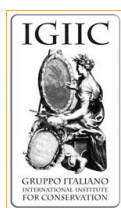




# YOUTH in CONSERVATION of CULTURAL HERITAGE Palermo (Italy), May 24<sup>th</sup> – 26<sup>th</sup> 2010



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**YOUTH in CONSERVATION of CULTURAL HERITAGE**  
Palermo (Italy), May 24<sup>th</sup> – 26<sup>th</sup> 2010

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**Y**OUth in **C**ONServation of **C**ULTURAL Heritage  
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## PROGRAM

**Monday, May 24, 2010**  
**Sala Baroni, Palazzo Steri, Piazza Marina 61, Palermo**

**09.00 – 09.30** Registration desk

**09.30 – 10.20 Opening Ceremony:** invited guests: Prof. R. Lagalla ( Rettore Università di Palermo), Arch. Guido Meli (Direttore Centro per la Progettazione ed il Restauro, Regione Siciliana), Dr. Maria Pia Casaletto (CNR, Presidente IA-CS – Sezione Sicilia)

### First Session: Organic Materials and Textiles

<b>10.20 – 10.40</b>	Microbial degradation of historical textile objects	Katja Kavkler, Nina Gund Cimerman, Polona Zalar, Andrej Demšar
<b>10.40 – 11.00</b>	Application of anoxia atmosphere to stop light induced degradation of dyes?	Monika Koperska, Joanna Lojewska
<b>11.00 – 11.20</b>	New Antioxidants Systems for Stabilization of Ink Damaged Paper	Olga Darčanova, Birutė Sivakova, prof. Aldona Beganskienė, prof. Aivaras Kareiva
<b>11.20 – 11.40</b>	“Reading between the lines” of ancient manuscripts	G. Piantanida, A. Sodo, M. Monti, M. Bicchieri
<b>11.40 – 12.00</b>	Magnetic and Optical Supports for Preservation – Problems and Perspectives –	Franco Liberati, Giovanni Marinucci, Maria Teresa Tanasi
<b>12.00 – 12.20</b>	Solid state NMR characterization of the waterlogged wooden part of Acqualadrone roman rostrum	S. Bastone, A. Spinella, M. Romagnoli, E. Caponetti
<b>12.20 – 12.40</b>	Multi-analytical approach to the study of varnishes from historical musical instruments	Francesco Caruso, Delia Francesca Chillura Martino, Steven Saverwyns, Marina Van Bos, Lucia Burgio, Cosimo Di Stefano, Eugenio Caponetti
<b>12.40 – 13.00</b>	On the identification of organic materials in painting cross sections by means of ToF-SIMS	Donata Magrini, Francesca Benetti, Giuseppe De Giosa

13.00 – 13.10

**Discussion**

13.10 – 13.40

**Lunch**

### Second Session: Glass and Ceramics

13.40 – 14.00

Issues in the Conservation of a Glass Icon. Case study: Ana Deji, "The Anguished Mother of God" (tempera on glass, 20th century)

Ioan Paul Colta

14.00 – 14.20

The browning of stained glass windows: characterization of Mn-corrosion bodies and evaluation of cleaning methods

Simone Cagno, Gert Nuyts, Kristel de Vis, Joost Caen, Koen Janssens

14.20 – 14.40

Treatment of Portuguese ceramic tiles with different acrylic polymers

Teresa P. Santos, M. Fátima Vaz, A. P. Carvalho

14.40 – 14.45

**Discussion**

14.45 – 15.05

**Graffiti in the Inquisition Jails, Palazzo Steri, Palermo (Arch. Policarpo)**

15.30

**Visit to the Inquisition Jails @ Palazzo Steri**

21.00

**Social Dinner**

**Tuesday, May 25, 2010  
Area della Ricerca del CNR, Via Ugo La Malfa 153, Palermo**

### Third Session: Cultural experiences

09.00 – 09.15

**Lecture**

09.15 – 09.35

The place of the medieval town of Shamkir in our cultural heritage protection

Namig Huseynli, Rasul Mirzoev

09.35 – 09.55

Cultural Heritage Protection, Preservation and Development in Historical Centres of Modern Towns in Context of Kuldiga, Europe and Nordic Countries

Jana Jākobsone, Ivars Strautmanis

<b>09.55 – 10.15</b>	Excavation, conservation and utilization of the archaeological sites in Azerbaijan	Dr. Jeyhun Eminli, Ulviyya Imamverdiyeva
<b>10.15 – 10.35</b>	The past reborn. Digital restitution of the archaeological site of Polizzello	Alessandro Fiamingo, Enrico Greco, Emanuele Sangregorio, Riccardo Giovanni Urso
<b>10.35 – 10.50</b>	Implementation of Intangible cultural heritage to achieve sustainable development strategy for autonomous cultural district	Basma Reda Rashwan Abou El Fadl
<b>10.50 – 11.05</b>	Historia de Concepción: the fate of a project	Carolina Ossa, Federico Eisner, Ernesto Borrelli,
<b>11.05 – 11.15</b>	<b>Coffee Break</b>	
<b>11.15 – 13.00</b>	<b>International Round Table</b>	
<b>13.00 – 13.40</b>	<b>Lunch</b>	
<b>13.40 – 15.10</b>	<b>Poster Session</b>	
<b>15.10 – 16.00</b>	<b>Sponsor</b>	

#### Fourth Session: Metals and Stones

<b>16.10 – 16.20</b>	Characterization and Thermodynamic Interpretation of Ancient Gold Refining Processes Based on a Dioscorides Recipe	Daniela Ferro, Sergio Brutti, David R. Loepp, Angela Celauro
<b>16.20 – 16.40</b>	Complementary of the XRF and LIBS analyses in the conservation science: the case studies of the bronze alloys	Maria Francesca Alberghina, Rosita Barraco, Maria Brai, Tiziano Schillaci, Luigi Tranchina
<b>16.40 – 17.00</b>	Artificial patina in experimental archaeology	Barbara De Filippo, Luigi Campanella, Stefano Natali, Daniela Ferro, Andrea Brotzu
<b>17.00 – 17.20</b>	Treatments to recovering the original chromatism of coloured stones	Ilaria Nicolini, Anna Maria Mecchi, Susanna Bracci
<b>17.20 – 17.40</b>	Inversion tests on ultrasonic tomography data	Patrizia Capizzi, Pietro L. Cosentino, Salvatore Schiavone
<b>17.40 – 18.00</b>	Characterization on degradation in Crypts	Delia D'Agostino, Rosella Cataldo, Stefano Siviero
<b>18.00 – 18.20</b>	A new preparation method of nanolime dispersion for the conservation of artworks	G. Nasillo, M. L. Saladino, Delia Francesca Chillura Martino, I. Natali, L. Dei, E. Caponetti

18.20 – 18.40

**Discussion**

19.00 – 21.00

**Aperitif or Match: five to five**

**Wednesday, May 26, 2010**

**09.10 – 09.30 Presentation of the Regional Centre for Restoration (C.R.P.R.), Dr. G. Spanò**

**09.30 – 10.30 Visit to the Regional Centre for Restoration (C.R.P.R.)**

**10.30 – 11.00 Coffee Break**

**Fifth Session: Pigments and Paintings**

**11.00 – 11.20**

**Lecture**

**11.20 – 11.40**

Mesoamerican mural paintings.  
Physico chemical characterization  
of materials and application of  
calcium hydroxide nanoparticles  
for consolidation

Lorenza Bernini

**11.40 – 12.00**

Investigation the history and  
consequences of past restoration  
interventions on frescos – the case  
of baroque paintings of  
Giulio Quaglio

Mateja Neža Sitar

**12.00 – 12.20**

Green pigments: Tradition and  
modernity in painting according  
to Portuguese 19<sup>th</sup> century  
technical literature

Sónia Barros dos Santos,  
António João Cruz

**12.20 – 12.40**

Spectroscopy Studies on  
Conservation Issues in Modern  
and Contemporary Art Paintings

Joana Domingues, Francesca Rosi,  
Grazia De Cesare, Costanza Miliani

**12.40 – 12.50**

**Discussion**

**12.50 – 13.20**

**YOCOCU Awards for the best oral/poster contribution and Conclusion remarks**



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## POSTER SESSION

Tuesday, May 25, 2010 - (13.40 – 15.10)  
Area della Ricerca del CNR, Via Ugo La Malfa 153, Palermo

### Metals and Stones

<b>M1</b>	Bronze ornaments from the Basarabi Culture The Restauration and Conservation issue	Adela Gabriela Dumitru
<b>M2</b>	Evaluation of Carboxylate-based Coatings for the Protection of Copper and Copper Alloys	A. Elia, M. Dowsett, G. Jones, A. Adriaens
<b>M3</b>	From waste to art and archaeology: polystyrene films as an innovative tool for protection of metallic artefacts	Francesca Giambi, Luigi Dei Piero Baglioni
<b>M4</b>	Raman analysis of historical materials of the figures of St. George (XVI c.) and Bartolomeo Colleoni (XX c.)	Anna Iwulskaa, Gerard Śliwińska
<b>M5</b>	Immediate XRF analysis of historical metal objects and its confidence level confirmed by complementary techniques	Iwona Żmuda – Trzebiatowskaa, Gerard Śliwińska
<b>M6</b>	Artistic reproduction of the “Guerriero da Petralia Sottana”	M. L. Saladino, F. Caruso, C. Di Stefano, V. Gennaro, E. Caponetti
<b>M7</b>	Laser Ablation coupled to Mass Spectrometry (LAMMS) applied to the Cultural Heritage	A. Torrissi, L. Giuffrida, F. Caridi, T. Serafino, E. Castrizio, G. Mondio, L. Torrissi
<b>S1</b>	Contribution of total suspended particulate (TSP) to the formation of black crusts on building materials in urban environments of Sicily (Italy)	Luciana Randazzo

<b>S2</b>	Selection of microbial strains for the development of a biocleaning procedure for shellac removal from Artwork surfaces	Nicoletta Barbabietola, Chiara Alisi, Flavia Tasso, Michela Grimaldi, Salvatore Chiavarini, Carla Ubaldi, Paola Marconi, Anna Rosa Sprocati
<b>S3</b>	Electrical measurements for the evaluation of water presence in stones	Fabiana Consalvi, Giovanni Ettore Gigante, Franco Meddi
<b>S4</b>	Some biodegradation aspects of stone after restoration at Stelea Curch, Târgoviște – Romania	Veronica Burtea, Oana Chachula
<b>S5</b>	Spectrophotometric investigations at the museum: monitoring the colour changes during differential cleaning of the marble statues	Maria Francesca Alberghina, Salvatore Schiavone, Fernanda Prestileo, Ermanno Cacciatore, Lorella Pellegrino, Donato Perrone
<b>M8</b>	Evaluation of the conservation state of a metallic sculpture by Michel François Pascal at Palazzo Mirto (Palermo, Italy)	Maria Pia Casaletto, Agata Evelina Di Marco, Gabriel Maria Ingo, Franco Palla, Mauro Sebastianelli
<b>M9</b>	Conservation of copper alloys artifacts from archaeological excavation: the restoration of a pilgrim flask	Maura Mereu, Vilma Basilissi, Giuseppe Guida, Massimo Vidale, Maria Pia Casaletto, Gabriel Maria Ingo, Luciana Drago
<b>S6</b>	Removal of Black Crusts on Historic Stoneworks By the Use of Sulfate Reducing Bacteria	Maryam Rafiee Fannod, Fatemeh Mehdizadeh Seradj
<b>S7</b>	Analytical characterization of plasters and stones coming from the 19 <sup>th</sup> century Palazzo Fragapane in Grammichele	Fernanda Cantone, Enrico Ciliberto, Enrico Greco, Salvatore La Delfa, Gabriella Murgana
<b>M10</b>	Noninvasive physicochemical characterization of two 19 <sup>th</sup> century English ferrotypes	Emiliano Carretti, Marco Milano, Luigi Dei, Piero Baglioni

### Glass and Ceramics

<b>G1</b>	Optical spectroscopy for the characterization of ancient glass	Andrea Ceglia, Wendy Meulebroeck, Kitty Baert, Hilde Wouters, Karin Nys, Herman Terryn, Hugo Thienpont
<b>G2</b>	Ceramic of Caltagirone, from production to the erchaeometric characterization	A. M. Gueli, E. Nicastro, A. Privitera, G. Stella, S. O. Troja
<b>G3</b>	Some considerations about the methodological approach for the archaeometric study of glass	Chiara Letizia Serra, Alberta Silvestri, Gianmario Molin

## Pigments and Paintings

<b>P1</b>	Frescoes of the Castiglioni College Chapel (PV): preparatory investigations for restoration work. A material study of the pictorial display	Marco Simone Grandi, Chiara Zanchi, Camilla Irine Mura, Pietro Galinetto, Maurizio Licchelli, Maria Pia Riccardi
<b>P2</b>	Spectrocolorimetry applied to the study of five frescoes placed in the town hall of Anguillara Sabazia – Rome	Simona Barberio, Claudia Bosco, Ombretta Cocco
<b>P3</b>	Identification of protein-based additive in gypsum painting support by FTIR spectroscopy and PCA	Elena Rogoz, Olimpia Barbu, Oana Cachula
<b>P4</b>	Characterization of plaster and stucco paintings from Basilica of Santa Maria Maggiore in Trento	Silvia Minghelli, Pietro Baraldi, Maria Teresa Guaitoli
<b>P5</b>	Problems of illumination of Cultural Heritage: the case of realgar	A. Macchia, L. Campanella, A. Maras, E. Borrelli, S. Plattner
<b>P6</b>	Polyvinyl alcohol hydrogels for cleaning works of art: recent developments	Irene Natali, Emiliano Carretti, Luigi Dei, P. Baglioni, Lora Angelova, Richard G. Weissb

## Cultural experiences

<b>C1</b>	The diagnostics in the field of Cultural Heritage: high school students first experiences	Salvatore La Delfa, Pamela Costanzo, Marzia Canonico, Alessandra Corso, Marika Lanzafame, Monica Mangiafico Houda Nazih
<b>C2</b>	Community participation in Heritage Conservation Programs in Kotagede	Punto Wijayanto, Maria Paramita
<b>C3</b>	Analytical investigations in Ostia - Porta Marina, Rome	Giacomo A. Orofino, Carlo Rosa, Marcello Turci
<b>C4</b>	Shaping of the Meaning of Dwellings Inscribed on the World Heritage List	Hsiu-jui Lin
<b>C5</b>	How to get CHIC?	G. Bitelli, R. Di Giulio, M. Mannina, R. Mazzeo, E. Piaia, S. Prati, M. Quaranta
<b>C6</b>	Analysis of the Architectural heritage of El-Mansoura city, Egypt towards urban conservation approach	Mohamed Ali Mohamed Khalil, Alaa Shams El-Eashy

## Organic materials and textiles

- |           |   |   |
|-----------|---|---|
| <b>O1</b> | The Research and Conservation of Archaeological Textiles Kept at the National Museum of History of Azerbaijan | Fariz S. Khalilli   |
| <b>O2</b> | Scientific researches on historical photographic materials  | L. Botti, A. Corazza, M. Placido, L. Residori, D. Ruggiero                              |
| <b>O3</b> | Termite control with low environmental impact methods for the conservation of cultural heritage               | Mauro Colapicchioni, Giovanna Pasquariello, Italo Tigliè, Mario Marini, Roberto Ferrari |



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## INTERNATIONAL ROUND TABLE

Tuesday, May 25, 2010  
Area della Ricerca del CNR, Via Ugo La Malfa 153, Palermo

<b>Maarten van Bommel</b>	Instituut Collectie Nederland / Netherlands Institute for Cultural Heritage (ICN), Amsterdam
<b>Luigi Campanella</b>	Sapienza University of Rome
<b>Emilio Cano</b>	National Center for Metallurgical Research (CENIM)-Spain
<b>Henry A. DePhillips</b>	Department of Chemistry, Trinity College - Hartford
<b>Stavroula Golfomitsou</b>	Directorate of Conservation of Ancient and Modern Monuments of the Greek Ministry of Culture
<b>Marisa Laurenzi Tabasso</b>	Centre for the science applied to the conservation of environment and cultural heritages, Sapienza University of Rome, Italy
<b>Rocco Mazzeo</b>	Microchemistry and Microscopy Art Diagnostic Laboratory (M2ADL) - University of Bologna
<b>Silvia Prati</b>	ARG (Environment, Research, Young people) - M2ADL – University of Bologna
<b>Sophia Sotiropoulou</b>	Art Diagnosis Foundation Centre - Ormylia Greece
<b>Sergio Tinè</b>	Forum Conservation and Restoration
<b>Gouda Venice Kame</b>	National Research Center (NRC) Physical Chemistry Department El-Tahir Street Dokki, 12622, Cairo, Egypt

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## Microbial degradation of historical textile objects

Katja Kavkler<sup>a, b</sup>, Nina Gunde Cimerman<sup>c</sup>, Polona Zalar<sup>c</sup>, Andrej Demšar<sup>c</sup>

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*Keyword: historical textiles, fungi, deterioration*

### ABSTRACT

Museum objects are usually of high cultural and historical value. Thus one of the main aims of the museums is preservation of historical objects, together with their research and presentation to the public. Appropriate storage conditions are the best recipe for a long-term preservation of historical objects. Since fungal spores are in the air, they can grow very quickly in conditions, which encourage their growth, especially if they settle on a substrate, which provides nutritive substances. Since textiles are organic materials, they are very easily degraded by different environmental impacts, such as light, changes in temperature and relative humidity, or biological agents. Fungi grow more easily on the substrates that have been previously hydrolyzed or oxidized due to ageing processes (Seves [1]), thus historical objects are a suitable substrate for fungal growth. Fungal deterioration leads to structural and visual changes and slowly to partial or total destruction of material (Szostak-Kotowa [2]).

We investigated several historical objects made solely or partially of textiles, from some Slovene museums and other institutions that store works of cultural and historical value (e. g. churches). Together with the curators we chose some objects that showed uncommon features, which could be fungal spots. With cotton swabs we took samples from the surface of each object to check, whether the changes on the surface were of fungal origin. Types of fungi were determined with the DNA identification. Many different fungal strains were found on all types of substrates. Some strains repeated on different materials, whereas others appeared only on single objects. Some objects were affected by several different strains, on the others only one fungal species was detected.

Parallel with microbial investigation, types of substrate were determined with optical microscopy. Structural differences between affected, non-affected and modern fibers were observed with different methods, such as optical and scanning electron microscopy, infrared and Raman spectroscopy (Zotti [3]).

### References

- [1] AnnaMaria Seves et al, *A laboratory investigation of the microbial degradation of cultural heritage*. In: *Of Microbes and Art: The Role of Microbial Communities in the Degradation and Protection of Cultural Heritage*. Editors: O. Cifferi, P. Tiano and G. Mastromei, 2000, (pp. 121-133), ISBN: 0-306-46377-6.
- [2] Szostak-Kotowa, Jadwiga, *Biodeterioration of textiles*. *International Biodeterioration & Biodegradation*, 53, 2004, (pp. 165-170).
- [3] M. Zotti et al, *Microfungal biodeterioration of historic paper: Preliminary FTOR and microbiological analyses*. *International Biodeterioration & Biodegradation*, 62, 2008, (pp. 186-194).

## Application of anoxia atmosphere to stop light induced degradation of dyes?

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*Keyword: Dyes, Anoxia, ATR-FTIR, Raman*

### ABSTRACT

Five commercial, Kremer's dyes (all natural and used from antiquity: indigo, saffron, dragon's blood, carminic acid and madder) were submitted to accelerated ageing by exposure to intensive light in the visible range in both oxygen free (anoxia) and normal conditions. Decomposition of the samples was investigated by several analytical techniques (ATR/FT-IR, Raman, Reflectance UV-Vis, XRF).

Based on the comparison of the spectra obtained with ATR-FTIR, FT-Raman and UV/VIS of the dyes aged in the differentiating conditions the estimators of the degradation progress have been proposed. These allowed classifying the dyes according to their degradation susceptibility under anoxia and oxidative conditions. According to the classification made, the dyes of high symmetry are less prone to degradation and are resistant to anoxia atmosphere. The degradation effects for anthraquinone based dyes are higher in oxygen free conditions and with extreme ageing decomposed to phthalic anhydride and dimethyl phthalate.

These results do not contradict the conviction, that is constantly being popularized from the beginning of the 20<sup>th</sup> century, that placing objects in oxygen free cassettes is the optimum solution for preserving them for future generations, but highlight the fact that surrounding of the dye molecule (binding media, textile or paper fibers or other dye molecules) has a profound effect on the color stability of an object.

The results contribute to the ANOXIA project run together with the National Museum in Cracow, Poland.

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## **New Antioxidants Systems for Stabilization of Ink Damaged Paper**

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*Keyword: paper, stabilization, inks, antioxidants*

### **ABSTRACT**

A significant part of culture heritage was recorded with different types of inks. The large variety of different recipes and the compositional diversity of the natural raw materials result in a diversity of distinguishable degradation mechanisms leading to changes in color after time and, occasionally, resulting in ink corrosion. This process ends in a complete degradation of the paper or parchment [1-4]. Two principal causes are usually considered to be responsible for the paper degradation: the high acidity of some inks that leads to hydrolytic splitting of the cellulose (formation of acid) and the presence of soluble and mobile metal ions that may act as catalysts for oxidative decomposition of the cellulose [5-7].

The stabilization procedure of ink damaged documents includes: deacidification process and antioxidant treatments of inked paper. Aqueous solutions of calcium and magnesium hydroxide have been widely used for many decades, but unfortunately, they had often induced undesirable side effects, mainly due to paper (which is hydrophilic) exposure to strongly alkaline conditions with subsequent cellulose depolymerization. Halides such as iodide, bromide are well known antioxidants with acts as radical scavengers.

This study reports a new approach for ink damage paper stabilization methods with tetrabutylammonium bromide or potassium iodide as antioxidants and 3-aminopropyltriethoxysilane (APTES) as the deacidification reagent in alcohol solvents.

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## “Reading between the lines” of ancient manuscripts

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Keyword: Micro-Raman, parchment, ink, pigments

### ABSTRACT

The research here presented addresses the major issues in the practice of non-destructive analysis of parchment manuscripts. Micro-Raman, for instance, has been verified to be suitable for a complete characterization of many and mixed-up substrates, graphic media and treatments (Edwards [1]). The high quality of the

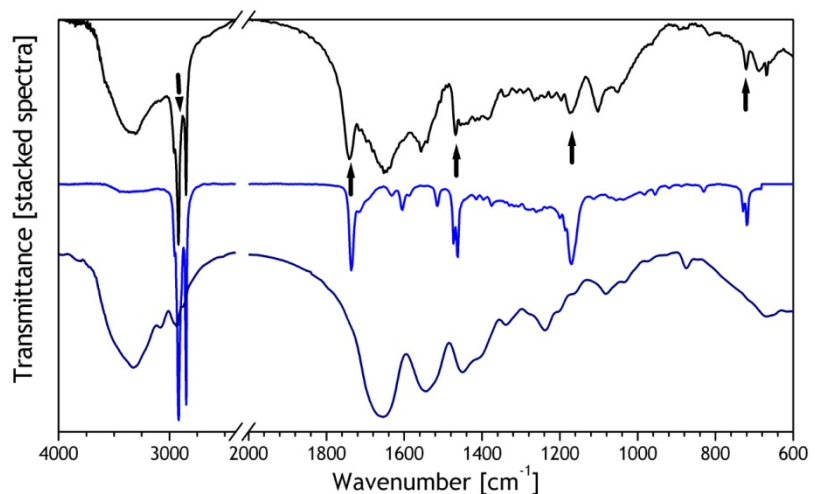


Fig. 1: Comparison of a stain spectrum to standards: stain (black), carnauba wax (blue), collagen (dark blue).

structural information provided by

Micro-Raman can be further

improved using other non-destructive techniques, as ATR-FTIR and XRF.

Occasionally, micro-sampling of stains, residuals, adhesives, frames used in former restorations et cetera is allowed, so as to perform destructive analysis. Methods applied in manuscripts analysis are demonstrated through laboratory experiments. Application of the results to conservation practice is presented by means of a case study: the diagnostics campaign on the manuscripts *MS 2 – In Clementinas* and *Additiones super Clementinas* belonging to the Biblioteca Universitaria of Cagliari (Italy).

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YOUTH in CONSERVATION of CULTURAL HERITAGE - YOCCU  
Palermo (Italy), May 24<sup>th</sup> – 26<sup>th</sup> 2010

## **Magnetic and Optical Supports for Preservation – Problems and Perspectives –**

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### ***ABSTRACT***

Today, archives and libraries are involved in definition of new policies and strategies in order to guarantee a long-term preservation not only of “traditional materials” such as paper and parchment, but also of “new materials” for example magnetic and optical supports for digitalized or born digital documents (audiovisual or multimedia).

In this paper we take into consideration digital supports with particular regard to magnetic tapes (SDL and LTO) and optical discs (CD, DVD and Blue Ray); differences on permanence of materials and reliability of data organization are explained. Then, we describe internal and external factors that can damage supports and data such as instability of components and environmental factors (temperature, humidity, light, air quality, etc.). Furthermore, we discuss about standard storage conditions for long-term preservation and about care and handling. Finally, we introduce *holographic data storage system*, an innovative technology which offers more storage density than traditional optical media because the holograms, representing binary information, are recorded throughout the volume of the support. Due to their large capacities and high transfer rates, the holographic system should become a candidate of next-generation storage media but several analyses and investigation occurs because, at this time, no exhaustive information are known about its structure and storage conditions.

## **Solid state NMR characterization of the waterlogged wooden part of Acqualadrone roman rostrum**

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*Keyword: waterlogged wood, CPMAS NMR, rostrum*

### **ABSTRACT**

The discovery of Rostra in archaeological sea sites is not easy. Even more difficult is to find them with wood attacked to the metal part.

In this work solid state <sup>13</sup>C NMR spectroscopy was applied to characterize the wooden part of a roman Rostrum found in the sea of Acqualadrone (ME).

The NMR analyses were performed because the assessment of the conservation state using physico-chemical techniques constitutes a preliminary step for the conservation and restoration.

A sample collected by coring was divided in four parts in order to correlate the conservation state of the wood to the depth. <sup>13</sup>C {<sup>1</sup>H} Cross Polarization Magic Angle Spinning NMR was used to identify the wood components [1].

The crystallinity degree of the cellulose, that directly indicates the state of conservation of the cellulose moiety, was obtained through the deconvolution of the C4 signals of the glucose unit [2].

Spectral editing methods were performed to obtain information about the condensation degree of the lignin [3]. This parameter indicates its state of conservation.

Structural and chemical modifications were assessed by comparing the structural features of archaeological pine wood to a modern one.

The quantitative determination of the holocellulose content was performed through variable contact time (VCT) experiments [1].

The degree of crystallinity decreases in depth. No hemicellulose was detected in the surface samples.

The main results concern the strong decrease of the sugar moiety going from the bulk to the surface. The extent of condensation of lignin was not modified during the aging in the water environment. The analysis of the NMR spectra reveals that the residues occurring during depletion of sugars were not recombined inside the lignocellulosic matrix.

Further dynamic studies demonstrated that cellulose and lignin are bonded in the ancient wood.

Finally the possibility of analyze small amounts (50 mg) of material within reasonable experimental time using a modern equipment will be illustrated.

It is worth noticing that all the structural determinations described above were performed with no modification of the samples such as solvent extraction or other chemical treatment.

Furthermore after all these NMR analyses the sample is still available for further analytical investigation.



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## Multi-analytical approach to the study of varnishes from historical musical instruments

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*Keywords: musical instruments, varnish, resins, conservation science*

### ABSTRACT

The varnishing and finishing of musical instruments has been an interesting debating point since the end of the 19<sup>th</sup> century for modern lute-makers and industries focused onto the (re)production of high quality instruments [1, 2]. Apart from the protective and aesthetic role of the varnish, its influence on the quality of the emitted sound is not yet demonstrated even if some authors claim the importance of such a contribution [2] to compensate for possible structural defects of the constituting wood.

Therefore there is nowadays considerable scientific interest in recovering the ancient formulations (the *secrets* of the old masters) using several scientific techniques [3] and transferring such knowledge to restorers, conservators, lute-makers and musicologists.

The present work follows the non destructive investigation on historical stringed musical instruments from the collection of the “Vincenzo Bellini” Conservatory in Palermo (Italy) [4]. The previous investigation was carried out by visible and UV-light examination and portable milli-X-Ray Fluorescence spectroscopy.

This paper reports on the results of the application of micro-destructive techniques, such as optical microscopy analysis of cross-sections, micro-Fourier Transform infrared spectroscopy and gas chromatography coupled to mass spectrometry (GC-MS), on samples from 7 different instruments (4 violins, 1 viola, 1 viola d’ amore, 1 cello). The study allowed obtaining micro-chemical and technological information (e. g. fig. 1) about the composition of the varnishes.

A comparison with several reference materials (reported on [1] and [3]) was useful to identify better the components of the varnishes.

Furthermore, the set-up of a Curie point Pyrolysis GC-MS (Cp-Py-GC-MS) methodology is in progress. This is aimed to minimise the chemical manipulation of the sample, before its separation and analysis, and reduce the size of the samples taken from the instruments. The analysis of hard-to-dissolve materials (such as ambers) becomes also feasible by Cp-Py-GC-MS.

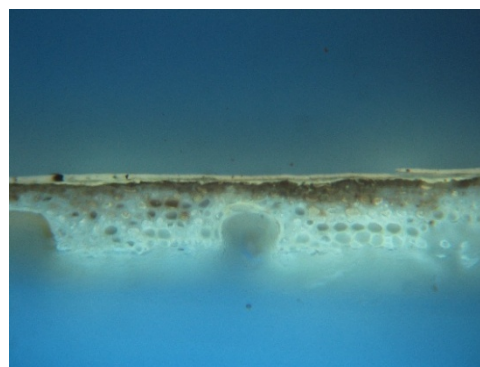


Fig. 2 Cross section of a sample taken from the viola n. 1996 under near-UV illumination (250x). Layers from bottom to top: wood cells, thermal and/or chemical treated brownish region, two layers of varnish.



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## **On the identification of organic materials in painting cross sections by means of ToF-SIMS**

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*Keyword: painting cross sections, binding media, ToF-SIMS*

### **ABSTRACT**

Molecular information on painting binding media and varnishes are traditionally obtained with conventional techniques such as chromatography and/or mass spectrometry [1-3]. These techniques give detailed information on lipids, proteins and resins; however, the disadvantage is the impossibility to employ the samples for further analysis and to obtain spatial distribution information on chemical components. The primary aim of this research is to evaluate the possibility, by using other analytical techniques, to obtain results for univocal identification of the organic substances used in different painting techniques with particular attention to the spatial distribution within the paint layers. In this paper we present the preliminary experimental results of the potentialities offered by the application of ToF-SIMS (Time-of-Flight Secondary Ion Mass Spectrometry) to painting cross sections. ToF-SIMS is a surface-sensitive technique widely used in material science and is well established as analytical method which provides elemental data and molecular information allowing at the same time depth profiling, mapping or imaging [4-8].

One of the main difficulties for the identification of organic materials used as binding media is due to the lack of a database to be used as reference. For this reason, the first part of this project has been focused on developing of a reference database. Samples of different binding media and resins were selected similar to those documented in traditional books of recipes. Binding media, such as animal glues, glair and egg yolk, casein, tri and di-terpenic resins and molecular fragments which could be considered as markers for the detection and the identification, have been investigated. Laboratory mock samples have been prepared following traditional painting techniques, and the samples were studied either embedded or not in epoxy resin as cross sections.

The results obtained are encouraging in the case of proteins, which contain typical amino acids. Among the proteins tested, animal glue was distinctive in containing hydroxyproline, so the detection of this amino acid, allow us to identify, in a definitive way, the presence of animal glue. Casein is distinctive mainly in its high intensity of glutamic acid signal. Glair and egg yolk have a high level of aspartic acid, and can be further distinguished from casein by higher levels of glycine and alanine and by the presence of cholesterol. Distinction between glair and egg yolk is mainly possible by detecting the higher threonine and serine signals in egg yolk.

These primary information will be employed to identify organic components present in the laboratory mock samples and chemical maps will be acquired.

In order to identify organic materials on a real sample, the second step of this project will be focused on the comparison of the results acquired on the standards and on the reference samples with an original painting cross section.

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## Issues in the Conservation of a Glass Icon. Case study: Ana Deji, "The Anguished Mother of God" (tempera on glass, 20<sup>th</sup> century)

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*Keywords: icon, glass, conservation*

### ABSTRACT

Romanian icons on glass are a popular form of religious art, a phenomenon that occurs for the first time in the 18<sup>th</sup> century in Transylvania. Orthodox and Greek-Catholic "Peasant-artists" from this region borrow their techniques from the secular western glass paintings (e. g. from the Eastern region of Central-Bohemia, Silesia, Moravia, etc.) giving them a deep religious significance, with new stylistic accents.

The unique and individual characteristic of this technique of painting on glass in tempera, consists of applying layers of color in a reverse order compared to regular painting. By using this technique, the painted side of the glass becomes the "back side" of the icon, while the side where no paint was applied becomes the "front side", the painting being thus visible through transparency.

In this paper, I would like to bring forward an approach, a methodology of icon conservation, and I will refer to the case study of "The Anguished Mother of God" (Fig. 1), an icon painted by Ana Deji, in the early 20<sup>th</sup> century, which now belongs to the ethnographic collection of the Arad County Museum, Romania.

The icon that is the subject of this study was in a precarious state of conservation. It was practically an incomplete icon, consisting of a rectangular-shaped glass, which lacked both the frame and the rear protective cover.

Following a simple analysis, one could see at first sight that the glass was cracked, and a piece of it was practically loose. At the same time, the pictorial layer was in an advanced stage of degradation, being covered by an adherent layer of dirt and dust, showing several areas of scaling, a natural consequence to the passage of time, and to the aging of the organic binder whose adhesive-cohesive properties have changed. As a result, the icon showed defective areas in the pictorial layer.

After observing and studying all conservation problems present in this case I have established my working methodology.

There were two important conservation issues that stood out of the many other operations that I had to carry on in the conservation process, namely the consolidation and the cleaning of the pictorial layer, issues to which I had to find appropriate solutions.

The pictorial layer was extremely fragile and brittle requiring an urgent intervention of consolidation. Having reflected over this issue and having conducted a series of tests, I concluded that the ideal option for this case was to achieve consolidation using an emulsion made of egg yolk, and that is, using the same material as that of the original binder.



Fig. 3 The Anguished Mother of God

After the consolidation process of the pictorial layer was over, I continued with the cleaning process, which implied removing the layer of adherent soil, obviously a superficial type of cleaning. I directed, therefore, my attention to the possibility of using a cleaning system based on surface-active substances. Applying this methodology was favored by the fact that I was dealing with an inorganic support for the pictorial layer, glass, which facilitated the use of aqueous cleaning methods. In this regard, in order to identify the right solution I needed, I carried out several types of cleaning tests. I started with the classical, traditional method used on this type of paintings, namely using a solution that was based on egg yolk. This is an empirical method, but perfectly valid, since egg yolk contains a surfactant, a natural detergent - lecithin. I tested then a series of surfactants, this time, however, only those designed specifically for restoration. Based on the results, I decided to finally achieve cleaning with a surfactant gel.

A final important aspect of reflection, which is also a subject of controversy among conservators, was related to the existence of defective areas in the pictorial layer. I wanted to remain faithful to the principle of minimum intervention; I also thought ethically questionable any chromatic integration applied directly on the glass, whatever the technique or method used. At the same time, I knew that the aesthetic factor must not be overlooked. I therefore resorted to an indirect chromatic integration by interposing between the back of icon and the rear protective cover a piece of cardboard painted as a background aimed at filling each defective area with adequate shades. The proposed solution proved appropriate both ethically and aesthetically.

## The browning of stained glass windows: characterization of Mn-corrosion bodies and evaluation of cleaning methods

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*Keyword: glass alteration, cleaning treatment, tomography, manganese*

### ABSTRACT

Ancient glass objects, such as stained glass windows or archaeological finds, show different patterns of alteration, depending on their composition, their conservation history and the environment of which they have been surrounded (Davison, Newton).

In this work we focused on the Mn-rich inclusions that cause the surface of ancient glass objects to turn brownish or black. Naturally coloured glass normally contains manganese in the Mn(II) oxidation state, or Mn(III) is present in the case of purple glass objects. The Mn-containing inclusions, instead, have been reported to contain Mn(IV). Several explanations have been proposed to this phenomenon: the manganese could originate from the external environment, carried out in aqueous solution, or the manganese present in the inclusion could as well have its origin from the glass matrix (Schalm *et al*). In restoration practice, dark surface layers can be converted into colourless ones by means of treatments with aqueous solution of different reagents (Fitz).

In this study we aimed at characterising the shape and distribution of the Mn-inclusions, and subsequently assess the effectiveness of the cleaning methods. The purpose was that of providing a better understanding of the browning phenomenon and selecting the most effective and suitable conservation approach.

First, fragments of glass windows dated to the 14<sup>th</sup> century, originating from the Canterbury (UK) Cathedral were examined by SEM-EDX (electron images and x-ray maps). These analyses showed extensive alteration due to Mn-inclusions. Then, high resolution tomography was carried out with both synchrotron radiation (ESRF beamline ID19, Grenoble) and a conventional instrument. Finally, the samples were treated with products commonly used in glass restoration practice, varying the concentration and exposure time, and the result of the treatment was evaluated with the same technique.

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Fig. 4 Stained glass windows affected by browning, Abbaye Royale de Fontaine-Chaalis, France

## Treatment of Portuguese ceramic tiles with different acrylic polymers

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*Keyword: tiles, consolidation, cultural heritage, acrylic polymers*

### **ABSTRACT**

This study follows previous works by the same authors [1, 2] on tiles conservation, which is an important cultural issue, particularly for South Europe. The effect of three different acrylic polymers applied as protective materials on ceramic tiles was evaluated on the mechanical and water absorption properties. An important aim is to reduce the amount of consolidation polymer, in comparison with the quantity used, generally, by the restoration departments of museums, where is common the use of a 10 % (w/v) solution of Paraloid B-72 in acetone.

The ceramic tiles analysed were handmade manufactured following a 18<sup>th</sup> century procedure, in an attempt to reproduce the behaviour of old tiles.

Three protective products were used, namely Paraloid B-72 (polyethyl methacrylate-co-methyl acrylate, 70/30) Elvacite 2046 (n-butyl methacrylate and iso-butyl methacrylate, 60/40) and Elvacite 4067 (iso-butyl methacrylate). The application method selected was immersion. Polymers were applied as dilute solution of acetone, on which the amount of polymer was changed between 1 and 10% (w/v). Samples are designated by the polymer reference followed by the solution concentration and finally “a” or “b” when one or two immersion treatment were made, respectively. Water absorption and four point bending tests were carried out to assess the protection effectiveness. Scanning electron microscopy observations were also performed.

Table 1 shows the results of the amount of retained polymer (rp), the water absorption coefficient (A), the maximum water content (CI), the open porosity (op) and the bending strength ( $\sigma_f$ ). With Paraloid B-72, one and two immersion treatments were performed.

Concerning the use of Paraloid (10% (w/v)), the results showed that a second immersion does not improve significantly the mechanical properties. Water absorption tests also indicate that there is no benefit in performing a two steps methodology. On the other hand, the hydrophobic and mechanical properties of the tiles are not reduced with the decrease on the amount of Paraloid from 10 to 5%. Nevertheless, a further reduction on the concentration to 1%, either with Paraloid or Elvacite products, showed to be less efficient in what concerns the open porosity, maximum water content and bending strength.

Table 1. Amounts of polymer retained and results of water absorption and mechanical tests

Sample	$rp$ ( $\text{mg g}^{-1}$ )	$Cl$ (%)	$A$ ( $\text{g cm}^{-2} \text{ s}^{-1/2}$ )	$op$ (%)	$\sigma_f$ (MPa)
Untreated	-	16.50	$1.70 \cdot 10^{-2}$	27.70	16.94
Paraloid-10-a	$25.10 \pm 3.80$	0.40	$3.00 \cdot 10^{-5}$	0.80	23.57
Paraloid-10-b	$42.90 \pm 4.10$	0.40	$3.00 \cdot 10^{-5}$	0.70	25.62
Paraloid-5-a	$9.30 \pm 1.00$	0.20	$4.20 \cdot 10^{-5}$	0.30	23.85
Paraloid-1-a	$2.00 \pm 0.10$	2.40	$7.10 \cdot 10^{-5}$	4.10	19.57
E2046-5-a	$10.00 \pm 0.90$	0.90	$3.20 \cdot 10^{-5}$	1.60	27.02
E2046-1-a	$2.20 \pm 0.20$	0.50	$2.70 \cdot 10^{-5}$	0.90	19.78
E4067-5-a	$8.80 \pm 0.20$	0.20	$2.40 \cdot 10^{-5}$	0.30	20.51
E4067-1-a	$2.30 \pm 0.10$	5.90	$2.00 \cdot 10^{-4}$	10.00	18.12

$rp$  - amount of polymer retained per gram of sample

Electron microscopy analysis show that, while for Paraloid B-72 the polymer is uniformly disperse, the Elvacite protective products do not give rise to an homogeneous coating.

In this work, it was found that the amount of consolidation products may be reduced without affecting the mechanical and water absorption properties of the ceramic tiles. A reduction of the amount of organic materials will result in a more economical and environmental friendly procedure.

#### Acknowledgments

The authors thank “Fábrica de Sant’Anna” (Lisbon, Portugal) for supplying the tiles and Lucite International (Southampton, United Kingdom) for the Elvacite samples. Teresa P. Santos wish to thank FCT for the PhD grant (SFRH/BD/48242/2008).

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## **The place of the medieval town of Shamkir in our cultural heritage protection**

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### **ABSTRACT**

The ruins of the medieval town of Shamkir are situated in the western region of Republic of Azerbaijan, in the north-eastern part of the Lesser Caucasus, on the left coast of the Shamkirchay River, on the Silk way.

Archaeological excavations along with a small strata graphical test excavation on the monument were held by Professor, Dr. T. M. Dostiyev in 2006.

The excavation was carried out in 6 areas and showed that the depth of cultural layer was 5 meters. The extracted material and cultural findings are the reliable source of clarifying different spheres such as: the professional production of the security system and trade relations, architecture, the life and welfare of the town. It reveals the intensive life of the town from the beginning of the 8th century till the first half of the 13<sup>th</sup> century in Shamkir.

One of the most important achievements of the archaeological excavations is the complete study of the citadel and partial study of the town tower. Fortification constructions evoke special interest in learning the military architecture of Azerbaijan. The walls of either the citadel or the town tower were built according to one of the 4 architectural schools which existed in 11-12<sup>th</sup> centuries in Azerbaijan, namely Arran school, the typical style of which was brick and stone laying. The laying consists of river stones, the combination of bricks and local white stones forming rhythmical patterns. Such laying is notable not only for building on the walls but also for artistic quality. The excavated construction remains had not been in the same condition and the possibility of destruction was very high for some of them. Taking that fact into consideration urgent actions of preserving is being implemented. First the danger of destruction of the central tower of the eastern wall of the citadel was avoided by its preservation. At the same time the dilapidated arches of the excavated arch spans of the construction site on the excavation area N<sup>o</sup> 5 were partially preserved and partially restored for the progeny. Only the construction materials gathered during the excavation and the strengthening solution corresponding to the one of the historical period in question were used during the preservation.

## Cultural Heritage Protection, Preservation and Development in Historical Centres of Modern Towns in Context of Kuldīga, Europe and Nordic Countries

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*Keywords: cultural heritage, preservation, development, foreign experience, old-town*

### ABSTRACT

City building is a continuous process. Plans and conceptions are changed, but it is essential importance that there is a common development idea and it is aligned with the processes run around. The development strategy of town Kuldīga is "...to preserve its unique cultural heritage – old-town and natural complex", what is also mentioned in Kuldīga town development program [1]. Variability through stability is a principle that has to be strengthened in development of historical centre of towns. It is necessary to have balance between existent environmental and historical heritage development and economical development of territory. The aim of development planning is to model harmonic space in Kuldīga old-town by providing possibility to save resources and to show respect to local traditions, as well as rational utilization of territory.

To analyze the subject in context of Europe and Nordic countries – preservation and development of town's historical centres, as well to exclude mistakes in planning of development and towns, what has been done already, the planning of town's historical centres in these countries and performed activities to preserve and develop is explored.

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**Y**OUTH in **C**ONSERVATION of **C**ULTURAL HERITAGE - **YOCCO**  
**Palermo (Italy), May 24<sup>th</sup> – 26<sup>th</sup> 2010**

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## **Excavation, conservation and utilization of the archaeological sites in Azerbaijan**

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### ***ABSTRACT***

Recently wide scale archaeological excavations held in Azerbaijan were discovered new archaeological monuments dating to different periods. Most of them were of scientific research character. In our co-authorship report we would like to bring to world's scientific community notice excavation, conservation and utilization of three archaeological sites.

One of them is found in Garajamirli village in Shamkir, western region of Azerbaijan.

In this area from early 80s of the last century during the agricultural work was found a column base very typical to Achaemenid period. This found caused interest to foreign researchers. Since 2006 by the financial support of Gerda Henkel Foundation and Institute of Archaeology and Ethnography of the National Academy of Sciences of Azerbaijan have been started archaeological excavations in this area together with German and Georgian researchers. During 2006-2009 had been carrying out excavations in the distance from each other 250-1000 meters at three hills uncovered mud brick buildings with limestone column bases in situ. Occasional finds of further column bases and artifacts, also geodesy studies in the vicinity suggest that uncovered buildings was part of a larger ensemble of monumental buildings which include in archaeological complex in a radius 1000 m. During the Soviet period in the area were too many hills which destroyed for extension of land under crops.

For future conservation works unexcavated areas included in the preserving site and excavated areas for continuing next years backfilled methods applied. Over ground finds and fragments of column bases collected for studying and conserving.

Artesian waters and irrigation ditches existing in the area exert destructive influence over monuments. Taking into consideration that in the construction of the building used mainly mud brick and lime stone, these monuments undergo of natural and anthropogenic danger. The use of shelters or roofs covering the monuments, re-route the irrigation ditches or conduct water through water pipes were devised.

Preserving this site as a cultural heritage it is planned to include this area in the tourist route together with other monuments in the region.

Conserving the monuments in a complex together with archaeological studying is the main responsibilities. The first samples of the utilization of archaeological sites are from urban archaeology when ruins of architectural constructions were unearthed and preserved in the formed city.

The next two interesting samples of archaeological monuments are involved in today life and utilized. After excavations of a few tumulus in Fazil village (Shaki, Azerbaijan) they were joined by labyrinth and was created underground museum in which all artefacts belonging to 3-2 century B. C. are remained in situ. In the neighbouring district (Oghuz) were unearthed 3 tumulus with numerous artefacts. With the aim of their display and preservation these tumulus were covered by domes. It looks like a gallery where possible to see all artefacts.

## The past reborn. Digital restitution of the archaeological site of Polizzello

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*Keyword: 3D modeling, pre-historical sites, Open Source, digital archaeology*

### ABSTRACT

In the last decade, the use of 3D reconstructions of antiquities has become a well established trend that is now widely applied to increase the value of cultural heritage.

Only recently have 3D computer graphics been interpreted also as a cognitive tool for the archaeological research, especially with regards to the great monuments of classical civilization.

The decision to produce virtual models of pre-proto historic monuments and sites, often characterized by bad conservation of the remains and lack of other classes of documentary sources, can be considered as a real challenge for archaeologists and experts.

This work, fitting the interests of Catania University's Archeomatica Project ([www.archeomatica.unict.it](http://www.archeomatica.unict.it)), aims to create a multi-phase virtual model, integrating the natural landscape and human constructions, of the Polizzello Mountain site (Mussomeli, Caltanissetta), that flourished between the 10<sup>th</sup> and the 5<sup>th</sup> century B.C.

In particular, in this paper, the 3D models of two large holy enclosures are presented. They were interpreted as the focus of the activities of the acropolis of the site between the 8<sup>th</sup> and the 6<sup>th</sup> century B. C. The elaboration has taken into account all the classes of data collected during the excavations, which have been recently completed, in order to give the philologically correct replica of what the

buildings were at the time of their use. The work tool chosen is Blender: an open source, multiplatform software that is extremely powerful and versatile in 3D modelling, rendering and animation.

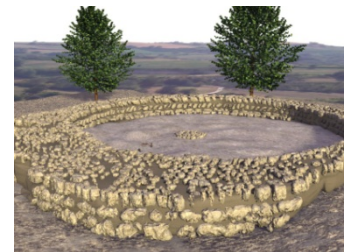
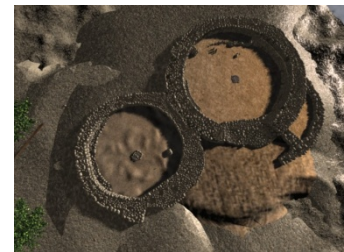


Fig. 1-2 Images of final render

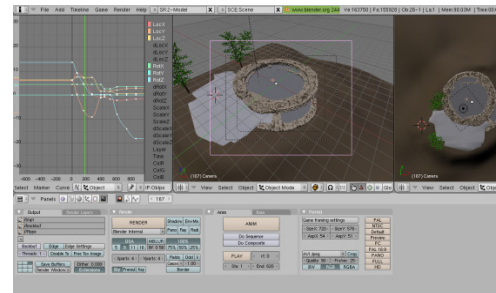


Fig. 3 Phase of the elaboration of the model

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## **Implementation of Intangible cultural heritage to achieve sustainable development strategy for autonomous cultural district**

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*Keywords: Intangible Cultural Heritage, Sociocultural expressions, cultural tourism, efficient utilization*

### ***ABSTRACT***

Sustainable development is a longstanding concern for authorities seeking to meet the needs of their constituencies in a socially, economically and environmentally responsible manner. The current sustainable development strategies focus on searching for a creative cost effective sector that produces direct economic benefits. This could be the cultural heritage sector with its creative talent. The experiences, products, and jobs that grow out of cultural heritage are an essential component of a creative economy. Until recently, this portion of the economic activity has been under-valued as a significant economic driver. Intangible Cultural Heritage is being treated as a new concept that can independently exert substantial influence on the local economy. Where opportunities are not limited to, cultural and heritage tourism, craft, design, music, performing arts, social practices and knowledge.

This paper, therefore, critically Looks at the valorisation of Intangible Cultural Heritage is preliminary stage, in order to transform it into a tool for sustainable development, beginning with scientific planning for the preservation and safeguarding. Then it comes the Intangible Cultural Heritage utilization role through various fields as cultural tourism. Community as premier actor is important for the continuous performing and practicing of Intangible Cultural Heritage [1].

The mutual relationship between tourism and Intangible Cultural Heritage comes to a niche market to create cultural tourism with low volume, optimal cost, and tailoring for individual demands and experience, with tangible and Intangible Cultural Heritage resources e.g. food and wine production, performing arts and shows, particular ritual festivals. Nowadays, tourists are equally as interested in the Intangible Cultural Heritage of the destination as in the tangible one. Intangible Cultural Heritage is both a tool for identifying and positioning cultural districts on a geographical map and a beneficial source of local economic development.

This paper aims to prove the efficiency of the utilization of Intangible Cultural Heritage by comparing the Sicilian and Egyptian cases autonomous territories. From a cultural perspective, they both possess a wealth of tangible and intangible heritage and

Potentials in both districts to create new areas of development. They Satisfy the great demand for specialised tourism through Creative Themes Ecotourism, Agro-tourism, Thematic Routes, Festivals and Traditional products where the Intangible Cultural Heritage plays a pivotal role.

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## **Historia de Concepción: the fate of a project**

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### ***ABSTRACT***

When a research project is planned with time, interdisciplinary team and funds needed, never is thought that the fate could reserve us such unexpected tests.

This project had as objectives to study materiality and decay processes presented by the mural painting *Historia de Concepción* by the Chilean artist Gregorio de la Fuente (280 m<sup>2</sup>), a fresco painted inside the ex Rail Station of Concepción City in 1943. Paradoxically the building replaced the older station after the 1939 earthquake. The expected output of this study would be an intervention proposal for the mural.

This paper aims to show the research state until the devastating earthquake of 8.8 Richter degrees, the past February 27<sup>th</sup> 2010, occurred the same year that Chile celebrates 200 years of independence, what has driven innumerable projects like this. The natural catastrophe affected the building structure, recovered from neglect just 5 years ago, to be the regional government house, and now its demolition is once again discussed. However, the painting has been declared some years ago as National Monument, what means that must be preserved, but not the building. Whatever their fate, the original planning for this project has changed dramatically, and we must to adapt reformulating our goals and being aware to politic decisions.

To the main conservation problem of the painting before the earthquake, its highly powdery state, now it's added some plaster detaching and new cracks occurrence. During April 2010 a mission for emergency consolidation will be carried on, and will be reported to the authorities all the data and conclusions, seeking to protect the mural and the building, both in the material and historic-symbolic dimensions.

The situation of this painting reflects many others reality's in the region, that are in serious risk of being lost for bad decisions when is not comprehended that mural paintings are integral part of the monuments and cultural heritage places, and that they must be preserved *in situ*.

## Characterization and Thermodynamic Interpretation of Ancient Gold Refining Processes Based on a Dioscorides Recipe

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*Keyword: Cementation, Experimental Archaeology, Thermodynamics*

### ABSTRACT

Gold artefacts were systematically produced as far back as 6500 years, making it one of the first mechanically processed metals. The aim of the submitted work (which was conducted during the training of my bachelor thesis) is the study of a possible metal refining recipe based on a passage by Dioscorides ( I century B. C.) in which he describes the cementation process. This recipe were translated by one of the author (Mr. David Loepp in collaboration with Sylvia Ronchey of the University of Siena and Professor Tommaso Braccini). Experimental archaeology was employed to reproduce the whole cementation process step by step.

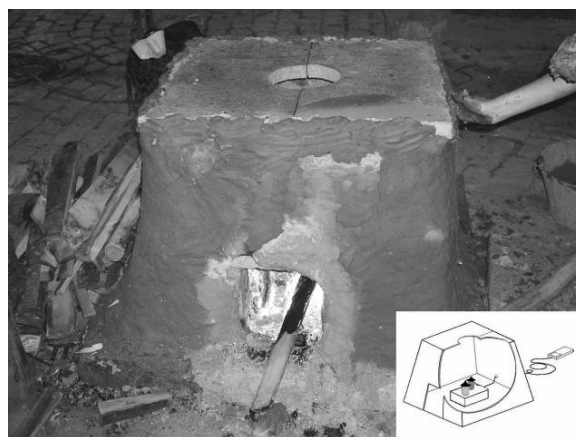


Fig. 5 Furnace built to carry on the trial using the experimental archaeology methods

In this way a mixture, which is the active agent of the recipe, was prepared. Ancient cementation recipes in most cases are composed of sulphates and chlorides. Experimentation based on sulphates of a single divalent metal were preferred, in this case the recipe of Dioscorides aimed to imitate the oxidation of a natural sulphide mineral complex reportedly used in ancient gold processing. Unrefined gold samples, put in close contact to the active mixture, were submitted to thermic process in a furnace built using ancient technics (Fig. 1). After every experimental step, the materials involved in the chemical process were characterized by micro-chemical analyses (EDS) and physical-chemical methods, scanning electron microscopy (SEM) and X-ray diffraction (XRD). Thermodynamic evaluation of all chemical processes involved in the entire gold refining procedure were carried out to understand each specific chemical equation which takes place in the cementation process and to obtain a correct interpretation of the complex phenomena involved. Thermodynamic considerations indicate the reliability of the chemical processes over a wide temperature range. The most surprising result is that ancient recipes based on sulphates and chlorides point to a refining methodology in which ingredients are combined in order to cause at least one agent to trigger the production of the active agent of gold refining, molecular chlorine, over a wide temperature range.

## **Complementary of the XRF and LIBS analyses in the conservation science: the case studies of the bronze alloys**

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*Keyword: XRF, LIBS, bronze alloys, cultural heritages*

### **ABSTRACT**

The present study confirms how the integrated use of non-destructive or micro-destructive spectroscopic techniques is capable to provide a clear response to the investigative needs in the conservation science. In particular, the X-ray fluorescence (XRF) analysis in association with laser-induced breakdown spectroscopy (LIBS) can be useful for collecting information about chemical composition and elemental stratigraphic distribution of the external layers.

Indeed, differently from the conventional techniques, such as XRF analysis, the LIBS together to the information about the superficial composition, yields data also regarding the depth profiles through successive laser pulses. LIBS technique detects the peaks of emission lines of ionized atoms completely for effect of high power laser pulse focused on the sample. In this way, it makes possible the characterization of the chemical elements with low atomic number and, therefore, the identification of materials not detectable by the other techniques.

The complementary of XRF and LIBS techniques has been tested by analysing bronze samples, made in the laboratory according to ternary and quaternary alloys typical of Roman archaeometallurgical production and buried for one year [1].

The comparison between these two spectroscopic techniques is particularly useful in the study of cultural heritage being their results complementary both in terms of thickness and composition of the investigated surfaces [2, 3].

These findings are of considerable interest both in the archaeometric and conservative context. In the first case, it is in fact important to study the constituent materials and to improve the knowledge about the realization techniques. In the second one, the characterization of the external deposits through the analyses of surface materials and the comparison with those of bulk is needed to establish the more suitable restoration treatments.

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## Artificial patina in experimental archaeology

Barbara De Filippo<sup>a</sup>, Luigi Campanella<sup>a</sup>, Stefano Natali<sup>a</sup>, Daniela Ferro<sup>b</sup>, Andrea Brotzu<sup>a</sup>

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*Keyword: Cu-Sn alloy, artificial patina, SEM-EDS, colorimetric measurements*

### ABSTRACT

The aim of this work is to investigate about the possible methods used for the realization of artificial patina on Roman and Greek bronze statues, starting from various ancient recipes and literary fonts

The “Patinatura” process produces a compact layer of copper compounds on the surface whose function could have been either to protect the statue from corrosion either to color statue. Several chemical recipes have been proposed in literature in order to obtain different surface colors (principally green, red, blue, black) [1, 2].

Ancient Greek and Roman bronze statues are usually characterized by the presence of patinas on the surfaces. According with the ancient literature, the roman bronze statues coloration could be obtained by treating the surfaces with “oil”. Unfortunately it is not clear what does it means “oil”, because this term comprises several organic compounds, starting from the common olive oil up to bitumen. However it is also reported that the repeated use of oil could darken the bronze surface owing to the formation of thin cuprite layers. These layers could be more darkened by oil and by dirty particles incorporated inside the oxidation products [2, 3].

In this work, preliminarily, patinas coming from several archaeological artifacts have been characterized by determining the colorimetric parameters, the chemical composition and the morphological structure. The obtained results have then compared with artifact patinas, realized in experimental archaeology, in accordance with the main methods reported in the ancient literature [4, 5, 6]. In particular the following statues: Mars of Todi, Young satire with wineskin, Taurus statue and a fragment of the Charioteer hand saved in Vatican museum (Roman antiquary section) have been the object of the present study. Besides, some colorimetric analysis have been carried out on the Riace bronze Statue A, which presents an uniform shining dark patina. The colorimetric data have been completed with previous compositional data reported in literature [7].

The reproduction of artificial patina in experimental archaeology, have been realized by employing two old metallurgical methodologies for bronze superficial treatments, so called: “hot” and “cold” process. In the “hot” treatment, the bronze samples have been placed in a refractory covered crucible. Sulphur powder has been put inside the crucible and heated at temperatures ranging from 280° C to 450° C. In the “cold” treatment, a mixture of olive oil or greasy olive oil with sulphur powder has been prepared. All samples are covered with these mixtures at 25° C for 24h- 48h.

Scansion Electron Microscope (SEM), Energy Dispersion Scansion (EDS), X-Ray Diffraction (XRD), colorimetric measurements and NMR and UV absorption analysis have been carried out for the characterization of artificial laboratory patinas [8-13].

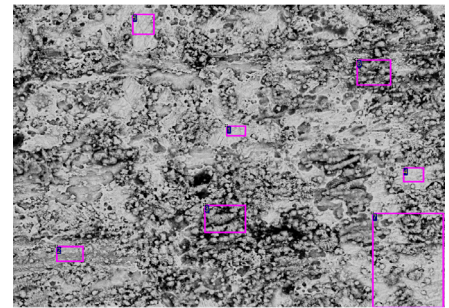


Fig. 1: EDS analysis on artificial patina.

The results give useful information about bronze statues black patina, allowing not only to verify the hypothesis deriving from the study of ancient sources, but also to define important parameters for the patina characterization.

The ancient metallurgical procedure, applied to laboratory condition, is a valid method for the patina study. Experimental treatments allow to modify exposure parameters and consequently to investigate the variation of chemical and physical effects on patina formation.

This methodology approach has been applied for the first time to the surface study of the great statuary (Riace Bronzes, Mars of Todi). More in detail the colorimetric analysis, that is an unique non invasive technique, monitor the colour parameters modification before and after patina formation, by allowing to compare colorimetric parameters obtained either by the original and either by the artificial one. The differences found, could be considered as diagnostic markers for dating and geographical collocation of artefact, purpose.

The obtained data on experimental reference samples, compared with those relatives to the archaeological items, allow to define the technique of patina formation employed during artefact manufacturing. In this way it was possible to support with scientific consideration the historical research about the different metallurgical techniques applied during the Hellenistic and the Roman periods. In particular the results of the present study lead to hypothesize that the statues, manufactured during the Hellenistic period, are characterized by black patina produced by cold process, while those of the Roman period has been characterized by black patina produced by hot process.

Furthermore the identification of the patina chemical-physical characteristics is an useful contribution for the restorer. In fact the correct identification of the patina nature allows to adopt the best polish and preserving procedures.

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## Treatments to recovering the original chromatism of coloured stones

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*Keyword: marble, chromatism, artificial weathering*

### ABSTRACT

Many ancient coloured marbles don't show their vivid original colours even after a careful cleaning restoration mainly due to two reasons: either because of alteration of their chromophore compounds or because of the increase of micro roughness of their surfaces. To solve this problem modern marbles are usually mechanic polished, but this operation is not appropriated for ancient marbles, which can be instead treated with the application of chemical products. The aim of this paper is to study chemical products useful to revitalize chromatic values out dangerous effects over time. Ten commercial products were selected and applied on stone samples of different colour (white, red and black). The stones were similar with the main mineralogical component of calcite and with the Total Open Porosity % of c. 1. The selected products were silicone and acryl-silicone polymer, polyether and fluo-polyether, aliphatic resins, microcrystalline wax. A first screening was carried out on treated samples by colour measurements. Out of this screening the six best treatments were selected for further experimentation. The treatments were applied on the different colour stone samples, the measurements of colour by reflectance colorimeter and measurements of water vapour permeability were carried out on treated samples before and after an artificial ageing by xenon test. Furthermore FTIR analysis and reversibility testes were done on products alone before and after artificial ageing. The three best products selected by this study were also applied on ancient stones often used in roman Opus sectile (Giallo antico, Africano, Cipollino, Greco scritto, Pavonazzetto and Bardiglio) and measurements of colour were done before and after ageing. The products with the best performances were Regalretz 1126 applied at 5% (GEAL), Marble Toner (GEAL), Idrorepel Tone (CIR). The performances of these products are presented and discussed in the present paper.



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## **Characterization on degradation in Crypts**

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*Keyword: degradation of cultural heritage, non-destructive investigations, microclimatic surveys, biological attack*

### ***ABSTRACT***

In cultural buildings, processes of degradation are a direct or indirect result of unsuitable environmental conditions. We studied ancient Crypts located in different sites in Italy, showing different types of decay. Some have moulds, fungi, algae and bacteria present on columns and shafts; while in others salt efflorescence is spread along the masonry and on the base of the columns. To characterize the complex interactions leading to damage in these historical buildings, microclimatic conditions were accurately monitored. In addition, non-destructive methodologies, involving biological and physico-chemical approaches, were utilized and the experimental results are compared and discussed. Then, building location, historical background, climatic characteristics, stone typology and features, natural-artificial lighting and ventilation were taken into account and correlated in order to properly understand the state of conservation and to address possible strategies for the safeguard of these Crypts.

## Inversion tests on ultrasonic tomography data

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*Keyword: 3D Ultrasonic tomography*

### ABSTRACT

3D Ultrasonic Tomography for non-destructive test and for diagnostic study works of art is a rather established methodology. This method allow us to locate, within the volume of work of art, areas of structural non homogeneities, areas of decay, fracture or damaged.

This non-destructive analysis, that can be applied in situ, would be a valuable diagnostic tool both to verification of a restoration and to monitor trends over time.

Usually, both travel-time and amplitude tomographies ignore scattering phenomena and the band-limited character of the signals. But, for amplitude tomography implementation every amplitude variation has to be interpreted as absorption effect. This is a very rough approximation because scattering can actually be more remarkable.

We have used a lots of acquired data sets to implement only travel-time tomography, according to geometrical optic approximations and assuming that dispersion and scattering effects are negligible. A critical step in travel-time tomography is the first arrivals picking and the optimization of the inversion parameters Agnello [3]. This work wants to present same tests carried out to optimize these parameters in order to obtain a better anomaly image resolution for the case history presented Capizzi [1, 2].

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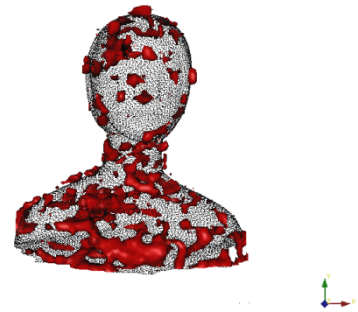


Fig. 6 Isosurface of ultrasonic velocity on Eleonora d'Aragona

## A new preparation method of nanolime dispersion for the conservation of artworks

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*Keyword: nanolime, consolidation, insolubilization*

### ABSTRACT

The application of innovative nanolime dispersions for consolidating wall paintings constituted a valid alternative to the lime traditional ones [1]. Different preparation methods have been investigated from the Nanomaterial Group at the CSGI Consortium of the University of Florence in order to obtain a good product to avoid chromatic alterations of surfaces, to reduce the penetration depth and to obtain a complete conversion of lime into calcium carbonate that leaves free particles on the surface.

The dispersions of nanolime have been applied in many case studies. They were recently applied in some important *graffiti* of the Steri's Prison, Palermo (Italy) and in the lunettes of the SS. Giuda e Simone Cloister, Corniola (Empoli) [2, 3].

Particles size, polydispersion, and agglomeration depend on the preparation method. Tailoring the experimental condition of the synthesis, it is possible to produce nanodispersions for other specific artistic artworks such as stones, papers or woods.

In this presentation a new preparation method, the insolubilization, will be shown. It was used to obtain small nanoparticles dispersed in a water-isopropanol mixture.

The stability of dispersion together with particle size and their morphology was studied as function of temperature and water-isopropanol ratio. Results will be discussed.

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## Mesoamerican mural paintings. Physico-chemical characterization of materials and application of calcium hydroxide nanoparticles for consolidation

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*Keyword: Mesoamerican paintings, pigments and dyes, organic binders*

### ABSTRACT

Painting technique, used by Mesoamerican people to make *murales* in the pre-Columbian era, is partially unknown. In this work we tried to improve the knowledge of this technique, with the final aim to apply calcium hydroxide nanoparticles for consolidation of the painted surfaces. In order to reach this goal we analyzed pigments, dyes, binders and mortars and also we investigated the degradation causes that affect the paintings.

To characterize the paintings we used optical microscopy and SEM-EDS to observe and analyze the cross sections, FTIR spectroscopy to distinguish the different compounds (presence of soluble salts, organic binders, and clays as colorant supporting material, etc.), XRD to characterize pigments. Organic binders used by Mesoamericans were mainly based on gums (polysaccharides). MALDI-TOF, HPHPLC-UV, GC-MS were used to identify gums composition.

Painting samples were collected from three archaeological sites in central Mexico, Cholula (II-IV sec. B. C.), Cacaxtla (VII sec. B. C.) and Tlatelolco (second decade of 1500, first age of the Spanish Conquest).

A set of ten natural resins and gums was selected as a reference material, to create a database to be used for an easier identification of binders extracted from wall paintings samples. The percentage of water combined with the binder and the glass transition temperature of gums were measured by thermal analysis, DSC and DTG. It was hypothesized that the high durability of the paintings in the extreme conservation condition (very high humidity and temperature) could be explained with the specific interaction of gums (binder) and water.



Fig. 1-7 Cholula mural de los Bebedores

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## Investigation the history and consequences of past restoration interventions on frescos – the case of baroque paintings of Giulio Quaglio

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*Keywords: Giulio Quaglio, baroque fresco, conservation, restoration*

### ABSTRACT

One of the most illustrative example of negative consequences [1] of past restoration interventions we see on the unique self-portrait of the baroque painter Giulio Quaglio (1668–1751) from Laino near Como in Italy [2]. He painted himself on 1st July in 1704 on the right wall in the presbytery of Cathedral of S. Nicholas in Ljubljana [3]. I am going to present many other interesting examples that are demonstrating the nature of decay on wall and vault paintings and the consequences of unskilled and unprofessional restoration decisions in the past. With the mentioned subject I will present one part of the conservation-restoration project – executed in years 2002-2006 by Restoration centre in Ljubljana under the Institute for the Protection of Cultural



**Fig. 8** Photo of the only self-portrait of Giulio Quaglio in year 1903 (left) and in 2007 (right) in the Cathedral of S. Nicholas in Ljubljana

Heritage of Slovenia as one of the most complex projects in Slovenia [4]. The research was made as the preliminary investigation in the first and very important phase of restoration project, when different professional researching domains, from history of art to science, take place with the main intention – to provide exact and verified information for the restorers. Researching history of past restoration interventions on Quaglio's frescos in Ljubljana Cathedral through archive sources, literature and especially photographic and graphic material has given us very successful results (the photo-material for example helps us with reconstructions on damaged parts of fresco), that help us preserve an important work of art, such as Quaglio's illusionistic fresco in Ljubljana for future generations.

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## Green pigments: Tradition and modernity in painting according to Portuguese 19<sup>th</sup> century technical literature

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*Keyword: green pigments, painting, treatises*

### ABSTRACT

During the 19<sup>th</sup> century a large number of new pigments, dyes and lakes appeared due to chemical science and industry development. Their discovery was not only economically advantageous but also stimulated, since some had a great impact in industries namely in the fundamental textile and dyeing fields. A new generation of *colourmen* based on consistent chemical knowledge emerges and the painter moves away from the traditional setting as workshop habits and structure are simplified and new painting contexts and techniques allowed by new materials introduction. Concomitantly, the gap between artists and their knowledge of materials increases as industrialization develops.

Green traditional pigments include minerals and natural products such as malachite and atacamite and green earth. Malachite and atacamite and their artificial versions are not intense colours. Green earth, although stable, was transparent in oil binding media. Vegetable green lakes had a poor permanence and were not appreciated for oil painting. Also copper greens, like *verdigris*, whose production varied along ages and places, resulted in chemically different substances, generally unstable and of poor compatibility with other pigments. Compounded greens had, according to the components, different characteristics. A clear need and appetite for better green colours were obvious. However, throughout 19<sup>th</sup> century new modern synthetic green pigments were not defect-free. For instance, Scheele green, named after the Swedish chemist who invented it in 1775, was promptly adopted despite its high toxicity. It was replaced by other arsenic green pigments like Schweinfurt and emerald green. Their characteristics were similar and they too rapidly became obsolete with the production and commercialization in larger scale of green compounds based in recently discovered elements, such as chromium, zinc and cobalt. Prussian and ultramarine greens are also among these new materials.

The adoption of these new products depends on different factors, namely their availability in trade markets, their price and characteristics. Also, personal aspects, such as the artist's knowledge about them and his willingness to change must be taken into account. In recent surveys, 19<sup>th</sup> century Portuguese technical literature demonstrated an average 37 years delay between new blue synthetic pigments first written reference and the beginning of commercialization [1]. For new yellow pigments such average delay is 52 years [2]. Do the data relative to new green pigments confirm these studies? Considering written sources indirect information about actually used materials, which green pigments, traditional and modern, can be identified in contemporaneous Portuguese technical literature? How did authors characterize them? When were they first mentioned? Which was the delay compared to the dates of their introduction in markets? These results will be discussed within the context of what happened in countries central to pigments production and new materials development.



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## Spectroscopy Studies on Conservation Issues in Modern and Contemporary Art Paintings

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*Keywords: micro-Raman, micro-FTIR, laser cleaning, synthetic binders*

### ABSTRACT

With the aim of follow the today's ethical values introduced by Camillo Boito and developed by Cesare Brandi for the conservation and restoration of cultural heritage, the scientific investigation is being inevitably developed in order to assist the conservator's work. When it comes to modern and contemporary art the matter becomes more difficult, mainly, because of the variety of modern materials used by artists in the twentieth century as demanded by the exponential industrial growth and artists willing of experimenting new material possibilities (Jones [1], Learner [2]). This variety of new materials brings necessarily problems for the conservator-restorer, who sees his work limited by the original material doubtful answer in the presence of the conservation products typically used. However, it is common to see posterior over paints in modern and contemporary art paintings with paint formulations very similar to the original materials (Pouli [3], Melessanaki [4]). Facing this situation, a today's conservator has to be assisted by scientific investigation, integrated in a multidisciplinary team. Therefore, the aim of this work was to set-up a spectroscopic methodology to evaluate harmfulness and effectiveness of the laser cleaning for the selective removal of overpaints made by different commercial synthetic based paint formulations. The study was carried out by micro-FTIR and micro-Raman on mock-ups painted with two acrylics, a vinyl, two alkyds and a nitrocellulose as binding mediums and the ultramarine blue, phthalocyanine blue, dioxazine violet, and titanium white as pigments. Some alterations phases could be found, mainly by binder degradation, and the titanium white showed significant alteration in micro-Raman spectra. By other hand, the other pigments did not show any significant alteration and were removed easier. Because of the difficulty on mock-ups reproduction of modern and contemporary art painting materials, the cleaning evaluation must continue also in the original painting, hence, portable spectroscopy equipments were covered as well, which can be used *in situ*, and therefore, of great value in this matter.

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## **Bronze ornaments from the Basarabi Culture The Restauration and Conservation issue**

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### ***ABSTRACT***

The poster presents the saving, stabilization, conservation and restauration issue of some bronze ornaments – bracelets – and their evolution from their discovery till the moment of the exposition in the museum.

The bracelets, four by number, two plurispiralic, with ten spirals (G – 84,300 g, d – 75x65 mm; G – 92,200 g, d – 72x72 mm) and two spiralic bracelets, with two spirals (G – 54,200 g, d – 63x65 mm; G – 41,700 g, d – 63x67 mm), are dated back in the VII century B. C.

The ornaments belong to the Basarabi Culture, a Middle Hallstatt Culture, located in the danube-carpathian space, dated between 700-650 B. C., were discovered in interment graves in the city of Desa, Dolj county, Romania, situated in the Danube's holm.

One of the characteristic feature of the Basarabi bronze bracelets is the lack of adornments from wire or metal bar of bronze warm moulded.

The accentuated conservation state is caused by bronze's composition, the salty soil in which were also discovered the organic substances proceeded from the interment graves.

The corrosion layer is formed by carbonates (green copper ore and azure copper ore) and basic copper sulphates, oxydes and copper sulphides and in the extend areas copper chloride along with copper phosphate.

The treatment aimed to preserve the patina by eliminating the chlorides by stabilizing the metallic surface through inhibating techniques and final conservation of the metallic structure.

## Evaluation of Carboxylate-based Coatings for the Protection of Copper and Copper Alloys

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*Keywords: copper, corrosion inhibition, carboxylate coatings, ethanolic solution*

### ABSTRACT

Together with its alloys, such as bronze and brass, copper has always played an important role in art and human life, since it has been used throughout history for the realization of various functional items (like coins and tools) and artistic objects, from statues to jewelry.

Like many other metals, copper corrodes once it comes into contact with an aggressive environment, such as seawater, soil, or moist air. Historical copper-based objects are often preferred in their corroded state, because of the aesthetically pleasing colors, and also because the presence of corrosion products is evidence of the passing of time, thereby adding extra value to the object. However, problems can arise, especially when specific corrosion products, such as chlorides, come into contact with the metal core. Under certain conditions, the deterioration of the underlying metal will continue, leading to the destruction of the object [1]. One way to preserve these objects is to isolate them from the corrosive environment with a protective coating, but the major problem of presently available treatments is that products for protective coatings and corrosion inhibitors are dangerous for conservators: 1,2,3-benzotriazole, for example, is very efficient against copper corrosion, but it is extremely toxic with a possible carcinogenic effect [2].

Recent studies have demonstrated the effectiveness of carboxylic acids and sodium-carboxylates as aqueous corrosion inhibitors; moreover protective layers of metal-carboxylate deposited on the surface from aqueous solutions have been described as effective inhibitors against lead, copper alloys and iron corrosion [3, 4, 5].

Collaboration with the Flemish Institute for Heritage (*Vlaams Instituut voor het Onroerend Erfgoed/VIOE*) has highlighted that corroded archaeological cupreous artefacts recovered from wet environments, such as archaeological sites in Flanders (both rural and urban), are very susceptible to further corrosion when exposed to humid air. Therefore we have tested a novel method of depositing carboxylates from ethanolic solutions, which allows long chain molecules to be deposited rapidly. We used this here as it has the added benefit that the artefact is not brought into contact with water after the drying process applied to recovered artefacts. In our work we experimented with different carboxylic acids, different concentrations and times of immersion.

The final objective is to have a practical and easy method for producing layers of improved moisture and corrosion resistance fitting with the specific requirements of heritage preservation (in particular the question of reversibility and aesthetic appearance).

The coatings were evaluated from a visual point of view through characterization with optical and electron microscopy. Moreover electrochemical tests (polarization resistance experiments and corrosion rate measurements) were performed in order to compare corrosion rates before and after the treatment.



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Preliminary results show that treatment with neutral solutions (pH 7–7.5) of carboxylic acids (with carbon chain length >10) in ethanol improves the corrosion resistance of copper.

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## **From waste to art and archaeology: polystyrene films as an innovative tool for protection of metallic artefacts**

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*Keywords: protection, films, low adhesion, metallic artefacts*

### **ABSTRACT**

The protection's question is one of the most important in a conservation operation on artistic artefacts. Most of the methods for the protection of artistic and archaeological surfaces are based on the use of organic substances that form a film on the object surface. Generally also the films undergo various degradation processes, so they lose their initial characteristics and it's necessary the removal with specific solvents, often dangerous for artefacts and for operators.

One possible solution to eliminate the problem of solvents for removal might be to put onto the artistic objects a film, with thickness equal to that of varnishes and coatings currently used, that has the main characteristics a low adhesion to the surface and strong internal cohesion; a kind of protective “peel off” or “disposable”, which, once degraded, can be removed without problems and without leaving any traces.

These films, well known for the protection of delicate surfaces like computer and mobile phones screens, are made of pre-formed polyethylene adhering onto the surface. But in the case of artefacts there is the need to form a protective film directly onto the surface so that it be possible to follow perfectly the modelling of the artefacts.

In this light a type of products suitable as target are identified in the Pressure Sensitive Adhesives (PSA), that are a class of adhesives that usually adheres to the support by contact and without chemical reactions. It is noteworthy that the adhesion strength is not proportional to the pressure, but that a small compression (comparable to a hand pressure) active the bonds that serve to attach to the surface [1].

Among the classes of these products there are the various styrene copolymers, so we thought of using the polystyrene, that, known from the literature, has film-forming ability. The choice of polystyrene was also favoured by some advantages of this material, especially the availability and cost, because currently it is much used throughout the industry of packaging. In this view, the idea was to devise a procedure for the preparation of polystyrene-based protective films with low-adhesion from waste packaging material made of expanded polystyrene.

The present contribution reports the polystyrene films preparation and characterisation by means of AFM, optical microscopy, DSC, DTG/DTA, UV-vis spectroscopy and their application on metallic surfaces. In particular, a meaningful test was performed on some samples of “bronzed” brass artificially degraded following a procedure reported in the literature [2]. Morphological and chemical – elemental – analysis carried out using AFM and SEM/EDX showed very interesting and promising results in terms of protection against corrosion. The results are discussed also in view of a possible innovative therapy for the so called “bronze cancer”.



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Palermo (Italy), May 24<sup>th</sup> – 26<sup>th</sup> 2010

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## **Raman analysis of historical materials of the figures of St. George (XVI c.) and Bartolomeo Colleoni (XX c.)**

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*Keyword: Raman spectroscopy, wax, corrosion*

### **ABSTRACT**

For the needs of the recent conservation project studies were carried out on two historical objects: the gold-plated, all-metal (Cu) and natural height figure of St. George Killing the Dragon (Gdańsk, XVI c.), and a statue of a condotier Bartolomeo Colleoni, made of cast zinc alloy with electroplated copper layer (Szczecin, XX c.).

The confocal spectrometer (Renishaw InVia) providing sample excitation at 785 nm and average power of 150 mW was applied. The objective of magnification of 50 x assured the spectral footprint of the sample surface area of approximately  $50 \times 50$  microns. Spectra measurements were performed in the range from 100 to  $3200 \text{ cm}^{-1}$  at resolution  $2 \text{ cm}^{-1}$  and exposure time: 10-15 s. In order to improve the signal-to-noise ratio summed over the surface several times: to wax three times, for the contamination and corrosion from 50 - 100 times. Uses diffraction grating 1200 lines / mm. For measurements small samples of different parts of the figure of St George, including these covered by wax and from both historical objects, including the contaminations layers were prepared.

The wax covering the statue of St. George was analyzed and the presence of the original beeswax was concluded [1, 2]. This was supported by comparison with reference spectra used for identification: beeswax, paraffin and microcrystalline wax (cosmolloid H80). Also the literature data [3] show that beeswax was used commonly in XVI c. in order to improve the appearance of gilding.

For both objects also measurements of the corrosion layers were performed and basically the copper sulphate – antlerite, and also carbon were identified [4]. This is a agreement with the typical reaction products resulting from the urban atmosphere pollutions.

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## **Immediate XRF analysis of historical metal objects and its confidence level confirmed by complementary techniques**

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*Keyword: X-ray spectrometry, LIBS, metal objects*

### **ABSTRACT**

The aim of this work was to analyze the elemental composition of the historical metal objects using a portable XRF (X-ray Fluorescence) spectrometer and to improve the confidence level of the analysis by the results obtained by means of other analytical methods. The paper contains results of the elemental analysis of two coins: the copper Pfennig (1867) and silver coin (1825), and of several parts of the figure of St George Killing the Dragon (Gdansk, XVI c.), complemented by the data obtained by means of the Laser Induced Breakdown Spectroscopy (LIBS). The XRF measurements were made by the portable spectrometer completed at IF-FM. The spectrometer X-ray tube used for excitation produced the beam collimated to 4 mm in diameter. The energy resolution of the detection was 155 eV (at the Mn K excitation line) and the material dependent detection limits between 60-340 ppm were confirmed during the instrument calibration. The operating parameters for tube voltage and anode current during the measurements were set to 55kv and 1 mA. No blowing of He during the measurements was used. The acquisition time was 120 s for each spectrum. Results of the XRF measurements of elemental analysis of the coins (copper coin: iron, copper, lead) and (silver coin: copper, silver) have been confirmed by complementary LIBS technique. The LIBS investigations of coins were carried out using the Nd: YAG laser (Quantel B) with single laser pulses ( $2 \text{ J/cm}^2$ ) at 1064 nm. Spectra were acquired over the range of 200 to 800 nm. The elements sulphur and sodium, not detected by the XRF technique, have been identified by LIBS. The XRF data taken from several parts of the figure of St George Killing the Dragon were compared with results collected by using the Energy Dispersive Spectroscopy technique (EDS). These tests on small material sample were performed using the SEM microscope (Zeiss LEO 1430 VP) coupled with the EDS apparatus (Quantax 200 & Detector XFlash 4010). The EDS data confirmed the X-ray analysis of the basic elemental composition of materials (Ca, Cu, Fe, Pb, Ba). The measurements allowed also to identify the techniques of gilding originally used on the object, as well as subsequent maintenance work.

The results indicate, that the combination of more than one technique in addressing analytical questions can be advantageous. The use of complementary approaches assures higher level of confidence and deliver more complete information. This agrees with the literature data and indicates on a proper strategy in analysis of historical objects [1, 2].

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## Artistic reproduction of the “Guerriero da Petralia Sottana”

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Keyword: reproduction, bronze

### ABSTRACT

The small artwork known as “Guerriero da Petralia Sottana” of the Collisani Collection of the Civic Museum of Petralia Sottana (Palermo, Italy) is a bronze of 5.75 cm in height, 3.61 cm in width and 62 gr in weight. It was found out during cultivations in a private land of southern Imera, near to Petralia Sottana. The artwork represents a naked warrior, having in a hand a circular shield and in the other a cone. It wears a helmet on the head. Respect to other small *siculi* bronzes, it is similar to the Greek ones.

The aim of this work was the manual reproduction of the artwork on the basis of the original manufacture and following the guidelines of the Italian “Codice dei Beni Culturali e del Paesaggio”.

Prior to the manual reproduction, a physical chemical study was carried out to obtain information about the composition of the alloy and the technological properties of the artifact.

Optical Microscopy in visible and ultraviolet light showed that the warrior was prepared using the lost-wax casting, direct method. X-ray fluorescence investigation indicated that Cu, Sn and Pb are the principal element of the alloy, but minor components such as As, Fe and Ca were also discovered.

These findings are in agreement with the hypothesis of the archaeologists that placed its creation between VII and III century a. C.

The *guerriero* reproduction was conducted in three steps: the study of its anatomical parts, movements, postures and gestures; the reproduction in wax; the bronze casting using the old lost-wax casting, direct method.

The production of a series of artwork, having a specific high quality, could economically support the museum and prove job.

This work could be the first for new museal roles and perspectives: the "scientific" reproduction of important artefacts could make the institution invest resources for spreading its knowledge.



The “Guerriero da Petralia Sottana”

## **Laser Ablation coupled to Mass Spectrometry (LAMMS) applied to the Cultural Heritage**

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*Keywords: Laser, Ablation, Mass-spectrometry, coins*

### **ABSTRACT**

A NdYag pulsed laser (3 ns pulse duration, 532 nm wavelength, 15-150 mJ pulse energy, 1-10 Hz repetition rate) is employed to irradiate ancient coins placed in vacuum ( $10^{-6}$  mbar).

During Laser Ablation a Mass Quadrupole Spectrometry (MQS) permits to detect the ablated masses from the sample surfaces with less than 1 amu mass resolution, in a range of 1-300 amu, with a sensitivity of the order of 1 ppm.

Bronze coins from IV–X century A. D. coming from different Mediterranean sites (Egypt, Greece and Italy) are ablated, in a controllable manner to remove about 1  $\mu\text{m}$  per laser shot from 0-5  $\text{mm}^2$  spot.

During laser ablation the removed species are analyzed with MQS relatively to special elemental composition, chemical compounds and isotopic species.

The elements of interest are those of the surface and bulk composition, preliminary checked out through XRF analysis.

The chemical compounds concerns the main species of the patina and of the first bulk layers.

The Pb isotope ratios measurements concerns the lead contents in the bronze coins.

The used technique, the obtained measurements and the result correlations are presented and discussed.

## Contribution of total suspended particulate (TSP) to the formation of black crusts on building materials in urban environments of Sicily (Italy)

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Keyword: total suspended particulate, black crusts

### ABSTRACT

The blackening of building material surfaces constitutes one of the major stone decay processes to be faced in the field of conservation of the Cultural Heritage. In this context, the increasing requirement to preserve the monumental and historical heritage put forward to consider the economic advantages in applying preventive actions instead of expensive restoration interventions. This contribution has been focused on the weathering agents that caused permanent damages of the historical buildings in Palermo and Catania, that are the biggest towns of Sicily, representing a fitting example of the “coastal Mediterranean city” where pollution due to road traffic prevails on industrial emissions. In order to discriminate between natural and anthropogenic contribution to the processes of stone decay, TSP (Total Suspended Particulate) and black crusts were sampled in both the urban areas and subjected to mineralogical, chemical and isotopic analyses. Samples were analysed by means of X-ray diffractometry (XRD), Fourier transformed infrared spectroscopy (FTIR), observation of thin sections through the polarizing microscope (MO), micro-morphological and chemical analysis through Scanning Electron Microscopy (SEM), dosing of soluble salts by liquid chromatography (IC) and measures of  $^{34}\text{S}/^{32}\text{S}$  by mass spectrometry (MS). The chemical and isotopic characterization of TSP, with some insights into the identification of the main sources, has been obtained. Air quality in the urban area of Palermo is mainly due to vehicle exhaust emissions (Varrica [1], Dongarrà [2], Montana [3]) while Catania episodically also suffers the presence of Mt. Etna. The investigation demonstrates also how composition of black crusts reflects that of the atmospheric combustion sources. The data obtained can provide useful indications for a correct partitioning of pollutant sources and the identification of the threshold levels required for a sustainable protection and conservation of the Cultural Heritage.

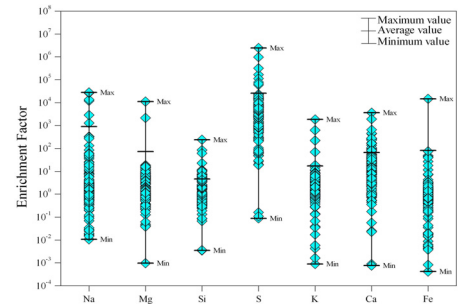


Fig. 9 Enrichment factors of elements in TSP samples respect to crustal composition. Note that the enrichment factor is on a log<sub>10</sub> scale

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## **Selection of microbial strains for the development of a biocleaning procedure for shellac removal from Artwork surfaces**

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### ***ABSTRACT***

The use of biotechnology is quite well developed in many fields, whereas in the art and restoration domain it is scantily applied. In this field biotechnological procedures could be useful to integrate rather than replace conventional chemical-physical restoration procedures, when these are ineffective or toxic for end-users and for the environment. Microorganisms, which are usually related to biodeterioration, can represent a source for the development of new biotechnological solutions for restoration and conservation.

In the present paper the use of selected bacterial strains for the removal of shellac resin from artworks' surfaces was investigated. Shellac, a natural organic resin of animal origin, has been largely used as a fixative for wall paintings, due to its good penetration and adhesion features; when exposed to environmental factors it loses its elasticity and mechanical strength and, by ageing, it becomes hard and insoluble, making the painting matt. The traditional cleaning procedures are ineffective in the removal of aged shellac, as well documented by the case of the Ajanta caves. In this case a biological approach could usefully integrate the chemical procedures to complete the removal without damaging both the artwork as the operators. Thirty-two strains, isolated from the Etruscan tomb of Tarquinia and from contaminated environmental matrices, were selected for their capacity of oxidizing shellac substrate, by means of BIOLOG<sup>TM</sup> system methodology. Four of these strains showed to be the most effective and were tested for the capability to use the target substrate as sole carbon source: CONC 11 e CONC 12 (*Pseudomonas stutzeri*), CONC 18 (*Achromobacter xylooxidans*) and LAM 21 (*Acinetobacter calcoaceticus*).

To check the effectiveness of the shellac degradation and the presence of undesired by-products, the microbial transformation of shellac resin was monitored by GC-MS. Butolic acid has been identified as a marker for the molecular pattern recognition of the resin. Gas-mass analyses showed variations in shellac composition after 1 day of incubation with the selected strains and, after 3 days, the concentration of butolic acid was reduced by more than 80%.

Work is in progress to understand if other components of shellac are also undergoing microbial transformation.

To carry out *in vivo* tests for bio-removal of aged shellac, specimens of wall paintings were prepared purposely, spreading three different pigments (kaolin, cinnabar and indigo) diluted in three organic media (rabbit glue, linseed oil and arabic gum) over a thin plaster layer. Specimens were then incubated in a climatic chamber with 96% R. H. and 34° C, so as to simulate the climatic conditions of the Ajanta caves. At the end of the weathering period, specimens will be treated with a bacterial suspension in order to check their capability to remove the shellac film. Bacterial strains will be tested in different combinations and successions, in order to set up a tailor-made microbial formulas and procedures, for specific restoration requirements.



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## **Electrical measurements for the evaluation of water presence in stones**

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### ***ABSTRACT***

This study deals with the use of a non-invasive measuring system, to discover the moisture content in objects of interest for cultural heritage. The study has principally focused on certain types of stones, however, this analytical method can be employed in many other fields, such as the building sector in general.

A method based on Direct Current Resistivity (DCR: Direct Current Resistivity) measurement through four aligned electrodes on the sample surfaces is proposed to obtain a wetlands mapping of at various depths of investigation. To achieve this project several electrodes contact devices in conformity with the Wenner array were made.

**Some biodegradation aspects of stone after restoration at Stelea Church,  
Târgoviște – Romania**

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***ABSTRACT***

Stelea Monastery is a unique place from the architectural point of view. This monastery was built in the XVI century and is located in “Tara Romanesque”, which a region in S of Romania.

The church’s walls were degraded due to the weather in time. Therefore, a construction company started rebuilding it in 2007. In consequence, all the windows from the churches were replaced with new ones made of PVC. The company did not replace the windows correctly, in other words, they used various materials which did not provide an excellent isolation. This lead to the formation of various size wholes. Therefore, the water could penetrate much easier. Since the humidity in the church increased considerably, the overall effect was the apparition of fungi’s.

This paper presents the biological consequences, which can occur due to the inadequate use of PVC. Additionally, it also draws the attention regarding the techniques used. This methods can have a disastrous effect on the mural paintings. Since these pictures are very old, they have to receive a special attention.

## **Spectrophotometric investigations at the museum: monitoring the colour changes during differential cleaning of the marble statues**

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*Keyword: spectrophotometric investigation, cleaning, marble statues*

### **ABSTRACT**

The spectrophotometric investigation carried out during the cleaning treatments on the marble surface provides an useful support for choosing the best method to employ depending on the case, monitoring, before and after the tests, both the chromatic coordinates and the spectral reflectance. Moreover, the colorimetric measurements allows us to evaluate the goodness of the chromatic level and the uniformity of the cleaned area [1, 2].

The Laboratory of Physics and Indoor Environment of the Regional Center for Planning and Restoration (CRPR) has carried out the spectrophotometric investigation on the marble statues belonging to the Renaissance statuary collection of the Regional Gallery Palazzo Abatellis in Palermo [3]. The purpose of these analyses was to monitor the superficial colour changes during the cleaning treatments and after the restoration works.

In particular, this paper reports the results obtained from the analyses made on: the famous “*Busto di Gentildonna*”, known as “*Eleonora di Aragona*” (by Francesco Laurana, XV century), the “*Natività con cori di angeli*” (by Palermo school, XV century) and the “*Annunciazione*” (by Antonello Gagini, XVI century). Before the cleaning phase, for each artwork, the representative areas of the typical chromatic levels have been selected. Furthermore, the measurement points have been selected in order to obtain a good contact between the optical head of the portable spectrophotometer and the marble surface. Each sample area identified has been localized by means acetate sheets ensuring the repeatability of the measurements during the different phases of restoration works. Indeed, the repetition of spectrophotometric measurement on sample points after cleaning allowed us to realize a surface mapping representing a reference (coordinates of "zero point") useful for monitoring the degradation processes and/or aging of the artworks over time.

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**Evaluation of the nature and conservation state of the metallic sculpture group  
by Michel François Pascal at Palazzo Mirto, Palermo**

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*Keyword: sculpture, electrolytic copper, XIX century, Palazzo Mirto*

**ABSTRACT**

The study of the metallic sculpture group by Michel François Pascal (XIX century), kept in the Regional Museum of Palazzo Mirto in Palermo, was carried out with the aim of a better understanding of the artistic work from a material, historical and scientific point of view, in order to place it in its specific cultural and stylistic context and to assess its conservation state by analyzing the nature of its degradation and the causes of its alteration.

Thanks to an extensive literature search it was possible to determine not only the individuation of the historical and artistic context of the work, but also the reconstruction of the key stages of the author's artistic career. The collaboration of some major French museums (Museum of Beaux Art in Tours and Angers Museum), where gypsum and marble models of the same group, attributed to Pascal, are kept, was essential for this work and gratefully acknowledged.

The scientific support, based on diagnostic tests with the application of scanning electron microscopy coupled with microprobe for chemical analysis (SEM-EDS) and X-ray induced photoelectron spectroscopy (XPS), was fundamental for a further and complete knowledge of the nature of the artifact and the manufacturing techniques.

Thanks to these studies now we know that the sculpture was made by electrolytic copper and realized by the electroforming technique, consisting of the electro-laying of a metal on a suitable conductive matrix.

Finally a general framework of the conservation state of the sculpture group was determined, also in relation with the environment of the place where the work is actually displayed.

## Conservation of copper alloys artifacts from archaeological excavation: the restoration of a pilgrim flask

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*Keyword: copper alloys, corrosion, inhibitors*

### ABSTRACT

The topic of this paper is the “conservation of copper alloys artifacts from archaeological excavation. Restoration of a pilgrim flask” as content of the Diploma thesis at the School for Conservators of the “*Istituto Superiore per la Conservazione e il Restauro*” in Rome.

One of the most difficult issue of the conservation of metals is the stabilization of archaeological copper alloys. Generally common treatments employ corrosion inhibitors, which are substances that can delay the natural corrosion process. Benzotriazole (BTA) is the most used product, although not always effective and highly toxic. These evidences call for new research of effective and safe products.

This study started with a survey of all stabilization treatments commonly used in the restoration practice. In this paper the proposal of a conservation treatment for the copper alloy pilgrim flask n° 36942 (fig. 1), recovered from the necropolis of Veio, Casale de Fosso (Rome), is presented. The experimental work on corrosion inhibitors on a group of copper-based artifacts from the same necropolis is still in progress.

Therefore this work can be considered the starting point for a research that involves ISCR, CNR-ISMN and “Sapienza” University of Rome and will be able to provide scientific data to improve some critical conservation issues. At the same time the choice to select archaeological artifacts from *Veio* (Rome) could be a significant starting point of an archaeometric research on laminated and casted copper alloys artifacts from one of the most important archaeological site in north-central Italy.

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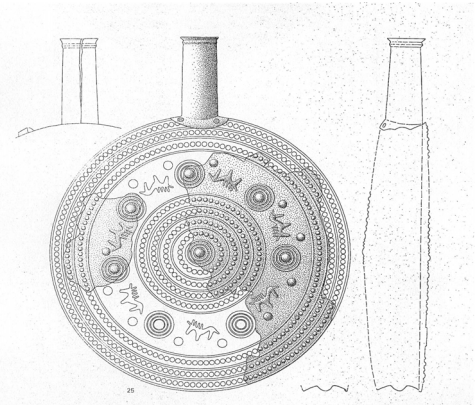


Fig. 10 Veio, Casale del Fosso, pilgrim flask n°36942

## **Removal of Black Crusts on Historic Stone works By the Use of Sulfate Reducing Bacteria**

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*Keyword: Black Crust, SRB, Historic Stone works*

### **ABSTRACT**

Cleaning is one of the crucial issues in the preservation of historic buildings. The important concern is to consider authenticity while keeping the original surface away from harmful materials. One of the most important causes of decay of calcareous stones is due to the conversion of calcium carbonate into calcium sulfate (gypsum). As a consequence, calcite leaching increases the material porosity and decreases its mechanical features with a general weakening of the superficial structural strength.

Increasing air pollution in cities accelerates the deterioration of stone and threatens artistic stonework. This study will attempt to review the effects of SO<sub>2</sub> pollution on calcareous stones. Black crust is a deteriorated layer of stone material formed from the interaction between gypsum and the airborne pollutants. In order to optimize a strategy for the removal of the black crust from historic stone works, a procedure based on the use of sulfate reducing bacteria, has been established. In this study mixed cultures of sulfate reducing bacteria (SRB) were applied on the sample surfaces directly in the laboratory. The obtained results show that the sulfate removal was effective. Although the technology is still in its infancy and , therefore, not readily available, the results so far indicate that it promises to offer a viable alternative to those working preserve the cultural heritage.

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## Analytical characterization of plasters and stones coming from the 19<sup>th</sup> century Palazzo Fragapane in Grammichele

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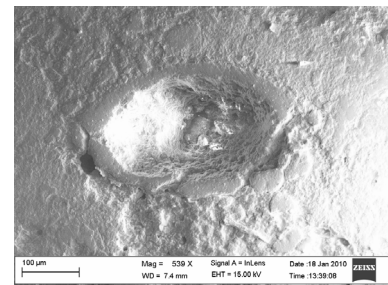
*Keyword: Plaster, Stone materials, Physico-chemical characterization, Sicilian architecture*

### ABSTRACT



Plaster and stone samples coming from the 19<sup>th</sup> century Palazzo Fragapane in Grammichele (Catania) were collected and characterized by using several microanalytical techniques such as X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive X-ray analysis (EDX), Fourier Transformed Infrared Spectroscopy (FT-IR). The Analytical investigations were

addressed to investigate the microstructure and the composition of the different samples and to define the type and the level of the weathering in order to design the best procedures for the maintenance and conservation of the historical building.



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## Optical spectroscopy for the characterization of ancient glass

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**Keyword:** glass, optical spectroscopy, stained window, authenticity

### ABSTRACT

Glass is a very spread material found in several archaeological and historical contexts [1].

Science is often asked to give information about the chemical and structural composition of glass. This is to reveal information about material's origin, technology of production, period of fabrication and, consequently, authenticity.

It is well known that usually this kind of information is gained through the use of archaeometrical research which covers the involvement of physical and chemical sciences with archaeology and art history. Most often the destructive chemical technique Scanning Electron Microscope - Energy Dispersive X-rays spectrometry (SEM-EDX) is applied [2-5].

For museological and archaeological collections and, even more, for art pieces that are still preserved *in situ*, it is very important to have a relatively cheap, non-destructive, compact and user-friendly portable method for analyzing materials. Therefore the main objective of this work is to evaluate two different optical techniques as possible tools for the characterization of ancient glass. These are: UV-VIS-NIR spectroscopy and Raman spectroscopy.

As a case-study a Renaissance stained glass window of the Holy Mary with Child (Fig. 1) situated in the Church of Our Lady (Bruges, Belgium) was studied. The Royal Institute of Heritage (KIK/IRPA) states that this window was donated by John de Baenst and his wife Marguerite Bladelyncx. This makes the window could be dated between 1401 A. D. to 1500 A. D.

UV-VIS-NIR spectroscopy and Raman spectroscopy were applied to this material and SEM-EDX was employed in order to check the results obtained.

Optical spectroscopy revealed to be highly sensitive to identify the colouring agents employed. We were able to recognize the presence of metal ions, such as Fe<sup>2+</sup>, Fe<sup>3+</sup>, Co<sup>2+</sup>, Cr<sup>3+</sup>, Mn<sup>3+</sup> and Cu<sup>2+</sup>. Its application was successful also to study colours made of metal nanoparticles, such as silver and copper colloids. Recognizing colouring agents can also be used in dating an artefact as some colourants were only used in certain periods. This is the case for chromium glasses studied in this

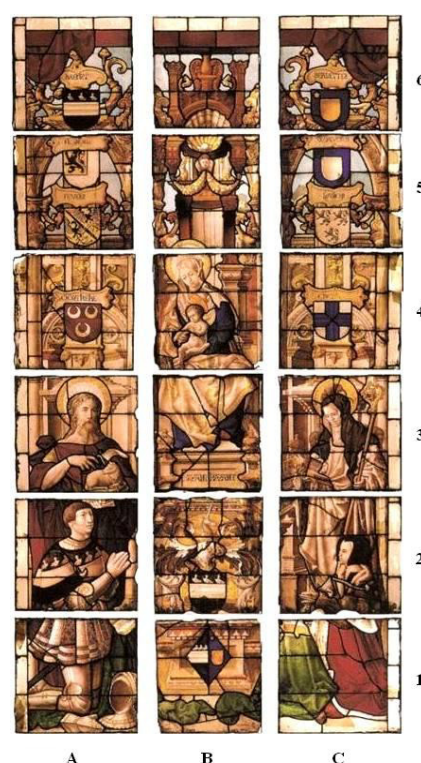


Fig. 11 The window of the Church of Our Lady

work, which could not be original as this transition metal was introduced in the glass industry only after the second half of the 19<sup>th</sup> century.

Raman spectroscopy allowed us to recognize many soda rich glasses produced after the 19<sup>th</sup> century and some lead rich glasses.

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## Ceramic of Caltagirone, from production to the archaeometric characterization

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*Keyword: Ceramic, Caltagirone, XRF, Colorimetry*

### ABSTRACT

This work presents the initial results obtained in the study of experimental ceramic material, produced through the collaboration of the Istituto Statale d'Arte per la Ceramica "L. Sturzo" of Caltagirone with the Dipartimento di Fisica e Astronomia, University of Catania. Caltagirone in fact stands as one of the main production centers of pottery in Sicily and in southern Italy.

This activity is attested since Neolithic Age and still represents a vivid tradition. In the field of archaeological ceramic, the production of Caltagirone plays an important part in the reconstruction of relations (cultural and / or business) between the various populations that have lived in Sicily or who have had contact with them. The choice of sites from which to draw the raw materials for this work, which are the same as those used in the past times, and information on traditional production, it then leads back to this ancient activity. The ceramic material under study consists of specimens moulded with clay of Caltagirone and consolidated by controlled firings. These specimens were subjected to fluorescence X and Colorimetric measurements to identify the specific characteristics of that pottery production, and shed light on the different contexts of production technology, drawing information related to production processes and which may be elements useful to identify the manufacturing factories of archaeological samples.

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## **Some considerations about the methodological approach for the archaeometric study of glass**

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*Keywords: archaeometry, glass*

### **ABSTRACT**

Glass has been extensively used from ancient until modern times in many sectors, thanks to its unique mechanical and chemical-physical properties. It is therefore frequently discovered during archaeological excavation. Glass represents the transformation resulting from melting natural raw material, and thus expresses the various degrees of technological development achieved in ancient cultures. The production of such findings requires knowledge of natural materials and firing techniques; so archaeometry, together with the more precisely morphological aspects peculiar to archaeology is of considerable importance in providing information on how a given article was manufactured. In this context, it should be stressed here that glass finds may be used as archaeometric markers only when sufficient information is available on the relations among composition, working methods, type and provenance of raw materials and, if possible, the socio-economic context. All this requires an ample data-base on finds from specific historical epochs and geographic areas, obtained by appropriate analytical methods which guarantee high standards of precision and accuracy of data.

In addition it should be stressed here that there are many different kinds of glass artefacts, which requires specific analytical approaches.

Transparent glass findings are usually characterized by an homogeneous texture. Productive processes involving melting of glass paste and repeated operations of homogenising the resulting melted mass do not generally leave traces of the crystalline phases of the starting materials. So information on the raw materials and production technologies could be deduced from chemical composition of glass and comparison with data already present in the literature. In this context the potentiality of the statistical treatment of chemical data in defining homogeneous groups from chemical point of view has been demonstrated.

Opaque glass, like those of vitreous mosaic tesserae, due to their variety of colours, refined use of opacifying agents, and the complex technology of thermal and reductive kiln treatments, are a stimulating and, at the same time, problematic field of research in archaeometry. Therefore glass mosaics need more complex analytical approach.

Aim of the present work is to show the different analytical approach (instruments and experimental procedure) for the archaeometric study of both transparent and opaque glass samples. Some significant study cases on glass samples of different types (vessel and mosaic tesserae), age (from I-VI cen. A. D.) and provenance (from Italy and Cappadocia) will be presented.

**Frescoes of the Castiglioni College Chapel:  
preparatory investigations for restoration work.**

**A material study of the pictorial display**

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*Keyword: frescoes,  $\mu$ -Raman, microscopy*

**ABSTRACT**

The frescoes of the Castiglioni College Chapel are one of the most important examples of painting of the age of Galeazzo Maria Sforza in Pavia and, in general, in Lombardy. Historical documents testify that the bishop Branda Castiglioni, great-nephew of the founder of the College, was the commissioner of the frescoes and that they were completed by the end of 1475. The Castiglioni-Brugnatelli College Alumnae Association and the CISRiC (Interdepartmental Center for Study and Research for the Preservation of Cultural Heritage of the University of Pavia) promoted a didactic activity, on the model of an “open didactic laboratory”, during which different diagnostic investigations have been performed. The results of these study will be very important for the preparation of a preservative restoration that will take place in the near future.



**Fig. 12 Frescoes on the vault of the Castiglioni Chapel with indication of the areas of origin of the analyzed samples**

Material investigations have been conducted on minute fragments coming from the vault of the Chapel, and more specifically from the North-West and the South-West corner of the vault. Microstratigraphies, textures, composition of technical layers and pigments have been studied by means of:

- i) optical and scanning electron microscopy (SEM-EDS);
- ii)  $\mu$ -Raman spectroscopy;
- iii) infra-red spectrophotometry (FTIR).

Coarse technical layers were realized using medium sand, characterized by a quartz-micaceous composition with infrequent fragments of rock. In their microstratigraphic sequences the binders used in the fragments of the vault showed high values of MgO (dolomitic limestone) and important contributions due to SiO<sub>2</sub> e Al<sub>2</sub>O<sub>3</sub>. On the other hand, other investigations performed on samples collected from the walls of the Chapel indicate that binders were made by means of limestone or Mg-limestone firing. The same goes for the preparatory layer that seems to be rich in carbon on the walls while on the vault this element is absent.

IR measurements revealed that the preparatory layer of the vault is predominantly made of gypsum ( $\text{CaSO}_4$ ), but some samples showed also the presence of  $\text{CaCO}_3$ .

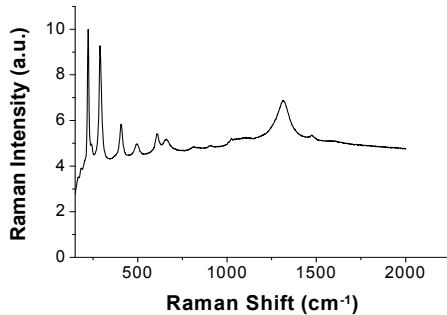


Fig. 14 Raman spectrum of a red sample

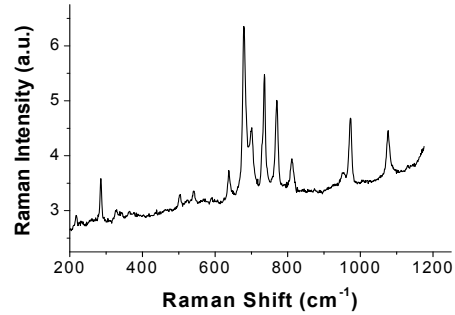


Fig. 13 Raman spectrum of a green sample containing Phtalocyanine

Analysis of the pigments by means of Raman spectroscopy and SEM-EDS clearly demonstrate the utilization of *Red* and *Green earths*. Some microregions in green samples showed the presence of *Ultramarine blue*, moreover, the spectrum of the pigment *Phtalocyanine green* was present in a good number of fragments.

## **Spectrocolorimetry applied to the study of five frescoes placed in the town hall of Anguillara Sabazia – Rome**

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*Keyword: spectrophotocolorimetry, frescoes, chromatic alteration*

### **ABSTRACT**

Colour like a perception of the naked eye, is a characteristic due to the individual sensitivity and interpretation that can be described only in a subjective manner. But colour is also a physical property of each object that can be objectively measured and its value can be reproduced and subjected to a comparison. To do it, the CIE (International Commission on Illumination) introduced, in the 1931, a colour space based on the tristimulus values by which a colour can be defined through a number independent from the observer response (Gigante, Diana [1]).

Spectrophotocolorimetry is a well known non-invasive and portable method that enables the colour measure in an objective, accurate and exact manner using a specific colour space (Oleari [2]). In this work, the CIE L\*a\*b\* model has been used; it classifies the colours using a value of brightness (L\*) and two colour values, one that varies from green to red (a\*), the other from blue to yellow (b\*). These values allow to know the colour variation between two measures by calculating the  $\Delta E$  value (Palazzi [3]).

Applied to artworks, this technique is able to evaluate the potential chromatic alterations suffered by the colours (by doing two measures at least) during time and therefore their decay. With this aim, five frescoes dated back to the early mid-sixteenth century, placed in the town hall of Anguillara Sabazia (Rome) have been subject to two series of measurements carried out in 2007 (after a restoration) and in 2010. During the data-gathering, two different models of portable spectrocolorimeters have been used: a Techkon SP 820  $\lambda$  for the frescoes smaller areas (measuring area: 3 mm), and a Minolta CM-500i/500c SERIES for the bigger one (measuring area: 3 cm).

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## Identification of protein-based additive in gypsum painting support by FTIR spectroscopy and PCA

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### ABSTRACT

Technical examination is quite scarce on the painting techniques used for decorating the interior of the 18<sup>th</sup> century Romanian wooden churches, from *Maramures* county. In situ observations of the painting indicate a low adhesion of the plaster to the wooden structure, maybe due to the low proteinaceous binder content in gypsum priming layer.

This paper presents the advantages of using principal component analysis (PCA) of Fourier transform infrared (FTIR) data for identifying the protein in the painting support. The results confirm the assumption about the small amount of protein in samples from *Dragomiresti* and *Ieud* churches, after comparing the FTIR spectra of real plaster samples with those of the mock up samples, prepared with different gypsum / hide glue ratio. Gypsum, used as support for painting can be detected easily by FTIR, giving attention to the highest absorption bands at 1150, 1121, 3546 and 3405 cm<sup>-1</sup>. The problem usually encountered in observing the smaller absorption peaks of the hide glue additive, is the overlapping of the absorption bands of gypsum at 1684, 1621 cm<sup>-1</sup> with the *Amide I* band of the protein, at 1650 cm<sup>-1</sup>, or with the C=O stretching band in oxalates, at 1622 cm<sup>-1</sup>. Therefore, we strived to demonstrate that chemometric analysis (PCA) applied to the FTIR data could be used to identify the protein in the gypsum – based grounds, even at lower concentration.

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## Characterization of plaster and stucco paintings from the Basilica of Santa Maria Maggiore in Trento

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*Keyword:* Santa Maria Maggiore, Wall Painting, Analysis of pigments

### **ABSTRACT**

We have studied fragments of stuccos and plasters polychrome found during the archaeological investigations carried out below the floor of the Basilica of Santa Maria Maggiore in Trento, Italy. The analyses, conducted in Chemical Department of the University of Modena and Reggio Emilia, has been of great importance to understand the composition and the executive time of the many fragments of paintings found. The main analytical techniques used to determinate the composition of the samples were infra-red spectrometry in Fourier Transform (FT-IR), Raman microspectroscopy and X-ray Fluorescence (XRF). Archaeological excavations carried out between 2007 and 2008 by the Department of Archaeology, University of Bologna, under the scientific direction of Prof. M. T. Guaitoli, allowed to identify the different building phases of the church: from the early Christian basilica, located within the city walls, to a Romanesque church that was demolished between 1519 and 1520 to give way for the current building of the sixteenth century. The history of this building goes through different periods of life of the city of Trento: from the age of late antiquity to the early medieval times, from the Romanesque age to the Renaissance, until reaching the current building inaugurated by the Prince Bishop Bernardo Clesio in 1524. Moreover, under the foundations of the first basilica of worship, a great public area of the Roman age was discovered. This work aims to a chemical and physical characterization of the numerous painted fragments discovered during the excavations in the church of Santa Maria Maggiore. These painted plasters and stuccoes have been discovered frequently mixed with other materials out of the original context, in layers often belonging to more recent times. Only rarely they were found still attached to the original wall structure. Consequently, the chemical identification of pigments and painting techniques used, were of great importance to know the nature of pictorial materials discovered during the excavations. This information was also essential to identify the time of execution of the decorations and to bind the decorations with the construction phases of the church. The Chemical analyses carried out on the pigments revealed the presence of different blue: Egyptian blue in roman painting; Lapislazzuli blue, known in European painting from the eleventh century (Romanesque age?); and Azurite blue associated whit cinnabar, mixture that seems to characterize stucco and plaster of later execution (pre-rinascimental age?). This evidence leads to the first hypothesis of classification of decoration in different ages of execution. Another interesting detail revealed during analysis, is the absence of cinnabar in roman paintings where red colours are obtained only by hematite. The study of the stuccos revealed the presence of frequent decoration made with pigments blue and red, identified whit azurite and cinnabar. Only one fragment of stuccos showing on its surface the presence of gold which is placed on a background made cinnabar and haematite. All the plasters has been made in fresco with “lime milk”, while the stuccos based on gypsum. Currently, the interpretation of the information found during the chemical analysis is in progress.

## **Problems of illumination of Cultural Heritage: the case of realgar**

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*Keyword: max four: lighting, realgar, oxidation*

### ***ABSTRACT***

To plan an exhibition in museum or of cultural heritage it's necessary to consider different aspects, firstly the conservation of the exposed objects, secondly the just vision for visitors. About conservation aspects it's necessary to analyze the deterioration directly due to the radiation falling on the object and the correlation with other factors of deterioration, such as micro-climate conditions, frequency of visitors.

Along with the needs to reduce possible damages, it is also necessary to consider those ones related to a sufficiently clear and enjoyable perception of cultural heritage by the visitor. Further important needs concern cheapness and low frequency of maintenance interventions by the curators.

The study intends to examine existing light sources, in particular their lighting "quality" and to develop a new system, based on LED technology, able to combine visual valorization with protection of cultural heritage. .

In first phase the material to be investigated was realgar, a natural and artificial mineral, whose molecule consists of four covalent bonds As-S. In the presence of oxygen it undergoes a cyclic and autocatalytic photochemical transformation which, among other, causes an anisotropic volume increase of the crystalline unit cell and formation of AS<sub>4</sub>S<sub>4</sub> in the form, known as pararealgar.

Analytical measurements have confirmed this hypothesis and allowed definition of the reaction kinetics. In these experiments a 150 Watt halogen lamp was used. Furtherly as many antiseptic products are based on compounds not very different as structure from pararealgar the antiseptic ability of this pigment was defined by using yeast cells considering its use in the ground layer of wooden supports of egg tempera paintings. Currently, the study continues in order to understand the behavior of the pigment in the binder, the damages suffered and the ventual positive action of the degraded compound against biodegradation.

## Polyvinyl alcohol hydrogels for cleaning works of art: recent developments

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*Keywords: hydrogel, cleaning, viscoelasticity, polyvinyl alcohol*

### ABSTRACT

The development of a new class of hydrogel for the cleaning of works of art is presented. The well known capability of polyvinyl alcohol to form a 3D network with borate ions has been already studied by many research groups [1], [2], [3]. Recently we have investigated the possibility to load a co-solvent into these aqueous systems in order to obtain an innovative tool for the cleaning of painted surfaces. In particular, the influence of the nature and the amount of the added co-solvent on the mechanical properties has been investigated [4]. Although conservators really appreciated the properties of this class of gels, some open questions needed to be solved. Polyvinyl alcohols at different hydrolysis degree have been selected as new gellants in order to make the procedure easier and to host a larger amount of organic co-solvent respect to the fully hydrolyzed previously investigated PVA-based gel. This study is focused on 75% hydrolyzed PVA based gels in which acetone and 1-propanol are added as co-solvents. Rheological properties and evaporation kinetics have been studied in order to investigate the viscoelasticity and the capability of the gel to retain solvent during the cleaning of the painted surface respectively. Application tests have been carried out in laboratory onto a fresco sample to remove from its surface Paraloid B72 (see Fig. 1). Mechanical properties and the high elastic modulus of this class of gels ensure an easy removal of the gel by peeling it off from the surface. Various formulations of gels have been applied also onto the surface of a XVI-XVII century oil-on-wood panel (“Santo Stefano” painted by Ludovico Cardi detto il Cigoli, 1559-1613) and onto the surface of wall paintings by Lorenzo Vecchietta in Santa Maria della Scala, Siena.



Fig. 15 The easy removal of the gel and its efficacy on the treated sample.

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## **The diagnostics in the field of Cultural Heritage: high school students first experiences**

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*Keyword: Cultural Heritage, stone, mortar*

### **ABSTRACT**

In the last years researchers are devoted with an increasing interest to the safeguard of the monumental and architectural heritage. A remarkable scientific production has been published and, contemporarily, economic investments have been allocated in that field. Despite that, professionals of the enterprises, essentially having the technical surveyor high school qualification, are still unaware of the techniques and know ledges in the field of Cultural Heritage and, in some cases, they persevere to apply techniques and materials advised for modern home building to the monumental and architectural heritage. With the purpose to overcome these gaps and to train the future surveyor professionals, the project called "Laboratorio dei Beni Culturali" (financed by the Ministero dell'Istruzione, dell'Università e della Ricerca - MIUR), was promoted and designed for the first time for the students of a technical high school. The goal of the project was to contribute to the formation in the field of the Cultural Heritage, by adding to the specific high school training course a new unit in order to improve the competencies in the field of the diagnostics of the cultural heritage.

During the project, different laboratory experiences were accomplished on three types of stones and on some samples of plasters coming from historical buildings of Ortigia (Siracuse) in order to characterize and analyze them. Other measurements were addressed to the determination of environmental parameters, such as, for example, relative humidity and temperature. All the results obtained agree with the data reported in literature. All the experiences, mainly having educational character, were accomplished in the chemistry and materials laboratories of the Istituto Statale Istruzione Secondaria for surveyor "Filippo Juvara" of Siracusa by using the instrumentation there present.

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## Community Participation in Heritage Conservation programs in Kotagede

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*Keywords: Participation, Heritage, Conservation, Kotagede,*

### ABSTRACT

Kotagede, the former capital of Islamic Mataram Kingdom in 16C, located about 6 km to the south east of Yogyakarta City, Indonesia. Kotagede, means “big city”, represents the Javanese site and its unique characteristics. Not only it has the complex of ancient mosque “Masjid Mataram” but also hundreds of 200 years traditional wooden houses with its unique roof called joglo. Those buildings have been expressed as both local and regional heritage. Kotagede district has been defined as conservation area as well. The stakeholders working on heritage conservation of Kotagede (government, heritage organization and local community) has held various development programs with focus on the conservation. After the earthquake occurred in May 2006 in Yogyakarta-Central Java region, attention to the management of heritage, particularly the reconstruction of the damage Joglo is increasing. The stakeholders has made various efforts to ensure that the special character of Kotagede will not lost due to the damage or the impact of the earthquake. Many efforts that are conducted in post-earthquake development in Kotagede also focuses on heritage conservation. Up to now, various forms of assistance program is still in progress. This paper focuses on how the stakeholders elaborate various development programs in order to revitalize and to preserve the character of Kotagede as a heritage district. Examples are the collaborative traditional house reconstruction program with the community in which several damage traditional houses was successfully reconstructed and the participatory heritage planning in CSP (community settlement plan) scheme. The findings show that the awareness and involvement of community in conservation action is an important issue. The community makes choice for what heritage to conserve and considers its new use and with support from heritage organizations makes use various conservation programs to fulfill it.

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## **Analytical investigations in Ostia - Porta Marina, Rome**

Giacomo A. Orofino, Carlo Rosa, Marcello Turci

### ***ABSTRACT***

The project Ostia Marina, headed by prof. M. Dr. David. A. Pellegrino, was founded in 2007 through an agreement between the Soprintendenza Archeologica di Ostia Antica, now Soprintendenza Speciale per i Beni Archeologici di Roma and the Archaeological Department of the University of Bologna for the study of the neighborhood outside Porta Marina. In this context the attention of the research has focused on an insula (IV, IX) only marginally affected by the earthworks of the '40s, located near the ancient shoreline.

Early stages of the project has adopted a multidisciplinary approach, providing, in addition to studying the archives, a campaign of geophysical prospecting carried out in 2008 and two stratigraphic tests to evaluate the potential of the site and design the excavations were carried out in 2009. Two types of prospectings were executed, one geo-radar by the A. Rosa (Lerici Foundation) and the other geo-magnetic by Dr. H. Becker. The topographic analysis now in progress in Ostia Marina archaeological site wishes to achieve two parallel purposes: firstly the area positioning in the local coordinate system, previously set for the Ostia Antica general relief map, and, secondly, the realization of the digital terrain model, to reproduce in 3D system the structural specifications of buildings being studied at the present time. The site analysis, carried out with Total Station (in order to measure the main topographic points and vertices) and with GPS system, is currently under preparation and oriented to know the possibilities (and limits) of several investigation strategies and instruments applied to surveying the area, which is a necessary and preliminary step towards future archaeological excavations. The lucky conservation of the original stratigraphic sequence, very rare for Ostiense archaeological context, focalized our attention to accurate study of the stratigraphic contexts and buildings emergence coordinates: this method emphasized the importance of obtaining archaeological information in 3D (measuring in the same time x, y and z coordinates of any point) and to reproduce a cartographic map using computing 3D models, to value quickly and correctly the stratigraphic sequence complexity and to formulate several topographic plans that show the history of site occupation. The topographic survey continuation on the Ostia Marina archaeological site will be focused on the improvement of the DTM model built during the previous excavation campaigns, by using the most suitable survey strategies and employing the GIS system for data computing elaboration. During the excavations, carried out between September and November 2009, was initiated extensive excavation for an area of 195 square meters, based on the information provided by geophysical prospecting, which has allowed the removal of the surface layer corresponding to arable (U.S. 0), and to reveal the wall ridges and the highest levels of burying environments. At the same time there has been a deep test inside a room, only partly affected by previous excavations, located immediately behind the area excavated extensively, which has returned an intact stratigraphic sequence of stages of life of the site. During the meeting we will publish the first results obtained from the integrated study of geophysical data, data of excavation and data obtained from topographic surveys; furthermore, it will highlight the potential that this approach offers both the design of future excavations, both in the study of a neighborhood of a buried ancient city.



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## **Shaping of the Meaning of Dwellings Inscribed on the World Heritage List**

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*Keyword: Dwelling, World Heritage, World Heritage List*

### ***ABSTRACT***

Dwellings are individual's primary anchor in an environment and represent the vast range of housing around the world. The concept "World Heritage" was developed in 1972, and since then the identification, protection and preservation of cultural and natural heritage sites have witnessed a global promotion as a hallmark of humanity values. Nowadays, the enlarging number of World Heritage Sites has included certain dwellings of diverse types and levels of meaning. However, in many of World Heritage dwelling sites, the value itself is mainly seen as an appendage with six official criteria. The further study of the extending and missing meanings of the dwellings could be regarded as a valuable reflection on human-environment interactions.

The reciprocity of the environment and the dwellings should be a central feature with broad thinking. While many Palaces inscribed before were with powerful symbolization, some other modern houses nominated with the honor of the architects or the unique architectural form or design, it is noticeable to observe Berlin Modern Housing Estates inscribed in 2008 with socialism aspects. The concept of World Heritage dwellings therefore has been largely enhanced.

Based on the inscribed cultural properties on the World Heritage List, the paper will explain the rationale behind the development and then classify them. The research also draws upon the wider reflections for World Heritage dwellings.

## How to get CHIC?

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### ABSTRACT

Cultural heritage is at risk: it is surely worldwide recognized. Risk management and preparedness is a topic of paramount importance as cultural heritage represents a fundamental source of richness for each country, on which tourism is based on. Moreover, according to the concept of sustainability, it needs to be preserved and conserved for future generation.

It is an important issue, which need to be faced at a European level, by the establishment of common policies and directives.

These statements represent the basis for a EU-funded coordination project, EU-CHIC aiming at introducing a systematic way for data collection and storage and developing directives and guidelines to propose a common strategy for the selection and implementation of the most effective tools for tracking environmental changes of immovable heritage.

EU-CHIC is the acronym for “European Cultural Heritage Identity Card” and the label of a project which involves a multi-disciplinary consortium, covering most European countries, of highly qualified experts in conservation, architecture, construction and natural and social sciences.

The university of Bologna, together with partners from the Department of Architecture of Ferrara, is actively involved and it is reviewing methodologies and tools for risk assessment and management currently employed in Europe exploiting the network of this and other EU-funded projects.

The Italian method, called Risk Map, developed by the I.S.C.R. (Superior Institute for Conservation and Restoration, former ICR, Rome) has been studied and evaluated. It is an informative system, based on a GIS technology, which is capable of creating thematic maps by superimposing CH distribution to potential risk areas, by giving colour maps corresponding to a level of danger.

Preliminary surveys, carried on among partners by forwarding a questionnaire, has revealed that risks already monitored and included in national programs for the CH safeguarding are mainly related to the effect of natural events (such as earthquakes, flood, landslide) which affect the static-structural condition of a buildings/site.

However, the Risk Map foresees monitoring of environmental parameters (PM, NO<sub>x</sub>, SO<sub>2</sub>) as air pollution has a crucial role in materials’ degradation being main causes of blackening and erosion of monumental surfaces. It is therefore proposed how the figure conservation scientists, with their specific and deep knowledge both on applied sciences and conservation ethics, may give an important contribution in this field.

## **The Research and Conservation of Archaeological Textiles Kept at the National Museum of History of Azerbaijan**

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*Keywords: archaeological textiles, HPLC-DAD method, natural dye, conservation!*

### **ABSTRACT**

Presently kept at the National Museum of History of Azerbaijan are scores of textiles having been discovered as a result of archaeological excavations in many regions of Azerbaijan. The textiles above has largely been unearthed out of Mongol graves in Mingechevir, Shirvanshah tomb in Baku and Hulaguid dynasty mausoleum in Nakhchivan. Note that the Nakhchivan textiles are noted for its multi-colored design and good intactness. In the meanwhile, the Mingechevir textiles have been unexplored since 1950 when it was first discovered (except for two robes), nor properly conserved.

It was Professors of Marmara University - Turkan Yurdun (Faculty of Pharmacology, Department of Pharmacological Toxicology) and Recep Karadag (Faculty of Fine Art, Laboratory of Natural Dyes) who, using HPLC-DAD method, succeeded in 2009 to analyze the whole of the Nakhchivan and Baku textiles and a part of the Mingechevir textiles and identify natural dyes used.

The results of the analysis were partly reported to the 28<sup>th</sup> International Meeting “Natural Dyes in History and Archaeology”, Poznan, Poland, and the International Conference “Baku is a Capital of Islamic Culture - 2009”, Baku, Azerbaijan.

In 2009, the state funds were allocated for restoration of National Museum exhibits, which made it possible to restore and conserve a lot of archaeological materials. The Azerbaijan Museum Wealth and Memorable Articles Scientific-Restoration Center have properly conserved a part of the archaeological textiles presently kept at the National Museum of History of Azerbaijan.

Of interest from scientific point of view are dyes and conservation methods, which became apparent following an analysis of archaeological textiles.

## Scientific researches on historical photographic materials

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*Keyword: max four!*

### ***ABSTRACT***

Italy's vast Cultural Heritage includes a large variety and quantity of photographic materials conserved in archives, libraries and museums. These materials have a significance as both artistic and historical evidence, which must be protected. The application of scientific methodologies, with the aim of identifying the photographic processes and to characterize their state of conservation, is a fundamental part for an appropriate preservation approach.

In this work, we present results obtained on different types of old photographic materials, both negatives and positives, belonging to different collections and institutions. We reviewed the main analytical techniques and methods necessary for a complete study of old photographic materials and, when possible, we focused our attention on using non-destructive techniques.

We also experimented new methods for the chemical and structural characterization of the three most common silver printing-out processes in the early decades of history of photography: salted papers, albumen prints and aristotypes.

Techniques performed for our purpose are: spectroscopic analyses (FT-IR, FORS, XRF, EDS), imaging techniques (UV fluorescence, NIR reflectography, UV-VIS-NIR multispectral acquisitions) and microscopy observations (SM, OM, SEM).

Obtained results encourage our team to continue this experimentation increasing the number of old photographic processes analyzed.

## **Termite control with low environmental impact methods for the conservation of cultural heritage**

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*Keyword: biodeterioration, cultural heritage, insects, termite control*

### **ABSTRACT**

The phenomenon of biodeterioration verifiable inside museums, libraries and archives can be caused, as known, by many biological agents, among which Insects. These organisms can be extremely dangerous for different typologies of artefacts, for the wood furniture in which they are preserved and also for historical and artistic buildings structures. In various zones of Italy is reported the presence of *Reticulitermes lucifugus* (Rossi) an underground termite which nests may be 6-7 meters deep and whose colonies can reach the million individuals. This hidden species digs or builds galleries to reach the alimentary sources which is able to attach and digest, mainly represented from any form of cellulose (paper, wood, etc..). This species is lucifugous and in order to move inside buildings can use the wire ways of the various systems (electrical, fire and air conditioning) which become real "highways" going in search of food. The nest (termite mound) is always connected with the environment colonized. The dangerousness of this underground species is due to the absence of evident signs of its presence; the only external signal of infestation is the presence of adult winged specimens (swarming) flying in search of new sites, which highlight an ongoing colonization of the swarming area. In the city of Rome, there are many alarms due to the phenomenon of the swarming, and we observed swarming episode in the monumental building Calcografia-Palazzo Poli. In this structure of singular architectural value and historical interest has been applied a system of termite detection and control which consists in a multiphase monitoring program: contact, control and eradication of the colony. This methodological approach is different from that used for other xylophagous insects because of the peculiarity of the species *Reticulitermes lucifugus*. The methodology includes: 1) the employment of special monitoring stations constituted by materials containing cellulose that represent known foddering points to the purpose of "to come into contact" with the termitic colony, to analyze its extension and the number of individuals, 2) delivering stations of Insects Growth Regulator (IGR) adsorbed in cellulose matrix, that inhibits the synthesis of chitin and deprives the termites of the fundamental tegument for their survival. With this methodology it is not necessary to know the location of the nest, in fact the termites themselves, exchanging food, distribute IGR to the whole colony reaching all the individuals. This system of control is not destructive and assures a low environmental impact. The minimum amounts of the IGR used (around a gram for site) doesn't require the evacuation of treated areas, thus represents a particularly effective and non-invasive method in conservation of monumental buildings and works of art in them preserved.



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## **Analysis of the Architectural heritage of El-Mansoura city, Egypt towards urban conservation approach**

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*Keyword: Egypt, Mansoura, Heritage, Architecture*

### **ABSTRACT**

Mansoura city is one of the Egyptian intermediate cities in the Nile delta, The city center heritage are in mostly the European Mediterranean style because of the presence of the foreigners in the city spatially Greek and Italian communities during the nineteenth and twentieth centuries.

As many other Egyptian intermediate cities, the city heritage suffers from lack of maintenance and the absence of organized conservation programs.

El-Mansoura architectural heritage are divided into main five zones around the city center. The first is the “private palaces and villas zone” in the west of the city center, it was the residence of the aristocratic Egyptians. The second is the “Northern city center” on the Nile, it was the administration zone near the old port. The third is the “Commercial center” with high concentration of commercial activities. The fourth is “El-Mokhtalat neighborhood” in the east of the city center, it was the residence of the foreigners and elite Egyptians. The last one is “Torel neighborhood” it is a combination of private villas in a grid of perpendicular street.

Their are some trials to preserve and restore some building of the city heritage but normally they are individual trails and some times without professional procedures and studies, Now there is some projects to make urban development of the city valuable zones in collaboration between “El-Dakahlia’ governorate and “Mansoura University, Department of architectural engineering” and that will lead to effective restoration and rehabilitation projects in the future.

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## **Non-invasive physicochemical characterization of two 19<sup>th</sup> century English ferrotypes**

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*Keyword:* ferrotypes; non-invasive

### **ABSTRACT**

The present work was one of the first attempts to analyze the conservation status of two ferrotypes, ancient photographic plates realized on a support made of iron. The photographic material was constituted of collodion as binder for the photosensitive silver halides grains. The two ferrotypes studied belonged to a private collection of a family from Durham, UK, and were made at the end of the 19<sup>th</sup> century. The analytical techniques used for the morphological and physicochemical characterization were noninvasive. The surface morphology was studied by means of optical microscopy (OM) and environmental scanning electron microscopy (ESEM) coupled with an energy dispersive X-rays (EDX) system for the elemental analysis. These techniques, together with microreflectance Fourier transform infrared spectroscopy ( $\mu$ -FTIR) and contact angle, allowed to obtain information on both the chemical – elemental – composition of the materials constituting the ferrotypes, and the conservation status of these photographic plates. The study showed that the physicochemical diagnostics allowed to characterize the two ferrotypes that, despite their similar age and provenance, showed different conservation status, surface properties, and elemental composition. Microreflectance FTIR indicated that some proteinaceous materials were present, ascribable to protective coatings for retouching and/or pre-coating and no presence of natural varnishes was found. The morphological investigation, performed both by means of optical and ESEM microscopy, allowed to establish the different conservation status of the two ferrotypes, indicating that F2 sample surface was homogeneous and not meaningfully damaged, while F1 surface roughness was clearly high. Contact angle measurements further confirmed this feature: indeed, only F1 surface was characterized by the presence of a texture attributable to the surface dewetting process of the collodion caused by the kinetics of the evaporation of the solvents used for the preparation of the collodion layer. Moreover, contact angle measurements clearly indicated that for F1 the wettability was altered, probably by a not homogenous protective layer. The analysis carried out by EDX spectra showed that even the chemical – elemental – composition was different comparing the two plates. In fact, F2 plate presented Ag and Fe amounts in agreement with a quite thin collodion layer, whereas F1 plate showed lower concentration of Fe indicating a thicker collodion layer. This was quite interesting since we were able to conclude that the thickness of the collodion stratum and concentration of silver in its upper layers are parameters not directly associated to the conservation status of the ferrotypes. In conclusion, our study allowed to compare the morphology, elemental composition, and surface wettability of two ferrotypes of the same period enabling to underline the differences of these parameters associated to the different status of conservation, despite their similar age and provenance.