## FA2-MS03-O1

**X-Ray Techniques Applied to Art Authentication and Conservation.** Dario Paulo Benedetti[a], Elza Bontempi[a], Laura Eleonora Depero[a]. [a]*Archaeometry Research Centre and Chemistry for Technologies Laboratory-University of Brescia, Italy.*
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The strong "individuality" of art objects imply a sort of analogous uniqueness in the analytical processes aimed to their characterization and conservation; therefore, a combined use of flexible and non-destructive techniques is mandatory to study ancient materials.
In this paper we present a short review of recent works carried out at the Archaeometry Research Centre of the University of Brescia (ITALY) in the field of cultural heritage studies.
Experiments involve both laboratory and synchrotron X-Ray techniques, and can be divided into three major areas:
1-development of innovative conservation methodologies by means of conventional analytical equipment;
2-design, prototyping and on the field test of new equipment, specifically designed to be used on art objects;
3-chemical/physical characterization of ancient materials applied to artifacts authentication and conservation;
The topics range from X-Ray Diffraction (XRD) quantitative measurements and Glancing-Incidence X-ray Diffraction (GIXRD) to study the growth of artificially induced calcium oxalate layers for marbles conservation, up to the design and prototyping of a synchrotron XRD multi-sample loader for the automatic analysis of a massive number of samples, aimed to the optimization of laser cleaning of the façade of "*la Loggia*" palace in Brescia.
Besides, X-Ray Fluorescence (XRF) and Total Reflection X-ray Fluorescence (TXRF) have been applied to the elemental analysis of historic metal objects from ancient *Longobard graves*, while laboratory 2D X-ray microdiffraction ($XRD^2$) has been used to study the sulphation of marbles from *Brescia monumental Cemetery and* from *Milan Cathedral* [1].
X-ray Photoelectron Spectroscopy (XPS) and SR-XRD have been employed in the study of sea water influence on chemical and physical degradation of archaeological glasses [2].
Finally, the results of two authentication problems (an unpublished "*Ghirlandaio*" painting [3] and the famous *Papyrus of Artemidorus* [4]), involving a wide range of X-Ray analytical techniques, are discussed.

[1] Pedrazzani R., Alessandri I., Bontempi E., Cappitelli F., Cianci M., Pantos E., Toniolo L. and Depero L.E., *Applied Physics A: Materials Science & Processing,* **2006**, 83; 689-694 [2] Benedetti D., Bontempi E., Bertoncello R., Dal Bianco B., Pantos E., Depero L.E., *Il Nuovo Cimento C*, **2007**, 30 [3] Bontempi E.; Benedetti D; Massardi A; Zacco A; Borgese L; Depero LE, *Applied Physics A-Materials science & processing*, **2008**, 92; p. 155-159 [4] AA.VV, ed. by Gallazzi C., Kramer B., Settis S.: *"Il Papiro di Artemidoro", ed. LED*, **2008**.

**Keywords: X-ray diffraction; X-ray fluorescence; synchrotron techniques**

## FA2-MS03-O2

**The Hoard of Becin – the Silver Content of the Akce Coins and the Monetary History in the Ottoman Empire.** Manfred Schreiner[a], Marta Rodrigues[a]. [a]*Institute of Science and Technology in Arts, Academy of Fine Arts Vienna, Austria.*
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In summer 2000 a great number of coins (approx. 60.000) could be found during excavations carried out by a team of archaeologists from Izmir University in Turkey, headed by Prof. Rahmi Ünal, at the medieval site of Becin Kalesi (close to the ancient city of Efes/Selcuk). It is the most important findings of coins and the most important Ottoman treasure ever discovered, as most of the coins stem from the Ottoman Empire and were produced during the 16th and 17th centuries under the Sultans Murad III, Mehmed III and Ahmed I in 18 different workshops.
In a co-operation between the Turkish and the Austrian Academies of Sciences a project was initiated in order to catalogue all the coins. Additionally, chemical analysis of the material used for the production of the silver coins was performed in order to confirm the geographic assignment suggested by the numismatists. It was agreed to take small samples of approx. 450 objects (mainly Akce coins), embed the specimen in epoxy resin for cross-sectioning and polishing in order to achieve flat surfaces. Investigations were carried out by means of micro-x-ray fluorescence analysis (XRF), energy dispersive analysis in the SEM, particle induced x-ray emission spectroscopy (PIXE) as well as micro-XRF by synchrotron radiation.
The coins analyzed were found to have a very high fineness (about 92 % Ag) and the varying content of the minor and trace elements Au, Pb, Bi, Fe, Ni, Zn, As, Hg, Sn and Sb a local assignment to the various mints could be explored.

**Keywords: ottoman coins; silver; monetary history**

## FA2-MS03-O3

**Crystallography and Industrial Design: Past, Present & Future.** Lindsay Sawyer. *School of Biological Sciences, The University of Edinburgh, Edinburgh EH9 3JR, UK*.
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*Homo sapiens* has been fascinated by symmetry for thousands of years including the external habit of crystalline materials but it is only within the last 100 years that the internal structures of crystals have been available. This talk will describe the uses to which the internal atomic arrangement of crystals have been put in the design of textiles, fabrics, some everyday objects and even buildings, but little, if any, mention will be made of the industrial uses of X-ray crystallography. A significant, but not quite the only, initiative to make use of crystal structures in industrial design concerned the Festival Pattern Group [1-2] which was set up to provide a vehicle for the influence of the UK's excellence in X-ray crystallography to create marketable materials in the 1950s. A description of the work of the Group will be followed by an investigation of

the more recent influence of the crystallographer's output as applied to the design of textiles and other products. Some speculation about possible future trends will conclude the presentation [3].

[1] Jackson, L. *From Atoms to Patterns*. Richard Dennis, Somerset ,UK. **2008**. [2] McGill, T. *Decorative Arts Society Journal*, #31, 92-115; **2007**. [3] Sawyer, L. *Acta Cryst. A*., submitted, **2009**.

## FA2-MS03-O4

**Multi-Grids Method Construction of Moroccan Geometric Patterns.** Abdelmalek Thalal[a], Youssef Aboufadil[a], Jamal Benatia[a], Abdelaziz Jali[a], My Ahmed Elidrissi Raghni[a]. [a]*Department of physics, LSM, Faculty of Sciences- Semlalia-Marrakech-Morocco.*
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The rise and spread of Islamic culture from the seventh century onward has provided us with history's great artistic and decorative traditions. In a broad swath of Islamic rule, at one time extending across Europe, Africa, and Asia, we find artistic treasures of unrivalled beauty. Islamic art encompasses great achievements in calligraphy, stylized floral designs, architecture, and abstract geometric patterns.
In this presentation we are interesting in the plane ornamental art, particularly in the geometric drawing or "Tastir". These patterns adorn buildings, particularly mosques and tombs, throughout the Islamic world. They are perhaps best known to Americans and Europeans through the Alhambra palace in Granada, Spain, one of the jewels of Islamic. Broadly speaking, an Islamic star pattern is a periodic arrangement of motifs, many of which are star-shaped.
Little is known about how the patterns were originally constructed. The design methods were the private domain of the artisans who practiced them. The knowledge was passed down from master to apprentice over generations and ultimately was lost as the practice of Islamic star patterns declined during the fifteenth century.
We describe here and analysis the multi-grids method construction of the geometric patterns encountered in the Moroccan art (Fig2). This method is widely adopted by the master craftsmen ("Maâlam") and handed over to their disciples. It is based on rigorous geometric rules and the concept of symmetry. It can be adapted to any material shape (plaster, wood, metal, marble,..). It consists in tracing a grid with precise criteria of measurement within a framework; the complete grid is defined by the intersection of four sets of parallel lines. It allows the construction of several kinds of patterns. In a large number of Moroccan patterns, the underlying grids contain 4-fold axis and mirrors m. The unit motif is then obtained by performing reflections and rotations on the template motif (Fig 1) which can be thought as the heart of the repeat pattern.

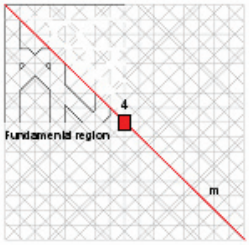


**Fig1**

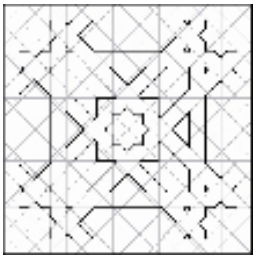

**Fig2**

[1] Bourgoin, J. **1973** Arabic Geometrical Pattern and Design, Dover Publications. [2] Abbas, S.J. and Salman, A. Symmetries of Islamic Patterns, World Scientific, **1995**. [3] Craig S. Kaplan. Computer generated islamic star patterns. In Reza Sarhangi, editor, Bridges **2000**.

**Keywords: multi-grids; symmetry; geometric pattern**

## FA2-MS03-O5

**The Javanese Colleagues of Karagöz and Their Dress.** Annegret Haake. *Jaminstr. 11B, D-61476 Kronberg.*
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The shadow-puppet Karagöz is known by everybody in Turkey. His stories teach the people "to behave better". In Java, the characters of a shadow play have a similar commission, but the stories tell about kings, priests, and other noble people. The tradition of these shadow-plays leads back to prehistoric times, when the ancestors were called in and asked for help. There are several meanings of the word "wayang": shadow, spirit, ghost, and ancestor. Nowadays "wayang" is also used for many kinds of traditional theatres and dancing performances. But for the inspection of typical dresses due to their social status it is useful to investigate the figures of the most traditional form "wayang purwa" (purwa means original). The stories are based on the old Indian legends Ramayana and Mahabharata, which were modified by the Javanese [1]. Former characters from Pre-Hindu times play the jokers Semar and his sons, at midnight. Their discussion of the latest events in the neighbourhood is enjoyed by old and young [2]. After that, the story of the noble heroes continues until the early morning. Due to "larangan" [3] (the law effecting the dress by the Royal courts of Central Java) the characters of the "wayang purwa"-play show typical dress designs according to their social status. Mostly the "larangan" contained designs which are based on batik patterns, but there were silk weaving patterns as well, which were reserved for the nobility. The jokers who have a servant status, mostly wear patterns typical for commoners or the lower nobility [4].

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**Keywords: plane symmetry; teaching aid; symmetric art**