Diagnostic investigation of the *Cycle of the New Church of Sarria* (Floriana, Malta) by Mattia Preti

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Abstract. In the present paper, we present the main results of a diagnostic investigation on different paintings by Mattia Preti, belonging to the *Cycle of the New Church of Sarria*, located inside the Church of the Immaculate Conception of Sarria (Floriana) in Malta. The analysis was carried out on the occasion of the restoration process and, due to the short time available, only on some representative areas of each painting. A multi-technique approach was applied *in situ*, employing X-ray fluorescence spectroscopy (XRF) and Raman microscopy. The aim was to achieve information on the execution technique, in a completely non-invasive way, following the requirements of the restorers.

1. Introduction

Near the main entrance to the city of Valletta lies what for centuries was considered its suburb: the city of Floriana. The area, initially intended for agricultural production for the supply of Valletta, was urbanized in 1724. Within the walls there is the Church of the Immaculate Conception of Sarria (Figure 1(a)), whose current conformation is closely connected with the figure of Fra 'Mattia Preti, being the only building certainly designed by the "Calabrian Knight" in the mid-seventies of the seventeenth century. Preti was also the creator of the entire interior decoration (Figure 1(b)), consisting in a Pictorial Cycle of seven paintings, all made between 1677 and 1679, inspired by what he had depicted twenty years earlier in seven frescoes, on the as many gates of the city of Naples, as votive offerings for the end of the plague epidemic of 1656. On the high altar of Sarria there is the monumental altarpiece of the *"Immaculate Conception defeats the plague"*, while along the circular wall of the church are the images of the thaumaturgy saints *Rocco, Sebastiano, Rosalia* and *Nicola di Bari* represented "with a fervor characteristic of the works of Preti", and in order to build a sacred conversation. Although separated from the central altarpiece, the four figures are in fact an integral part of it, placing themselves as

elements that recompose the ideal setting of the depictions of the Neapolitan *ex voto*, in which the saints praying at the feet of the Virgin are placed as an intermediate term between Heaven and Earth. The Pictorial Cycle of Sarria is completed with the two large Lunettes of the arches, representing examples of the struggle of Good against Evil in relation to the plague disease interpreted as divine punishment: the one on the right depicts the *Allegory of the Order of St. John the Baptist*, while the one on the left is dedicated to *St. Michael defeating Evil*.

Recently, to support the restoration works of the Pictorial Cycle, this last painting underwent a deep diagnostic and 3D survey investigation, reported elsewhere [1].

Figure 1. Church of the Immaculate Conception of Sarria, Floriana, Malta (a); detail of the interior during the restoration of the altarpiece (b).

Here, we present the results of a preliminary non-invasive, *in situ* analysis of some of the remaining paintings of the Cycle, aimed at clarifying their composition, at elemental level by XRF spectroscopy and at molecular scale by Raman microscopy, with particular regard to preparatory layers and pigmenting agents [2-4].

2. Experimental

2.1 Investigated paintings

XRF and/or Raman analyses were carried out on some representative areas of two paintings of the Cycle, namely *St. Rocco* and *St. Nicola Di Bari*, as reported in Figure 2 and described in Table 1.

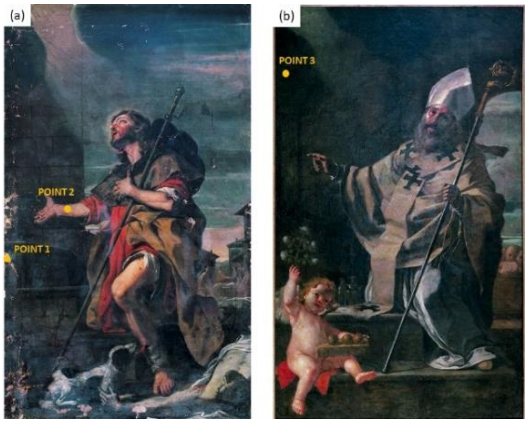

Figure 2. *St. Rocco* painting (a) and *St. Nicola di Bari* painting, with the investigated points displayed.

Table 1. Investigated points, description and employed techniques.

Analysed point	Description of the analysed area	Employed techniques
1	Preparatory layer	XRF
2	Reddish, incarnate of the arm	XRF
3	Dark, clouds of the sky	XRF, Raman

2.2 X-Ray Fluorescence spectroscopy

XRF spectra were collected by means of a portable XRF "alpha 4000" (Innov-X system) analyzer that allowed the detection of chemical elements with an atomic number (Z) between phosphorus and lead. The instrument was equipped with a Ta anode X-ray tube excitation source and a Si PIN diode with an active area of 170 mm^2 as detector. The instrument operated in "soil" mode, and two sequential tests were carried out: the first with operating condition of 40 kV and 7 μA, and the second with 15 kV and 5 μA, for a total collection time of 120 s. The calibration was carried out by soil LEAP (Light Element Analysis Program) II and was verified using alloy certified reference materials produced by Analytical Reference Materials International. The statistics of the measured spectra was improved by collecting the XRF signal for 60 s per run. Lines detected at ~ 8.15 keV and ~ 9.34 keV, observed for all the investigated samples, were attributed to the L_α and L_β energy transition of Ta anode.

2.3 Raman microscopy

Raman spectra were collected by a 'BTR 111 Mini-RamTM' portable Raman spectrometer (B&W TEK, USA), with an incident wavelength of 785 nm (laser diode), max laser power 280 mW, a Thermoelectic (TE) Cooled 2048 pixel CCD detector. The 62-3153 cm^{-1} spectral range was investigated, with resolution 10 cm^{-1}, acquisition time 10 s x 32 scans. The system was equipped with a BAC151B Raman microscope, used in the following configuration: 80x objective, working distance 1.25 mm, laser beam spot size 26 μm. The assignment of the Raman vibrational bands was performed with reference to the relevant databases and libraries.

3. Results and Discussion

Figure 3 reports the XRF spectra collected from the preparatory layer (point 1, the surface paint layer was, in this area, seriously damaged) and from the reddish area of the arm (point 2) in *St. Rocco* painting, as well as from the dark area of the clouds of the sky in *St. Nicola di Bari* painting (point 3).

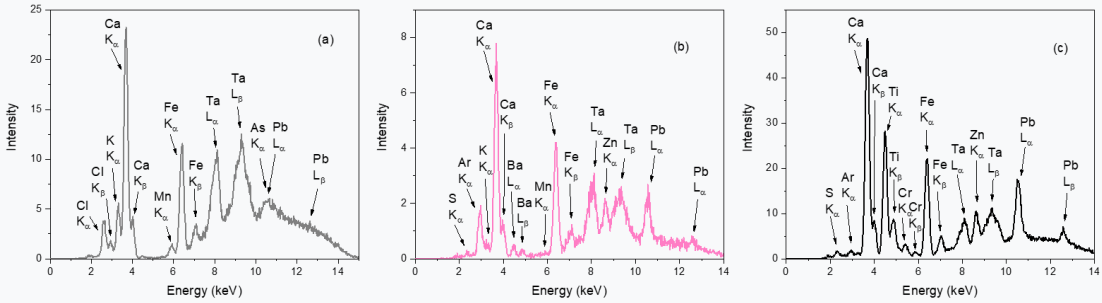

Figure 3. XRF spectra, in the 0-15 keV range, collected (a) from the preparatory layer (point 1) and (b) from the reddish area of the arm (point 2) in *St. Rocco* painting, and (c) from the dark area of the clouds of the sky (point 3) in *St. Nicola di Bari* painting.

The obtained elemental compositions are reported in Table 2.

Table 2. XRF results for the analyzed points.

Analysed point	Elemental composition
1	Ca, Cl, K, Fe, Pb, Mn, Sr, Br, Zn, Mo, Zr, As, Rb, Cu
2	Ca, S, Pb, K, Cl, Fe, Ba, Zn, Mn, Cr, Sr,
3	Ca, S, Ti, Pb, Cl, Ba, Fe, K, As, Zn, Cr, Sr, Mn, Se, Rb

As main results, the preparatory layer (point 1) appears to be mainly constituted by a Ca-based compound, probably calcium carbonate, $CaCO_3$. It is reasonably globigerina, the main rock in Malta, so supporting a local production of the painting [5]. This is a crucial task that will deserve further investigation. Going on, the observation of Fe and Pb suggests the use of materials containing these elements, reasonably ochre (Fe_2O_3) and lead white ($2PbCO_3 \cdot Pb(OH)_2$), in agreement with what previously revealed for the *St. Michael defeating Evil* Lunette of the same Cycle [1]. The reddish area of the incarnate (point 2) indicates a Fe-based pigment, probably red ochre, lightened by a Pb-based one, reasonably lead white. Interestingly, no Hg was detected, in contrast to what revealed up to now from the analysis of the aforementioned Lunette, and, generally, of other paintings by Mattia Preti [6]. For what concerns the investigated black area of the in *St. Nicola di Bari* painting (point 3), the high content of Ca detected is indicative of the use of an organic, Ca-based pigment, probably combined with Fe- and Mn-based compounds. In this case, no further hypotheses can be made, since XRF is not suitable for detecting organic colorants, and a molecular scale investigation, by Raman spectroscopy, was necessary. Raman spectrum collected on point 3 is reported in Figure 4.

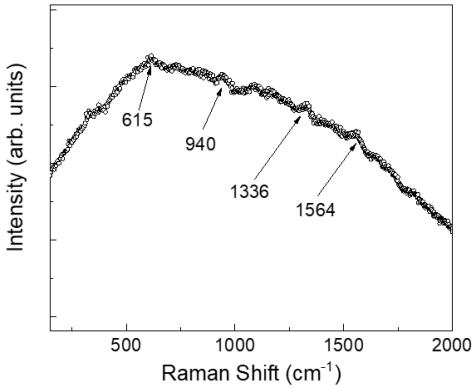

Figure 4. Raman spectrum collected the dark area of the clouds of the sky (point 3) in *St. Nicola di Bari* painting.

The spectrum evidenced a band at ~ 615 cm^{-1}, ascribed to iron oxides. As main result, the simultaneous presence of the band at ~ 940 cm^{-1}, associated to phosphates, and those of amorphous carbon (~ 1336 cm^{-1} and ~ 1564 cm^{-1}), allowed us to recognize as bone black the investigated pigment.

4. Conclusions

A non-invasive, *in situ*, investigation at elemental and molecular level, by XRF and Raman spectroscopy respectively, was here applied on two paintings from the Cycle of the New Church of Sarria (Floriana, Malta), namely *St. Rocco* and *St. Nicola di Bari*, by Mattia Preti. The analysis, conducted in support of the restoration works, gave us the opportunity to get insight into materials and techniques employed by the Calabrian Knight. The final aim of the work, other than furnishing useful information for future interventions, will be to acquire a complete *scenario* of the production activity of Mattia Preti in the Church of the Immaculate Conception of Sarria (Floriana, Malta) between 1677 and 1679, to be compared with the paintings sent by the artist from Malta to Taverna (Catanzaro, Italy) between 1661 and 1688, kept in the Church of St. Barbara in Taverna.

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