VIII Congresso Nazionale di Archeometria
Scienze e Beni Culturali: stato dell'arte e prospettive
Bologna 5 - 7 Febbraio 2014

THE MEMORIAL TO NATALE MAGNANI (CERTOSA OF BOLOGNA, 1906): STATE OF CONSERVATION

C. Soffritti[1,2*], L. Volpe[2,4], M.T. Camerada[3], C. Vaccaro[4], M. Leis[5], G.L. Garagnani[1]

[1,*] Department of Engineering, University of Ferrara, Via Saragat 1, 44122 Ferrara, Italy (chiara.soffritti@unife.it)
[2] TekneHub, Department of Architecture, University of Ferrara, Via Quartieri 8, 44122, Ferrara, Italy
[3] Department of Architecture, University of Ferrara, Via Quartieri 8, 44122, Ferrara, Italy
[4] Department of Physic and Science of Earth, University of Ferrara, Via Saragat 1, 44122 Ferrara, Italy
[5] Department of Life Science and Biotechnology, University of Ferrara, Via Luigi Borsari 46, 44121 Ferrara, Italy

In this work the state of conservation of the memorial named after Natale Magnani was evaluated. In 1906 the commemorative monument was located at the Certosa of Bologna and more precisely at the extension of the "Braccio di Ponente" of "Chiostro VI". The half-round chapel is 665 cm height, 380 cm width and 326 cm depth. A gate stylistically consistent with Art Nouveau closes the chapel inside which a tripod (122 cm height and 42 cm diameter) (Fig. 1a) and the sculpted group "Anima e Angelo" (343 cm height, 293 cm width and 255 cm depth) (Fig. 1b) are placed. Several mosaic tiles varying in colour from blue to green partially cover the wall behind "Anima e Angelo".

(a) (b)

Fig. 1. Details of (a) tripod and (b) the sculpted group "Anima e Angelo".

As can be seen by the signatures in Fig. 2 ("P. Rizzoli 1906" in Fig. 2a and "G.B. Bastianelli Fuse Roma" in Fig. 2b), the sculpted group was designed by Pasquale Rizzoli (1871-1953) [1] and made by Bastianelli - Avanzini art foundry (Rome).

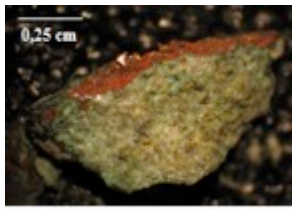
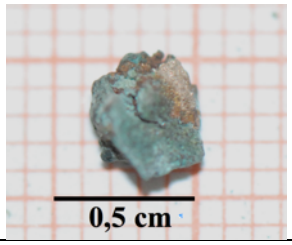
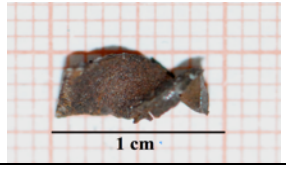
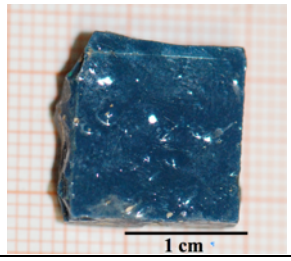
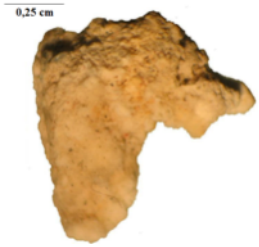
(a) (b)

Fig. 2. Macrophotographs of the signatures (a) "P. Rizzoli 1906" and (b) "G.B. Bastianelli Fuse Roma" engraved on the sculptural group.

Fig. 3. Macrophotograph of the double coat of arms observed on the outer architrave of the chapel.

On the outer architrave of the commemorative monument the double coat of arms of both Fabiani and Magnani families is visible (Fig. 3) [2].
Some metal fragments were taken from the sculpted group "Anima e Angelo" and from the tripod; the mortar between the basement in serpentine and the metal plate located at the foot of both aim and angel was also sampled. Finally, a blue mosaic tile and the mortar between tesserae and the wall behind the sculptured group were collected. The abbreviation and a short description of each specimen are listed in Tab. 1. Chemical and microstructural analyses were performed by means of Energy Dispersive X-Ray Fluorescence (EDXRF), Optical Microscopy (OM) and Scanning Electron Microscopy (SEM) equipped with an Energy Dispersive Spectroscopy (EDS) microprobe.
The obtained results showed that all surfaces of the commemorative monument are uniformly covered by encrustations, dust, bird droppings, biological patinas such as fungi colonisation, spider webs and so on. For instance, in Fig. 4 the XRF spectrum performed on the sample named 5_TD is reported. It can be noted that the sample is mainly constituted by calcium, strontium, silicon, iron and copper.
Optical and electron microscopy analyses performed on the metal samples taken from the sculpted group enable microstructure and chemical composition to be identified. In particular, the microstructure consists of a casting copper alloy containing uniformly distributed sulphur

Tab. 1. Abbreviation and short description of each specimen.

Abbreviation		Description
1_SG		Metallic specimen sampled from the dress of the angel covered by an inhomogeneous layer of dirty and corrosion products.
2_SG		Sample taken from one of the roses applied on the metal plate located at the foot of both aim and angel. The specimen was covered by an inhomogeneous layer of dirty and corrosion products.
3_SGM		Fragment of mortar between the basement in serpentine and the metal plate.
4_T		Metallic specimen sampled from the upper part of the tripod.
5_TD		Fragment of incrustation covered upper part of the tripod.
6_MT		Blue mosaic tile taken from the wall behind "Anima e Angelo".
7_MTM		Mortar sampled between tessera and the wall behind the sculptured group.

and iron-rich inclusions. Lead added to alloy in order to improve machinability was also detected in the form of a completely separate, less noble phase, segregated at the grain boundaries of the α-Cu solid solution [3]. As regards the chemical composition, the alloy contains copper (≈ 86 wt.%), tin (≈ 3 wt.%), lead (≈ 6 wt.%), zinc (≈ 2 wt.%) and small amounts of iron (≈ 0.46 wt.%), sulphur (≈ 0.56 wt.%) and aluminium (≈ 0.21 wt.%).

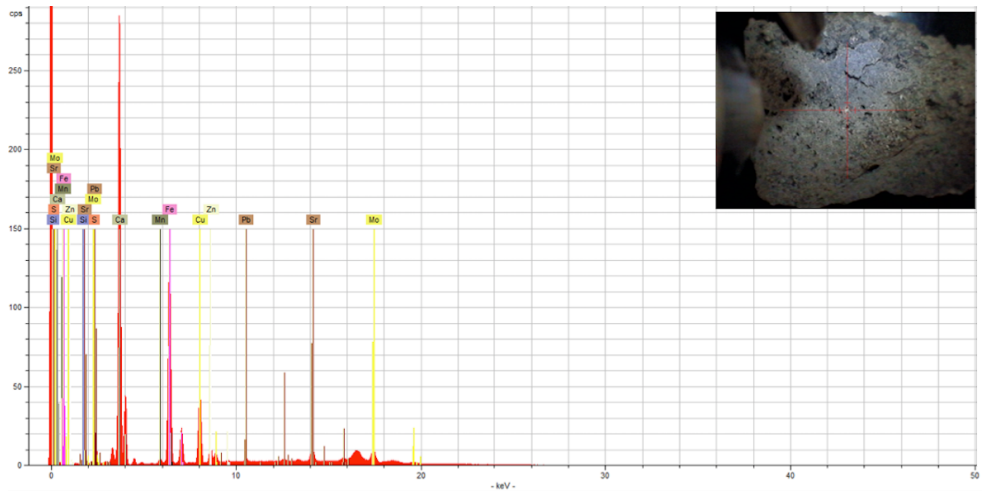


Fig. 4. XRF spectrum performed on the sample named 5_TD.

Corrosion products including copper, tin, zinc, chlorine and sulphur were highlighted (Fig. 5). The SEM observations showed that corrosion attacks the interdendritic paths resulted from local differences in composition, such as coring commonly encountered in alloy castings. However, corrosion attacks of the localised penetrating type were also detected.

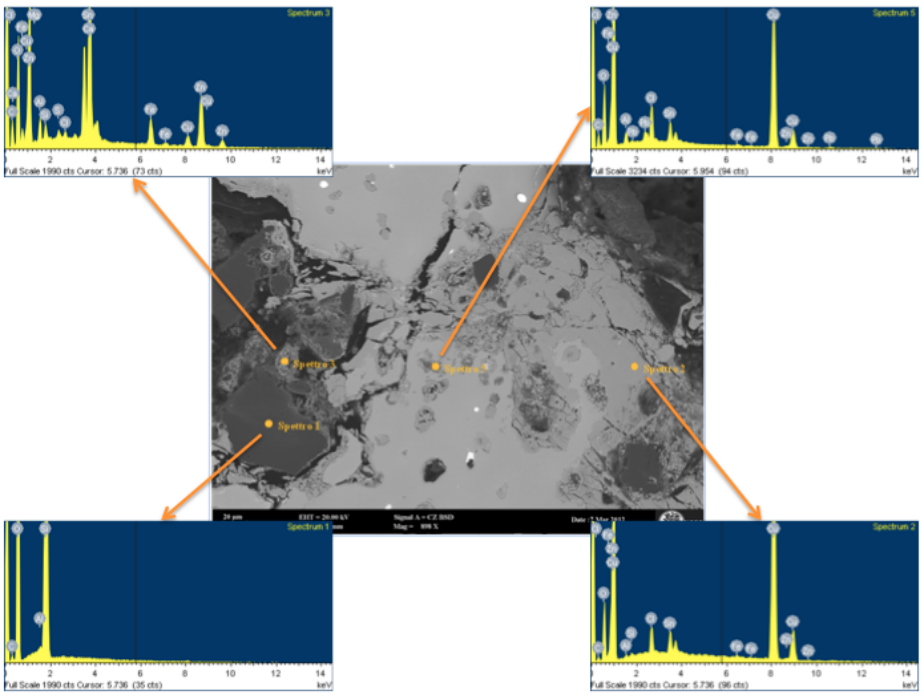


Fig. 5. Results from SEM micrograph and EDS analyses of the corrosion products observed on the sample named 2_SG.

In Fig. 6 the plastic deformation induced by forging process employed for the realisation of the tripod is clearly visible. Chemical analyses were able to verify that the microstructure consists of a low-carbon steel with a great amount of both manganese and iron sulphides.

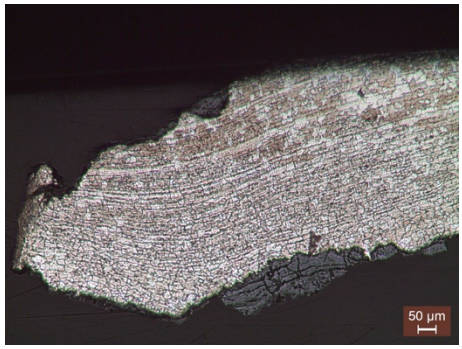
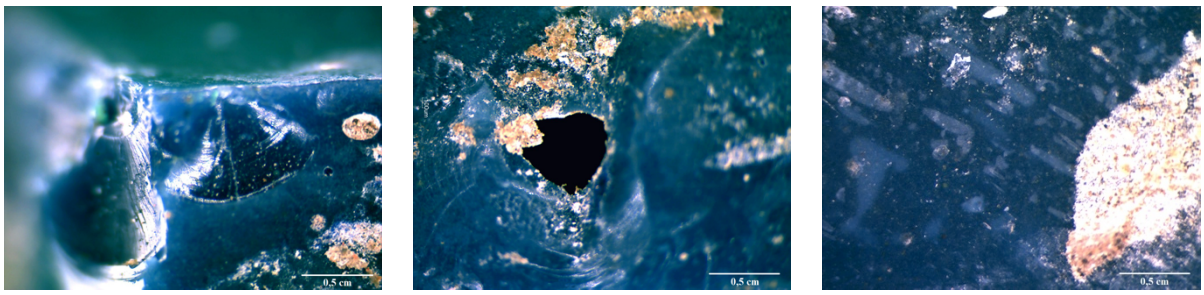


Fig. 6. OM micrograph showing microstructure of the transversal section of the sample called 5_T.

SEM observations carried out on mosaic tile allowed identifying the typical composition of K-alkaline glass, in which is not possible to exclude the presence of sodium due to experimental limits. Cobalt gives the particular blue colour [4].
The sampled tessera showed conchoidal fractures (Fig. 7a), pores produced during degassing of the glass (Fig. 7b) and, finally, bubbles oriented along the smoothing out direction of the vitreous paste (Fig. 7c).



(a) (b) (c)

Fig. 7. Macrographs of the sampled mosaic tile: details of (a) conchoidal fractures, (b) pores and (c) bubbles.

References

[1] Lo Faro, G. and Martorelli, R., 2006. *Pasquale Rizzoli - Sculture del Novecento tra Accademia e Modernismo*. Grafiche Zanini, Bologna.

[2] Di Crollalanza, G.B., 2005. *Dizionario storico blasonico delle famiglie nobili e notabili italiane estinte e fiorenti*. Arnoldo Forni (Ed.), Pisa.

[3] Davis, J.R., 2001. *Copper and copper alloys*. ASM International (Ed.), Materials Park, OH.

[4] Smirniou, M. and Rehren, Th., 2013. Shades of blue-cobalt-copper coloured blue glass from New Kingdom Egypt and the Mycenaean world: a matter of production or colourant source? J. Archaeol. Sci., 40: 4731-4743.