedicated to developing projects focused on the conservation of cultural heritage in her country.

One of the most significant projects she has coordinated is the research titled "Methodology, identification, and analysis of pigments in the work of painter Cristóbal Lozano (18th century) and the alteration processes under adverse environmental conditions."

She holds a degree in Architecture from the Universidad Nacional San Antonio Abad del Cuzco, a certificate from the Istituto Universitario di Venezia, Italy, and a Master's degree in Museology and Cultural Management from Universidad Ricardo Palma in Lima. Her main areas of interest include research on conservation methods and materials, technical and scientific documentation, environmental monitoring in museums and libraries, and preventive conservation, which she actively pursues through her work at UTEC's Heritage Center.

From 2015 to 2017, she served as a UNESCO consultant on projects related to post-disaster needs assessments in museums, recovery of fire-damaged documentary heritage, development of protocols for the transfer of archaeological objects, and the design of preventive conservation policies for institutions holding collections. She also has experience implementing the Re-Org program and developing projects for the diagnosis and conservation of museum collections.

Previously, she launched and led the Conservation and Restoration Workshop at the Museum of Art of Lima (MALI), where she coordinated several national and international seminars in collaboration with experts from Spain, the United States, and Canada. She has participated in professional congresses and advanced training programs across Europe, Asia, and the Americas, invited by institutions such as the Getty Foundation, ICCROM, CECOR (Brazil), the Canadian Conservation Institute (CCI), and the American Institute for Conservation (AIC).

She was part of the management team that developed the Master's Degree in Preventive Conservation and Collections Management at UTEC, and a member of the organizing committee for the 30th Biennial IIC Congress held in Lima. She has been a member of ICOM since 1989 and is a Fellow of the International Institute for Conservation (IIC).

# Advancing Cultural Heritage Research with Fourth-Gen High Energy Photon Source (HEPS)

The scientific exploration of ancient artefacts has long been integral to archaeological research in China. For years, scientists at the Beijing Synchrotron Radiation Facility (BSRF), part of the Institute of High Energy Physics (IHEP), Chinese Academy of Sciences, have utilised X-ray absorption fine structure (XAFS) spectroscopy to investigate the chemical states of elements used as principal colourants in various ancient Chinese ceramics,[1-5] e.g. copper-based colouring agents responsible for the brilliant reds in the famed Changsha wares[1] and sacrificial red glazes[3], and arsenic in royal italic porcelain[4]. This accumulated expertise has laid a robust foundation for advanced heritage science studies at IHEP's new ambitious megaproject, the High Energy Photon Source (HEPS).

Aerial view of High Energy Photon Source (HEPS) in Huairou, Beijing, China.

© Guang Yuan

Located in Huairou, Beijing, HEPS is Asia's first fourth-generation high-energy synchrotron radiation light source. It boasts world-leading performance with an electron energy of 6 GeV, an emittance better than 0.06 nm·rad, and an extremely high brilliance of $1\times10^{22}$ photons/s/mm$^2$/mrad$^2$/0.1%BW. Its high-energy X-ray beams, reaching up to 300 keV, allow deep penetration of dense materials like metals while minimising radiation-induced degradation, which is critical for non-destructive analysis of large, intact artifacts. Initially equipped with 14 user beamlines providing cutting-edge analytical capabilities across various scientific disciplines, HEPS is expected to be fully operational by early 2026. Future plans include expanding to over 30 beamlines in a Phase II upgrade around 2030, potentially including a dedicated beamline for cultural heritage research.

The heritage science programme at HEPS aims to revolutionise the study of heritage objects in China and beyond, by leveraging the powerful new techniques available with fourth-generation synchrotron radiation. With its rich material culture spanning thousands of years, China has an enormous diversity of archaeological materials to investigate. HEPS will enable multi-analytical approaches that can comprehensively probe artefacts to gain a holistic understanding of their materials, manufacturing processes, and state of deterioration at a spatial resolution of around 10 nm and a temporal resolution at the picosecond level.

The extremely bright and high-energy X-ray beams at HEPS will facilitate several new techniques ideal for heritage material analysis. Pair distribution function (PDF) will offer insights into the disordered structures

of glassy materials such as ancient ceramic glazes and glass. X-ray photon correlation spectroscopy (XPCS) will allow the study of dynamic processes in material alterations. Next-generation coherent X-ray imaging methods such as ptychographic and holographic nanotomography, will reveal unprecedented 3D detail of nanostructures within heritage objects.

In several pilot studies, researchers at the Hard X-ray Nanoprobe beamline (ID19) at HEPS have collaborated closely with synchrotron facilities worldwide. They have already made intriguing discoveries about the nanostructures in ancient Chinese ceramics, utilising nanoscale X-ray fluorescence, absorption, diffraction, and high-resolution 3D nanotomography[6]. These multi-modal experiments aim to understand how nanoscale structures contribute to the overall aesthetic expression of the artefacts, and the remarkable functional properties of materials used in ancient ceramics, potentially inspiring modern material synthesis[7]. Preliminary results have identified intricate nanofeatures in ancient ceramics, such as epsilon-$Fe_2O_3$ crystallites embedded in black glazes, and revealed the spatial correlation of different elements at the nanoscale around μm-sized cobalt blue pigment particles that produce striking visual effects in Qing Hua (blue-and-white) glazes. The combined use of the above techniques provides rich new insights into the ingenious nanostructures created by ancient artisans, long before the concept of nanotechnology existed.

As HEPS prepares to open for general user operations, it promises to offer cultural heritage scientists, archaeologists, conservators, restorers, curators, and art historians unprecedented analytical capabilities. With its extremely bright and penetrating X-ray beams, diverse experimental techniques, artificial intelligence (AI)-driven big data processing capability, and dedicated heritage science programme, HEPS is set to accelerate the frontiers of knowledge about ancient materials and manufacturing craftsmanship. The facility welcomes proposals for innovative projects that will deepen our understanding of cultural heritage and push the boundaries of heritage science research globally.

Further information on HEPS is available at: *https://english.ihep.cas.cn/heps/*


1-Li, Y., et al. 2016. Colour-generating mechanism of copper-red porcelain from Changsha Kiln (AD 7th–10th century), China. Ceramics International, 42(7), pp.8495-8500.

2-Chen, G., et al. 2017. Confocal depth-resolved fluorescence micro-X-ray absorption spectroscopy for the study of cultural heritage materials: a new mobile endstation at the Beijing Synchrotron Radiation Facility. Journal of Synchrotron Radiation, 24(5), pp.1000-1005.

3-Zhu, J., et al. 2020. The application of confocal depth-resolved micro-X-ray absorption spectroscopy to study colorant copper in ancient lead-silica glassy system at the Beijing Synchrotron Radiation Facility. Optik, 218, p.165239.

4-Li, Y., et al. 2018. Study of arsenic in Famille rose porcelain from the Imperial Palace of Qing Dynasty, Beijing, China. Ceramics International, 44(2), pp.1627-1632.

5-Xing, C., et al. 2025. Local structure of iron and its role in the colouration of Qingbai (blue-greenish white) glazes: A multi-analytical study of Zhonghe wares from Guangxi, China (1100–1300 CE). Journal of the European Ceramic Society, 45(2), p.116892.

6-CNPEM, 2024. Programa de Usuários CNPEM - Yu Li [Online]. Available at: https://www.youtube.com/watch?v=MtJ3Lfrjqn4

7-Li, Y., 2024. Plenary talk: Application prospects of High Energy Photon Source (HEPS) hard X-ray nanoprobe in cultural heritage analysis. Presented at the 2024 Annual Conference of the Cultural Heritage Analysis and Detection Technology Committee, China Association for Conservation Technology of Cultural Heritage, November 2024, Shanghai, China.

# Cultural Heritage Research at SSRF

Synchrotron radiation has proved being one of the powerful tools in the scientific research of cultural relics and archaeology. Since the commissioning of Shanghai Synchrotron Radiation Facility (SSRF) in 2009, we have consistently promoted the application of synchrotron radiation in archaeology and pushed for the cooperation with domestic research institutions of cultural heritage science, including the Palace Museum, Jingdezhen Ceramic University, Northwest University, Yungang Research Institute, and others, and strive to contribute to the understanding of sciences and technologies during the progress in Chinese civilization.

The Palace Museum has collaborated with SSRF for a long time in cultural heritage research. In 2015, we established "the Palace Museum—Shanghai Synchrotron Radiation Facility Joint Laboratory". By using advanced synchrotron radiation methods such as hard X-ray microprobe, micro-CT, XAFS, XRD, and synchrotron radiation infrared spectroscopy (IR), scientific issues in cultural heritage have been investigated including ancient materials science, manufacture and restoration techniques in ancient ceramics, paintings, ancient glass and enamel.

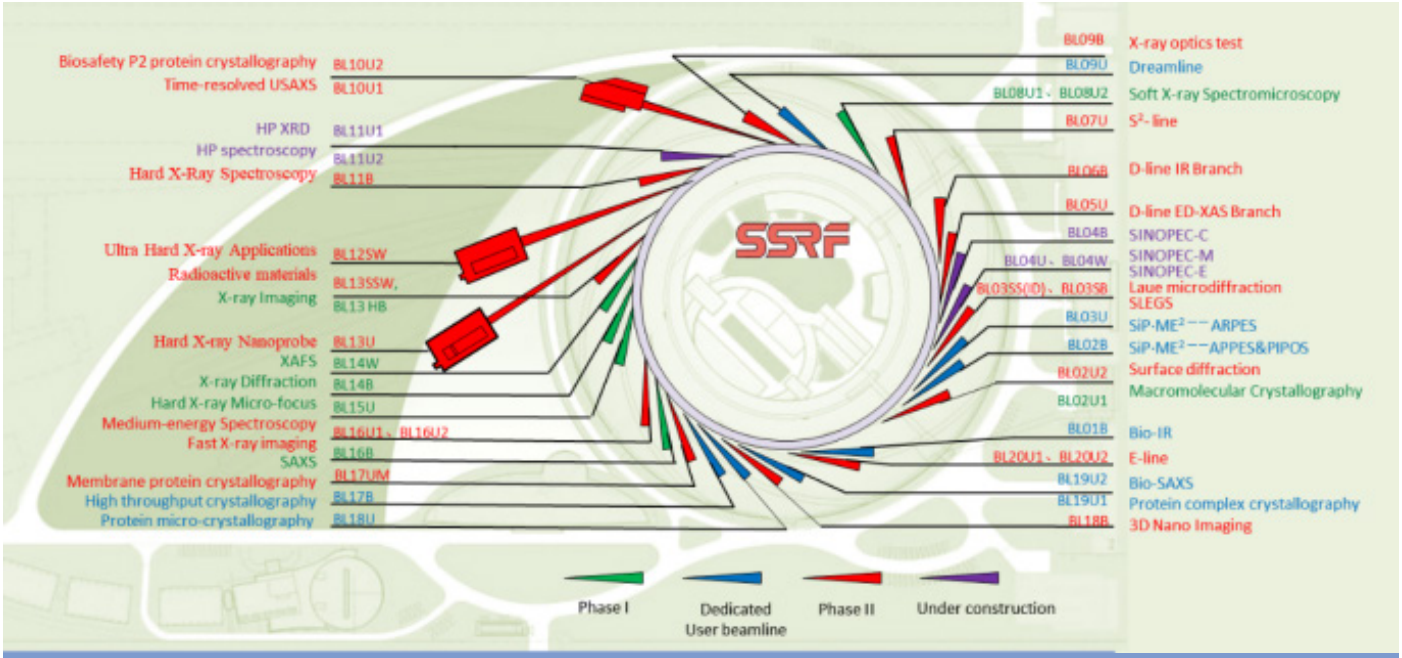



Fig.1, the layout of SSRF beamlines.

In order to disclose the faux bamboo painting techniques in Emperor Qianlong's Lodge of Retirement in Forbidden City, a three-dimensional (3D) X-ray analysis method was developed, a stratified structure in the painting was disclosed nondestructively, and it was found that this painting had undergone restoration once time in the history using almost the identical techniques as the original painting process[1].

In recent years, one of our important research progresses was the discovery that a metastable phase ε-Fe2O3 crystal commonly exists in high-temperature iron-rich black glazes from Tang Dynasty to Qing Dynasty[2-5]. Through the analysis of XAFS, XRD and Raman spectrum, we have shown that a high-alumina clay was used to create the glaze, which introduced the atoms Al, Mg or Ti into the ε-Fe2O3 lattices, thereby reducing lattice formation energy and playing a crucial role in stabilizing metastable crystals.


- *1-Xiangjun Wei, et al, Elemental depth profile of faux bamboo paint in Forbidden City studied by synchrotron radiation confocal mu-XRF. X-Ray Spectrometry, 2008.12, 37(6): 595~598*
- *2-Zhen Liu, et al, The morphology and structure of crystals in Qing Dynasty purple-gold glaze excavated from the Forbidden City. J Am Ceram Soc, 2018(101): 5229-5240*

As a result, ε-Fe2O3 crystals that can only exist stably at the nano scale are able to grow to micron scale. The explanation of Al-doping, combined with a new understanding of ancient firing manipulation, may provide alternative approaches for modern materials synthesis.

In fact, synchrotron radiation X-ray is not always a non-destructive probe in many cases. The combination of rapid in-situ ED-XAS and synchrotron radiation IR techniques was used to study the damage effect and mechanism of paint pigments[6]. It was found that most inorganic mineral pigments were relatively stable, while organic adhesive materials were prone to visible or invisible radiation damage. The research showed that radiation damage could be effectively reduced by energy selection according different method and adopt time-resolved techniques. Fig.2 is the ED-XAS and SR-IR coupling experimental system at SSRF

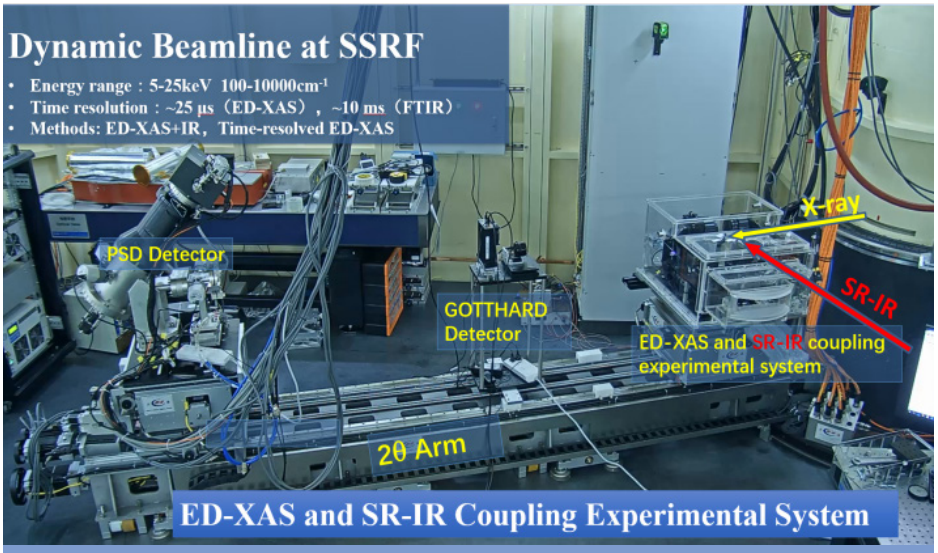



Fig.3, ED-XAS and SR-IR coupling experimental system at SSRF

In the future, the applications of nano-probe, ultrahard X-rays, three-dimensional nano-imaging and other advanced synchrotron radiation techniques, combined with neutron diffraction, scattering and imaging, will give many new opportunities to the cultural heritage science research.

Fig.2, Shanghai Synchrotron Radiation Facility, (SSRF)


- *3-Ming Guan, et al, Uncovering the mystery of Al(III) doping of ε-Fe2O3 in the ancient high-iron black-brown glaze. J Am Ceram Soc. 2023;1–12.*
- *4-Ming Guan, et al, The Microstructure of Multicolor Hare's fur Glaze: The Correlation between Morphological and Compositional Characteristics and Glaze Color. Heritage Science, 2021, 9(21).*
- *5-Gen Li, et al, The earliest known artificial synthesized ε-Fe2O3 in the Deqing Kiln ceramic ware of Tang Dynasty. Heritage Science, 2023(11:58).*
- *6-Zuning Zhang, et al, In situ investigation of synchrotron radiation damage effect of ancient paintings by time-resolved ED-XAS and IR combined techniques. X-Ray Spectrom. 2022; 51:394–402.*

# GETTY SYMPOSIUM EXPLORES THE FUTURE OF MUSEUM COLLECTION PRESERVATION

Last November, the Getty Center in Los Angeles hosted Mechanical Insights: Shaping the Future of Museum Collection Preservation, an event that united 120 attendees from 22 countries. The symposium served as a dynamic platform for cultural heritage professionals, early-career professionals, and external collaborators to discuss how advances in mechanical research are transforming the preservation of cultural heritage. Over three days of presentations, panel discussions, and poster sessions, participants explored innovative methods for understanding and mitigating the physical changes that threaten artworks and artifacts, all while balancing accessibility, sustainability, and effective communication.

Structured around three primary themes—mechanical testing, predictive tools, and monitoring and validation—the symposium addressed a broad range of challenges and opportunities, from laboratory testing of materials to the application of data-driven tools for preventive conservation.

The event highlighted how interdisciplinary collaboration is paving the way for more informed decision-making in museum environments, conservation practices, and art transportation.

Presenter and organizer Dr. Alexandra Bridarolli speaking at the symposium.

Photo by Cassia Davis.
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Poster sessions during social breaks.
Photos by Cassia Davis. © 2024 J. Paul Getty Trust.

## Themes and Key Topics

The symposium's program featured 26 presentations, 10 poster sessions, and four expert panel discussions, all centered on the application of mechanical research to cultural heritage preservation.

Topics included:

- Laboratory Testing: Evaluating historical and mock-up samples to simulate long-term wear and stress.
- Risk Assessment: Analyzing objects subjected to unstable climatic conditions or physical loads.
- Predictive Modeling: Validating predictive models through field studies and in situ monitoring.
- Emerging Technologies: Exploring advanced mechanical testing methods, including acoustic emission monitoring and nanomechanical analysis.
- Data-Driven Tools: Utilizing tools to predict material degradation and optimize conservation strategies.
- Education and Communication: Examining how research findings are communicated in multidisciplinary environments, with a focus on academic institutions that train conservation professionals.

Panel discussion led by Dr. Michal Lukomski.

Photo by Cassia Davis. © 2024 J. Paul Getty Trust.

Recordings of the symposium's presentations will soon be available, providing a valuable resource for fostering multidisciplinary collaboration and advancing conservation education.

For more information, visit the symposium's website:
https://www.getty.edu/projects/mechanical-characterization-historic-artistic-materials/mechanical-insights-symposium/

# INART2024- 6TH INTERNATIONAL CONFERENCE ON INNOVATION IN ART RESEARCH AND TECHNOLOGY.

The 6th International conference on Innovation in Art Research and Technology- InART2024 took place in Oslo (Georg Sverdrups Hus, Blindern Campus of the University of Oslo) from 4 to 7 June 2024. The conference program has been enriched by a pre-conference workshop titled "Colour and appearance for cultural heritage – new research approaches from the ApPEARS and PERCEIVE projects", hosted in collaboration with Munch Museum and Colorlab-NTNU, and by a post-conference event titled "Perceive color in new ways "was held at the Historical Museum on 8 June 2024, in collaboration with the Munch Museum.

InART is a biannual international conference started in Evora (Portugal) in 2013, gathering scientists from around the world to present the latest updates in terms in innovation in research and technology applied to the investigation of cultural heritage. InART, at its 6th edition, is recognized as one of the main conference series in the field of Heritage Science and as an open platform for knowledge-sharing among professionals in the field, including conservation and archaeology, which represent fundamental branches in cultural heritage research and are increasingly interested and involved in the exploitation of scientific analysis results. The need for improved collaboration between natural sciences, conservation and archaeology is an important aspect that InART2024 aimed to touch (see Keynote lecture given by Anna Villa). Heritage science is, in fact, a highly multidisciplinary research field and topics covered during the InArt2024 conference could be approached, discussed, and solved from different perspectives all relevant to the final aim of bringing innovation in the field of research on cultural heritage.

Indeed, the scope of the organization was to organize a conference relevant for conservators, conservation scientists and archaeologists, providing a unique overview about how the contribution of natural science to the study of cultural heritage is perceived and used by these communities. Grey areas - such as what is relevant to conservation, how information from natural sciences can be applied, and its impact on the practice of conservation – were highlighted.

InART2024 was organized by the Museum of Cultural History of the University of Oslo, chosen by the conference scientific board by virtue of the experience of the museum's SciCult analytical laboratory in the field of application of natural sciences to the study of artworks and development of new materials and approaches for conservation.

## The conference topics were:

- Development of new tools (devices, technology, software, etc.), advanced data analysis and FAIR (Findable, Accessible, Interoperable, and Reusable) data management.
- Development and/or implementation of new methods and routines (diagnostic and conservation) for the understanding of heritage materials, techniques, and degradation processes (chemical, physical and biological).
- Development, testing (includes mechanical testing), and characterization of new materials for conservation (special attention to green conservation treatments).
- Application of non-invasive/non-destructive techniques.
- Preventive conservation: environmental monitoring techniques and climate/microclimate effects on the conservation of heritage sites and exposed objects.

The call for abstracts closed on 30.11.2023 and a total of 245 abstracts, including both oral and poster presentations, were received.

The final conference program included 49 oral presentations divided into 14 oral session and three Keynote lectures given by Dr. Dante Abate (Advanced and Intelligent Aerial and Space-

Born Techniques to Safeguard Archaeological Sites Against Natural and Man-Made Threats), Dr. Michal Lukomski (Sustainable Management of Collection Environments) and Dr. Anna Vila (Building Bridges: Integrating Conservation and Conservation Science) and two poster sessions of two days each (poster session 1 on 4-5 June 2024, poster session 2 on 6-7 June 2024) for a total 114 posters (106 in the program and 8 extra posters).

Contributions represented the latest updates in research pointing towards the hottest topics in heritage science and future directions scientists and conservators must develop. Oral sessions focused on diverse topics such as Applications of Artificial Intelligence, 3D documentation and Virtual Reality, Data management, (e.g., creation or implementation of databases, reuse of existing stored data, application of blockchain technology, application of artificial intelligence), and digitalization. Some sessions focused on analytical techniques increasingly exploited in the last years for different purposes, such as spectral imaging, neutron-based analysis (imaging, diffraction), computed tomography, synchrotron-light based analysis, etc., and on research involving unusual analytical techniques (e.g., multiphoton microscopy, immunofluorescence microscopy, μ-IBIL, proteomics, etc.). On the other hand, a lot of space was also given to the development of more sustainable practices and protocols, development of greener and innovative materials for conservation, preventive conservation (e.g., microclimate/microenvironment, vibrations in museums, etc).

A sponsors' exhibition area (Riksantikvaren, University Museum of Bergen, Springer, Metrohm, Hirox, Truvue, Hyspex, Bruker, Blue Scientific, Renishaw, Shimadzu, Kremer, NTNU, Conversation Conservation) remained open for the entire duration of the congress, while the social program included an afternoon of visits to different museums of the Oslo area that kindly offered us guided tours of their collections or laboratories and storages (Museum of Cultural History, Natural History Museum, UiO original campus, Munch Museum, National Museum, Maritime Museum, Norsk Folkemuseum, Norwegian Museum of Science and Technology), a welcome cocktail at the Historical Museum and a conference dinner. The conference program is downloadable at: https://www.khm.uio.no/english/research/inart2024/conference-programme/index.html#june-3

A book of abstract published in a registered publication volume with ISBN has been produced and is freely available on the conference website: https://www.khm.uio.no/english/research/inart2024/publications/

In addition, a Focus point of the European Physical Journal plus (EPJ+) titled "Advances and Innovation in Heritage Science" has been activated, as well as a proceeding volume titled "Innovation in Art Conservation Research" (Springer).

The organization of InART2024 can be considered a success in terms of attendance of the conference: more than 200 researchers (177 in person attendees+ 41 online attendees+ 12 partners+ 19 UiO employees) from all over the word attended the conference making of InART2024 the most successful edition of the series so far. Last but not least InART2024 was supported by the Research Council of Norway in the frame of the calls for "supports for events", topic "Enabling Technologies".

# IDENTIFYING AND CHARACTERISATION OF NATURAL FIBRES IN CULTURAL HERITAGE AT THE UNIVERSITY MUSEUM OF BERGEN

The two last decades of research activities related to method development for archaeological and historical textile fibre studies anchored to the University Museum of Bergen and the Nanophysics group at the Department of Physics and Technology, University of Bergen has led to considerable results. Advancements in conservation and heritage science require continuous refinement of analytical methods and interdisciplinary approaches to understanding historical materials. Recent research has significantly contributed to improving fibre identification in cultural heritage contexts, expanding knowledge on ancient textiles, and developing novel scientific techniques applicable to conservation- and heritage science.

***A breakthrough in fibre analysis of heritage objects was achieved by refining methodologies for identifying archaeological and historical textile fibres.***

The use of optical and electron microscopy has been systematically examined, leading to the development of a transparent and structured approach to distinguishing between flax, nettle, jute, hops, and cotton (Lukesova & Holst, 2024). This work not only improves accuracy in fibre identification but also introduces documentation tables that standardise microscopy settings, ensuring that results can be replicated without consuming additional scarce material. The study further emphasises the importance of cautious and relative statements in fibre identification, acknowledging the limitations of working with degraded samples.

In a related study, the reliability of fibre cross-section shapes as an identification feature was critically evaluated (Lukesova & Holst, 2021). This work, recognised as the most cited paper in Archaeometry between 2021 and 2022, challenges the direct transferability of industrial fibre identification methods to cultural heritage science. Many heritage textiles exist in degraded conditions where conventional ISO standards cannot be applied due to ethical constraints related to sample conservation. This research encourages a re-evaluation of classical fibre identification techniques, advocating for adaptations that consider the complexities of ancient materials.

***The discovery and identification of hop fibres in historical textiles represent another milestone in heritage science studies.***

This work introduced a new methodology for distinguishing hop fibres (Humulus lupulus) in cultural heritage objects and provided the first experimental evidence of their historical use in Swedish textiles (Lukesova et al., 2018; Skoglund, Holst & Lukesova, 2020). By integrating fibre analysis with historical written sources dating back to the 17th century, this research significantly enhances understanding of material culture and textile production in Europe.

Investigating plant fibre textiles from Norwegian Merovingian and Viking Age graves has further enriched knowledge of ancient textile production. A systematic examination of burial textiles from the University Museum of Bergen's Late Iron Age Collection provided rare insights into material choices and textile craftsmanship during the Viking Age (Lukesova, Palau & Holst, 2017). By utilising advanced microscopy techniques, including the modified Herzog test, this study confirmed the widespread use of flax in fine

textile production and was highlighted in Nature Materials as a state-of-the-art contribution to heritage science (Ball 2017).

***The integration of computational techniques into textile reconstruction marks another significant advancement in the field.***

By merging expertise from conservation, archaeology, and computational sciences, researchers developed virtual reconstruction methods for fragmented and degraded textiles (Gigilashvili, Lukesova et al., 2023). This interdisciplinary approach bridges traditional manual reconstruction with cutting-edge automation, addressing the challenges of reassembling historical textiles with greater accuracy and efficiency. Through consultations with textile professionals, the study identifies critical automation needs and demonstrates the potential of computer-assisted reconstruction in conservation.

Beyond journal articles, significant contributions have been made in academic book chapters and monographs. An in-depth review of microscopy applications in historical textile analysis was provided in Handbook of Museum Textiles, offering an up-to-date resource on scientific and technological research in heritage textiles (Lukesova, 2022). This work compiles the most modern microscopy techniques used for characterising heritage textiles and serves as a foundational reference for conservation professionals.

These collective contributions illustrate the evolving nature of conservation and heritage science, demonstrating how interdisciplinary research can refine analytical methodologies, expand knowledge of historical materials, and introduce novel techniques for cultural heritage preservation. By continuously improving fibre identification methods, incorporating computational tools, and developing innovative scientific applications, this body of work strengthens the field's ability to safeguard and interpret historical textiles for future generations.

Expanding on methodological development, a PhD thesis addressed fundamental challenges in fibre identification and characterisation, particularly through imaging techniques (Lukesova, 2021). This research systematically evaluated the validity of established plant fibre identification methods when applied to archaeological and historical samples. Additionally, it developed an identification method for an overlooked textile plant fibre species and demonstrated the application of these techniques to cultural heritage objects. The findings underscore the necessity for standardised methods in heritage fibre identification, distinguishing it as a specialised sub-discipline that requires tailored analytical approaches. The thesis also highlights the importance of recognising that past societies utilised different textile resources than those commonly studied in modern fibre analysis.

References:


*Ball, P (2017): Seeking comfort in the Iron Age. Nature Materials 16, 789. https://www.nature.com/articles/nmat4950.*

*Gigilashvili, Davit, Hana Lukesova, Casper Fabian Gulbrandsen, Akash Harijan, and Jon Yngve Hardeberg. 2023. "Computational Techniques for Virtual Reconstruction of Fragmented Archaeological Textiles." Heritage Science 11 (1): 259–16. https://doi.org/10.1186/s40494-023-01102-3.*

*Lukesova, H., Holst, B. Identifying plant fibres in cultural heritage with optical and electron microscopy: how to present results and avoid pitfalls. Heritage Science 12, 12 (2024). https://doi.org/10.1186/s40494-023-01122-z*

*Lukesova, H. 2022. Microscopy of Historical Textiles. In: Handbook of Museum Textiles, Volume 2: Scientific and Technological Research, Jose, S., Thomas, S., Pandit, P., Pandey, R. (Eds.), Wiley & Sons, ISBN: 9781119983385, 45-59.*

*Lukesova, H, and B Holst. 2021. "Is Cross Section Shape a Distinct Feature in Plant Fibre Identification?" Archaeometry 63 (1): 216–26. https://doi.org/10.1111/arcm.12604.*

*Lukesova, Hana, and Universitetet i Bergen. 2021. Fibres in Heritage Objects : Identification and Characterisation by Imaging Techniques. Bergen, Norway: University of Bergen. https://hdl.handle.net/11250/2770227.*

*Lukesova, H, H. L Andersen, M Kolínová, and B Holst. 2019. "Is It Hop? Identifying Hop Fibres in a European Historical Context." Archaeometry 61 (2): 494–505. https://doi.org/10.1111/arcm.12437. https://doi.org/10.1007/s12520-020-01171-6.*

*Lukesova, Hana, Adrià Salvador Palau, and Bodil Holst. 2017. "Identifying Plant Fibre Textiles from Norwegian Merovingian Period and Viking Age Graves: The Late Iron Age Collection of the University Museum of Bergen." Journal of Archaeological Science, Reports 13: 281–85. https://doi.org/10.1016/j.jasrep.2017.03.051.*

*Skoglund, Git, Bodil Holst, and Hana Lukesova. 2020. "First Experimental Evidence of Hop Fibres in Historical Textiles." Archaeological and Anthropological Sciences 12 (9).*

> « *I would like to share two publications, each representing an ongoing project. These works have been possible thanks to cross-disciplinary – international – teams, and hard-working, smart, students!* »

## A SURVEY IN MATERIALS ANALYSIS, LEGAL, AND AESTHETIC CONTEXTS—TWO CASE STUDIES.

Spanish Illuminated Manuscripts are hand-written hand-painted documents made of paper or prepared animal skin, commonly calf or sheep. Most of these items are religious (e.g., bibles), although there are exceptions. A special case of illuminations are the Spanish-made executory certificates of nobility (cartas ejecutorias de hidalguía). These certificates detail the legal proceedings granting nobility to individuals meeting specific criteria, e.g., Catholic, skilled at wielding weapons, etc. Beneficiaries of such status would commission a copy for their personal use, likely to be displayed in their household. As a result, these manuscripts tend to be embellished with illuminations that include their coat of arms and –frequently– Catholic figures. As a genre, the contents of cartas ejecutorias has been studied, but the illuminations have received little attention.

I began working on these illuminations in 2022, becoming the first person to disseminate their technical analysis, with the 2023 publication in Heritage Science. The first two volumes I analyzed are part of the University of Delaware Morris Library's Special Collections. This work earned me an invitation to talk as part of the 2023 Morris Library Scholar in the Library, and the 2024 Seth Trotter Special Collections Research Award.

Since that publication, my students and I completed the analysis of one volume at the University of Pennsylvania Kislak Center for Special Collections, Rare Books and Manuscripts; as well as five cartas housed at the Morgan Library & Museum in New York City. We have scheduled analyses and collaborations both in the USA and in Europe. This is exciting, because I hope to help co-curate an exhibit on these fascinating volumes soon!

## EXPLORING ELUCIDATION OF RED DYE MIXTURES ON WOOLEN HISTORICAL TEXTILES VIA NON-DESTRUCTIVE SPECTROSCOPIC ANALYSIS AND MULTIVARIATE CLUSTER ANALYSIS.

Nondestructive Analysis of Textiles using Chemometrics on Spectroscopic Data is my other research project at the moment. This work evolves from my early career research on natural dyes, mostly on well-preserved late 18th-early 19th c. wools from Norwich, UK.[1-4] This new stage focuses on developing nondestructive analysis alternatives for textiles. Identifying dyes using chromatographic techniques (mainly HPLC) traditionally involves physically sampling invaluable materials – a procedure discouraged by

[5,6]

We have nondestructively analyzed 204 well-provenanced samples and applied multivariate cluster analysis (i.e., PCA or principal component analysis on regions of spectral high variance), to observe that clustering seems related to "recipes", (i.e., combinations of dye components or chromophores). HPLC on randomly selected samples from each cluster showed that indeed this was the case: each cluster revealed a different dye or combination of dyes (i.e., madder, cochineal, etc.). Our current dataset can identify dye combinations nondestructively, if they are of a similar provenance – late 18th -early 19th c. red Norwich wools.[5,6]

We are currently collecting other training datasets to expand to other combinations. To support this research, Prof. Karl Booksh (PI) and I (Co-PI) got NSF Award # 2003839: Challenges in Classification Near the Limit of Determination. The project was extended until July 2024 (see 2020 NSF-CHE-D3SC grant).


- *Mercado-Oliveras, V.; Alcántara-García, J. Cartas Ejecutorias de Hidalguía (executory certificates of nobility): a survey in materials analysis, legal, and aesthetic contexts—two case studies. Heritage Science 2023, 11 (1). DOI: 10.1186/s40494-022-00850-y.*

- *Celani, C. P.; Degano, I.; Chen, C.; Jaeger, O.; Speed, A. M.; Booksh, K. S.; Alcantara-Garcia, J. Exploring elucidation of red dye mixtures on woolen historical textiles via non-destructive spectroscopic analysis and multivariate cluster analysis. Heritage Science 2024, 12 (1). DOI: 10.1186/s40494-023-01108-x.*


## References:


*(1) Alcantara-Garcia, J.; Nix, M.; Pearlstein, T. Tracing the Trade: HPLC-PDA-MS study Norwich Wool Swatch Books Reveal the Secrets of Master Dyers. In International Council of Museums – Committee for Conservation (ICOM-CC) Triennial Conference, Copenhagen, Denmark; 2017.*

*(2) Alcántara-García, J.; Nix, M. Multi-instrumental approach with archival research to study the Norwich textile industry in the late eighteenth and early nineteenth centuries: the example of a Norwich pattern book dated c. 1790–1793. Heritage Science 2018, 6 (76). DOI: 10.1186/s40494-018-0242-x.*

*(3) Alcantara-Garcia, J. The `Industrial Patent´ of Norwich Dyers in the late 18th century revealed through science. Miscellany. Costume and Textile Association 2018, 5, 6, Invited.*

*(4) Alcántara-García, J.; Nix, M. The Norwich Textile Reference Database: A Collections Care Project. AIC Wooden Artifacts Group Postprints 2019, AIC's 46th Annual Meeting, 153-157.*

*(5) Celani, C. P.; Degano, I.; Chen, C.; Jaeger, O.; Speed, A. M.; Booksh, K. S.; Alcantara-Garcia, J. Exploring elucidation of red dye mixtures on woolen historical textiles via non-destructive spectroscopic analysis and multivariate cluster analysis. Heritage Science 2024, 12 (1). DOI: 10.1186/s40494-023-01108-x.*

*(6) Celani, C.; Degano, I.; Booksh, K.; Delgado Cornelio, M. F.; Spped, A.; Chen, C.; Jaeger, O.; Alcántara García, J. Non-destructive spectroscopic analysis and multivariate cluster analysis to potentially elucidate red dye mixtures on woolen historical textiles. In Dyes in History & Archaeology (DHA) 43, Leeds, UK; Paper P01, 2024.*

# ASSESSMENT OF AIR QUALITY WITHIN AN HISTORIC HOUSE MUSEUM: PARTICULATE MATTER AND GAS-PHASE RISKS TO COLLECTIONS

As the climate crisis continues to intensify, one of the biggest questions cultural heritage institutions faces is how to evaluate and mitigate environmental impacts and risks to collections and while improving financial and environmental sustainability. Some of these impacts are mitigated through strict control of indoor environments with minimal variation. However, if we over manage the indoor air, the exorbitant energy consumption will continue to have a negative impact on the climate.[1-3] Current management protocols are both energetically and financially expensive. At Winterthur we are working to incorporate low-cost air quality sensors into our environmental monitoring protocols to develop data driven strategies to reduce demands on heating, ventilation, and air conditioning (HVAC) systems while maintaining safe environments for the house and collections.

Winterthur, along with much of the North American eastern coast was impacted by the 2023 Canadian wildfire season, bringing heightened awareness of hazardous air quality to civilians and heritage professionals. This prompted Winterthur Museum to conduct a quick preliminary study of the air quality within the institution. These data showed increased black and brown carbon, a major component of wildfire smoke, indoors near the main egress points to the historic house. However, this prompted further questions, particularly about how much mitigation following these events is necessary to safely allow staff and the public to return to the collection. These questions can best be answered by first understanding the baseline air quality of the house and galleries, so we know how these systems are perturbed.

Photo of the smoke discolored sky above Winterthur on June 7, 2023 from the Canadian Wildfires,

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With air quality there are so many different metrics that could be investigated - for this pilot study we chose particulate matter (PM) and total volatile organic compounds (tVOC) as general metrics for airborne pollutants. While not all encompassing, these two measurements provide insight into general house occupancy, air flow and particulate- and gas-phase infiltration. These measurements can also be made with low-cost air quality sensors, which became more accessible during the COVID-19 pandemic.

Image of Gianna Puzzo and Liora Mael collecting data and placing low-cost sensors in the dining room at Winterthur Museum.

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Gianna Puzzo and I, in collaboration with the preventive team, programs, and facilities, ran a pilot study from November 2023 through January 2024, focusing on areas along the main tour route within the house. The sensors were rotated throughout the house, capturing data at the main entrance as well further in the space - comparing supply, mixed, and outdoor air quality. Preliminary data show interesting changes in the house environmental activity not reflected in the standard suite of environmental monitoring (light, temperature, and relative humidity) but require longer measurement periods as well as additional outdoor measurements to have a more comprehensive understanding of air quality in the collection. Air quality monitoring at Winterthur is ongoing - we hope to continue to expand this research, creating data driven plans for poor air quality events and improving institutional sustainability.

Image of Gianna Puzzo placing a sensor in a fireplace in the dining room at Winterthur.

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## Acknowledgements:

This work was done in collaboration with Gianna Puzzo, Anisha Gupta, Dr. Rosie Grayburn, Dr. Joelle Wickens, William Donnelly, as well as the preventive staff and facilities at Winterthur. This work was supported by the Winterthur/University of Delaware Program in Art Conservation as well as the University of Delaware Art Conservation Department.

## References:

*(1) Grzywacz, C. M. 2006.*
*(2) Thickett, D. 2022.*
*(3) Varcoe-Cocls, M. 2022.*

Barbara Jouves-Hann/ Sophie David/ Laurence de Viguerie/
Isabelle Rouget/ Loïc Bertrand

# NEW INITIATIVES SUPPORT CONSERVATION RESEARCH IN THE ÎLE-DE-FRANCE REGION

Since 2017, the Île-de-France Region has significantly strengthened its support for heritage science research through two successive "Domaines d'intérêt majeur" (DIM – Key Research and Innovation Sectors): Matériaux anciens et patrimoniaux (2017–2021) and Patrimoines matériels – innovation, expérimentation, résilience (2022–), operated through the CNRS from ENS Paris-Saclay[1] . One of the central objectives of these networks is to foster conservation research by actively involving conservation professionals in regional scientific programs.

In 2021, the network launched the Research and Restoration project with a survey aimed at evaluating the presence and needs of a research culture in restoration practice. In France, support for applied conservation research is limited because 75% of conservators are independent professionals. The survey collected responses from 37 respondents and identified several key priorities: building partnerships, improving access to laboratories, securing funding for intellectual service contracts, and enhancing mechanisms for data sharing. A study day on Histories, Practices, and Perspectives was held, emphasizing interdisciplinary collaboration inspired by large-scale European projects.[2]

The Research and Restoration Working Group, composed of scientists and conservation professionals, was established in autumn 2022. Its mission is to promote research on conservation-restoration processes, to integrate professionals into research projects, and to encourage cross-disciplinary collaboration, social and economic boundaries in the heritage sector.[3] Over the past two years, the group has organized multiple events—including half-day round tables and conferences—to foster dialogue among conservation professionals, conservators, and researchers.

One major achievement has been the introduction of dedicated funding for conservators enabling them to contribute to doctoral and postdoctoral research projects supported by the DIM PAMIR. Since 2023, this funding opportunity has been formally included in the network's application procedures, recognizing conservators as socio-economic partners who contribute essential expertise. The proposers estimate the time dedicated to a given project, and conservators' involvement is explicitly valued during the project selection process through an evaluation criterion dedicated to the quality of the partnership in the projects.

Other evaluation criteria include scientific quality, methodology, partnerships, outreach efforts, and the allocation of resources to support researchers. This measure has been renewed in the call for proposals for 2025. It encourages interdisciplinary projects and complementarity of skills, strengthening the role of conservators not only in conservation work, but also in advancing knowledge of heritage materials and processes, such as developing sustainable, innovative approaches.

- *1-The network brings together 114 laboratories, 33 socio-economic players, including 7 conservation professionals and the Fédération française des conservateurs-restaurateurs (FFCR). This network represents 1,282 scientists (968 researchers and 314 engineers). Since 2017, 340 projects have been supported (207 for MAP and 133 for PAMIR). https://www.pamir.fr.*

- *2-Barbara Jouves-Hann, Sophie David and Loïc Bertrand (dir.), Recherche et Restauration : histoires, pratiques et perspectives, Paris, HiCSA Editions [Online], 2023. <https://hicsa.pantheonsorbonne.fr/sites/default/files/2023-11/recherche_et_restauration_03book.pdf>*

- *3-The 'Research and Restoration' Working Group members are: Ann Bourgès (C2RMF), Jacques Cuisin (MNHN), Pauline Hélou de La Grandière (Conservator-Restorer, Painting), Delphine Morana-Burlot (Université Paris 1 Panthéon-Sorbonne), Gaëlle Pichon-Meunier (Ministère de la Culture) and Olivier Rolland (Conservator-Restorer, Sculpture).*

The DIM recognizes the essential role of master's-level education in introducing research methods. Strengthening restoration research also depends on academic training that emphasizes methodological rigor and knowledge exchange. A recent article highlighted these initiatives and the importance of developing research-based training in conservation.[4]

Among the DIM-sponsored events, several have focused on the relationship between conservation research and education—particularly the study day on Training and diffusing knowledge, and the DIM's support for the Paris meeting on Education for Green Conservation (January 2025) of the European Commission's GoGreen project, which promotes sustainable alternatives to conservation treatments.[5]

The activities of the Research and Restoration Working Group have sparked significant interest among professionals and students alike, combined with targeted communication and dissemination. By creating platforms for exchange and collaboration, the DIM facilitates the inclusion of conservators within research frameworks, ensuring their expertise is acknowledged and integrated.

Given the specific status of conservators in France, the DIM therefore aims to provide building blocks that can be further developed in the future to strengthen the essential role of conservation in the study, documentation, preservation and restoration of the world heritage.

Recherche et Restauration : histoires, pratiques et perspectives, Paris, HiCSA Editions [Online], 2023

*4-Ann Bourgès, Jacques Cuisin, Pauline Hélou de La Grandière, Barbara Jouves-Hann, Delphine Morana Burlot, Gaëlle Pichon-Meunier, Olivier Rolland, Sophie David and Loïc Bertrand, 'Domaine de recherche et d'innovation majeur (DIM) Patrimoines matériels — innovation, expérimentation, résilience (PAMIR)', CeROArt [Online], 13, 2024. DOI : https://doi.org/10.4000/12zk5.*

*5-https://gogreenconservation.eu/.*

From left to right: Éléonore Kissel, Clothilde Castelli, Élodie Lévêque, Annelise Roman-Binois, Élise Dufour, Thalia Bajon-Bouzid, Delphine Morana Burlot and Gaëlle Pichon-Meunier, study day on new ambitions to involve restorers (2023-2024), November 9, 2023

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# INTRODUCTION TO GOGREEN

The Horizon Europa funded GoGreen project (2022-2026) develops and promotes preventive and remedial conservation practices based on green principles to spearhead the green revolution within conservation in alignment with the Green Deal. As a consortium of 13 institutions, GoGreen is developing strategies to address key challenges in the field, including the lack of a unanimous green definition in the field, the urgent need to find greener alternatives to currently used toxic and pollutant products for conservation, and the necessity to raise conservation professional's awareness of the impact of their actions on energy consumption and the environment.

For the development of innovative green materials for conservation, GoGreen use interdisciplinary strategies to find inspirations from historical recipes and methods, biological processes, and green chemistry practices. The application of bio-originated and -degradable materials on metal, presented here, is of one of the major interests.

***In Work Package 3*** 'Green cleaning methods', the removal of tarnishing or corrosion products on brass and steel has been successfully achieved by sapoline, a newly developed method combining the natural surfactant saponin and the natural deep eutectic solvent aquoline[1]. (Fig.1) The newly developed amino acid-based protocols have shown promising results for the removal of corrosion products from both pure and sterling silver. (Fig. 1) Green gels combined with amino acids are currently under development. Meanwhile, the study of historical recipes also leads us to explore the potential of micro-organisms from ancient material systems. Ongoing research is investigating the use of lactic acid bacteria and yeast from food fermentation processes for silver tarnish removal. (Fig.2) These microbes have been proved to have heavy-metal absorption capacities that can be potentially engineered and optimized for conservation purposes.

***In Work Package 4*** 'Green stabilization methods', the development of greener protocols for the stabilization of archaeological iron and copper focuses on microbiologically derived approaches. A novel method using the dead biomass of Meyerozyma sp., an extremophilic yeast, has shown promise in both removing chloride ions and promoting the transformation of reactive corrosion products into more stable phases[2]. (Fig.3) This biologically based treatment offers a non-toxic, environmentally friendly alternative to conventional methods. Ongoing research is currently being optimized with respect to pH, exposure time, and corrosion morphology to ensure consistent and uniform results.

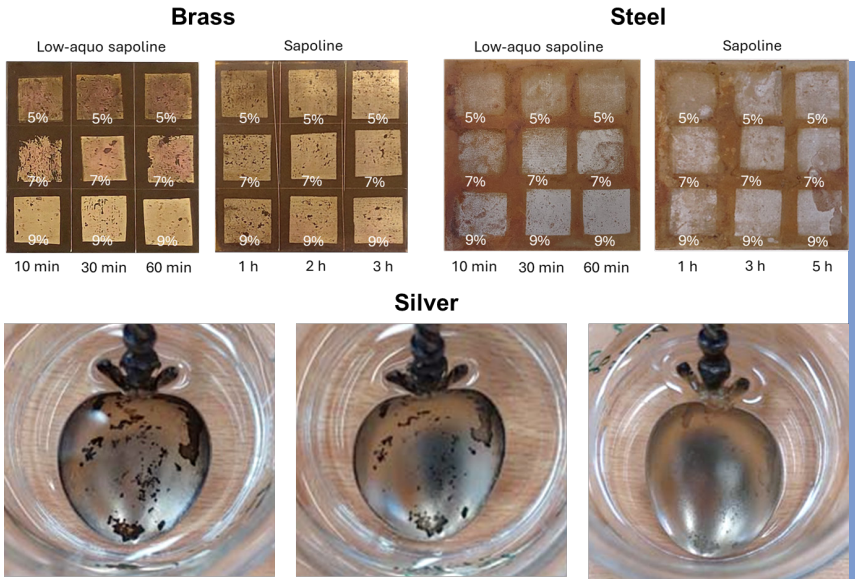


Fig.1 (upper row) artificially corroded brass and steel coupons cleaned with sapoline, reproduced from[1]; (lower row) cleaning process of a silver-alloyed spoon with our amino acid-based protocol.

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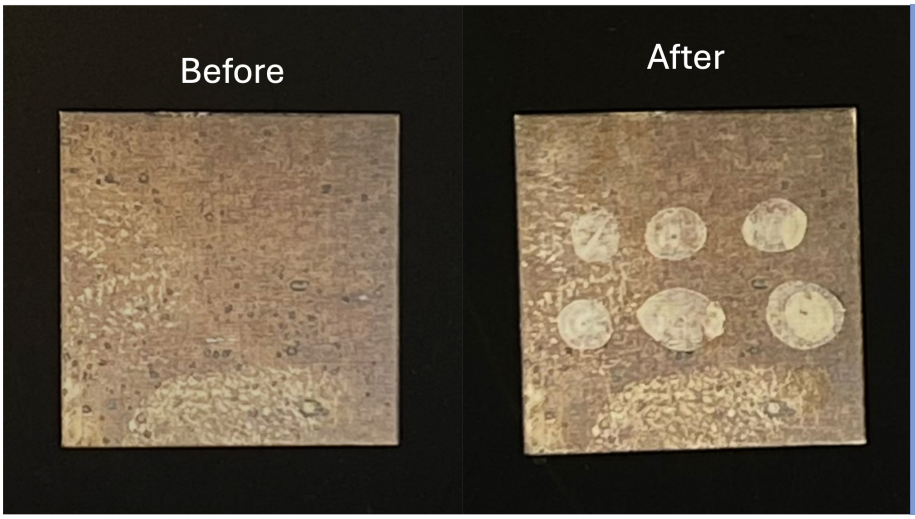


Fig.2 Artificially tarnished sterling silver coupon (2x2 cm) before (left) and after (right) contact with Lactococcus lactis MG1363. Microbes are suspended in MilliQ water and applied as droplets on the surface.

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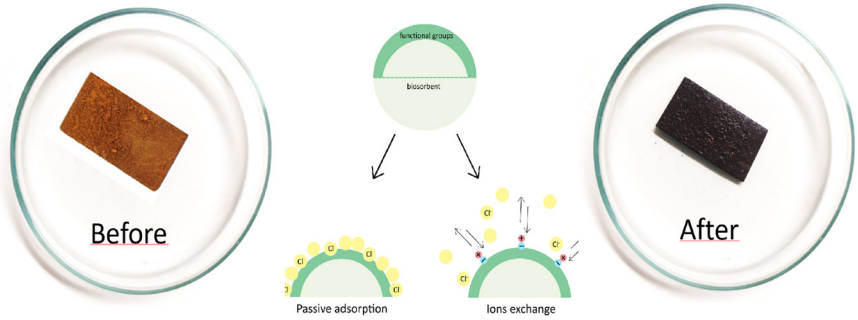


Fig.3 Mechanism of the use of the dead biomass of Meyerozyma sp. to stabilize iron corrosion.

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The above-mentioned studies showcase our endeavours to promotes greener practices for heritage conservation. Other ongoing projects include the development of damage functions with improved insight into material vulnerability in order to reduce carbon footprint in preventive conservation; development of analytical strategies for innovative assessment of GoGreen treatments; creation of a digital web-app to support green conservation decisions; and design of educational materials to strengthen the profession through education. The latest definition of green conservation, green parameters and much more information can be found on our website: *https://gogreenconservation.eu/*, or through our social media accounts on Instagram (gogreen_conservation), Facebook (GoGreen), and LinkedIn (GoGreen Conservation).

*1-Wu, Q. and E. Joseph. "The application of an innovative green material 'sapoline' for the cleaning of historical metal objects". ICOMCC-Metal2025, in press.*

*2-Petrasz, P., Zhioua, S., James, S., Bindschedler, S., Junier, P., & Joseph, E. (2024). Green alternatives for archaeological iron stabilization. Studies in Conservation, 69(sup1), 270-280. https://doi.org/10.1080/00393630.2024.2336880*

# INNOVATIVE METHODOLOGIES AND RECENT DEVELOPMENTS IN THE RESEARCH ON SANXINGDUI BRONZE CASTING TECHNOLOGY

At Sanxingdui, the application of X-ray CT and flaw detection technologies has revealed the prevalence and technical complexity of piece-mold casting as a primary bronze manufacturing method[1]. This technique involves a series of sophisticated joining methods, such as interlocking joints, tenon insertions, riveting, wrapping connections, pin fastenings, modified joints, and copper rope bindings. These diverse and intricate connections underscore the advanced technical proficiency achieved in Sanxingdui bronze craftsmanship.

A key innovation in Sanxingdui's casting technology lies in the use of core rods and strip chaplets[2], which exhibit unique structural and functional features. Fig.1 shows the core rod and strip chaplet of a bronze figure. These elements not only reflect a high level of technical refinement but also underscore both connections and distinctions between Sanxingdui's bronze tradition and those of the Central Plains and the middle and lower Yangtze River regions. These findings establish Sanxingdui as the site of one of the earliest and most technically advanced bronze casting systems employing core rod structures known in the world.

Further insights into the casting technology at Sanxingdui have been gained through petrographic analysis, major and trace element analysis, and rare earth element (REE) profiling[3] which together elucidate the technical characteristics of clay cores used in different artifact types and suggest the presence of multiple production centers. Petrographic analysis reveals that the clay cores from locally styled artifacts—such as masks, anthropomorphic figures, and sacred trees—contain abundant amorphous calcium carbonate and mica, demonstrating distinct mineralogical traits. In contrast, container-type bronzes display significantly different characteristics in mineral composition, grain size distribution, and sorting. Chemical analysis shows these differences: clay cores of locally styled artifacts exhibit high calcium and magnesium levels, consistent with the observed mineralogical profile. Meanwhile, container-type artifacts show different compositional traits, likely indicating different production origins.

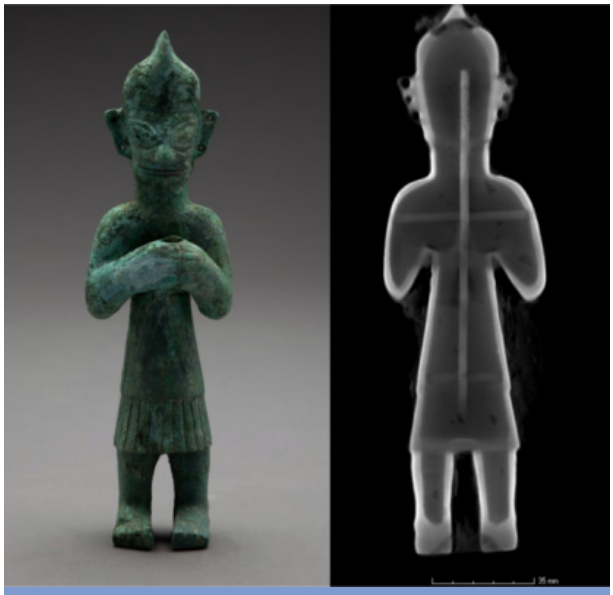

Fig.1 Core rod and strip chaplet of bronze figure

References:

- *[1] Jianbo Guo, Hao Tian, et al, A supplementary study of the casting technique of bronze objects from the Sanxingdui site, Cultural Relics in Southern China, 2021(3): 145-152.*
- *[2] Jianbo Guo, Jianjun Mei, et al, On the application of core rod and strip chaplets in Sanxingdui bronzes, Palace Museum Journal, 2025(2): 17-28.*
- *[3] Huiru Lian, Xiaotian Zeng, et al, Deciphering the origins of Sanxingdui bronzes through petrographic and elemental analysis of casting cores, Journal of Archaeological Science, 2025(178): 1-11.*

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# ICOM-CC Scientific Research Working Group Newsletter

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