Supplementary materials for the Article

Supplementary Materials

S.1 Brief description of the artwork Poesia *by Alessandro Kokocinski*

In the contemporary artwork *Poesia*, the artist reworks the technique of collage using, as a primary support, a typographical print on poster paper of one of his autograph drawings, depicting oval shield in the baroque style, embellished with volutes and acanthus leaves. Inside the shield, the face of a woman is replicated twice. The complete stratigraphy of this complex artwork is shown in graphical form in the Figure S1.

The plywood panel that serves as the secondary support is composed of three layers and has a rectangular shape (153.7 cm x 88.5 cm x 0.35 cm), however the bottom edge of the support is uneven and has missing wooden material in both bottom corners. The primary support adhered to the thin plywood panel and was made of a poster paper called *blue back*.

The graphic media application technique adopted for the creation of the poster is based on Drop-On Demand technology where drops of colour are irregularly imprinted on the surface, creating a specific typographic pattern. The four-colour process used for printing is made up of coloured pigment-based inks identified with the acronym CMYK (Cyan-Magenta-Yellow-Key black) from which a black and white image is obtained. The artist's palette varies according to the aesthetic intent: the complexion of the central face is made with ochre pigments, while the background is obtained with a dark impasto, thicker and denser in some places and less so in others. A brown glaze, used probably to decrease the clarity of the paper, is brushed over almost the entire surface of the poster.

The subsequent phases of execution include the addition of three-dimensional elements such as paper inserts in the center of the composition and in the upper part of the collage; medium-grained sand applied irregularly to the paper support or mixed with pigment to increase its roughness; a fiberglass mask decorated with a cardboard crown painted in gold colour and attached to the upper part of the composition.

The state of conservation of the artwork was characterized by a serious microbiological attack mainly due to the unsuitable context of its storage site; the room in which the work was kept, in fact, had centuries old masonry walls with pockets of humid air, high relative humidity and poor air circulation which increased the widespread accumulation of dust.

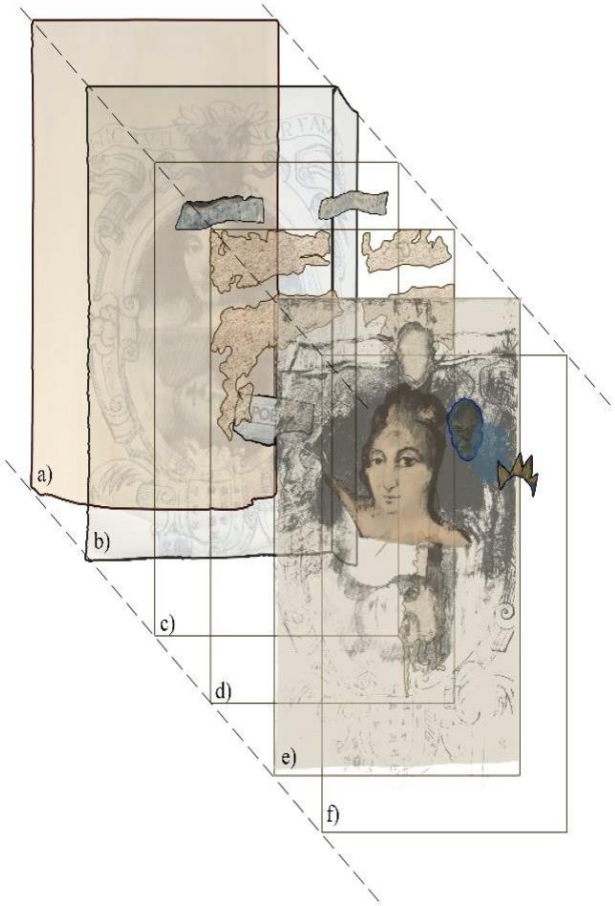

Figure S1. Stratigraphic scheme of the artwork *Poesia* by Alessandro Kokocinski: a) plywood panel; b) blue back poster paper; c) paper fragments of magazine and newspaper; d) medium-grain sand; e) pictorial layer; f) fiber-glass mask with cardboard crown.

In the Figure S2 the documentation photos of the artwork before and after the restoration are shown with the colochecker.

The RGB photo before the restoration was obtained through HMI system that, as explained in the section Materials and Methods of the main document, is obtained by acquiring two images with filer A and B (with and without colorchecker). Then the calibration software processes the images and produces sever tiff files that are the calibrated monochromatic bands centered at 350, 450, 550, 650, 750, 850 and 950 nm and the RGB output, without the colorchecker. So, the image shown in the figure S2(A) is a work file.

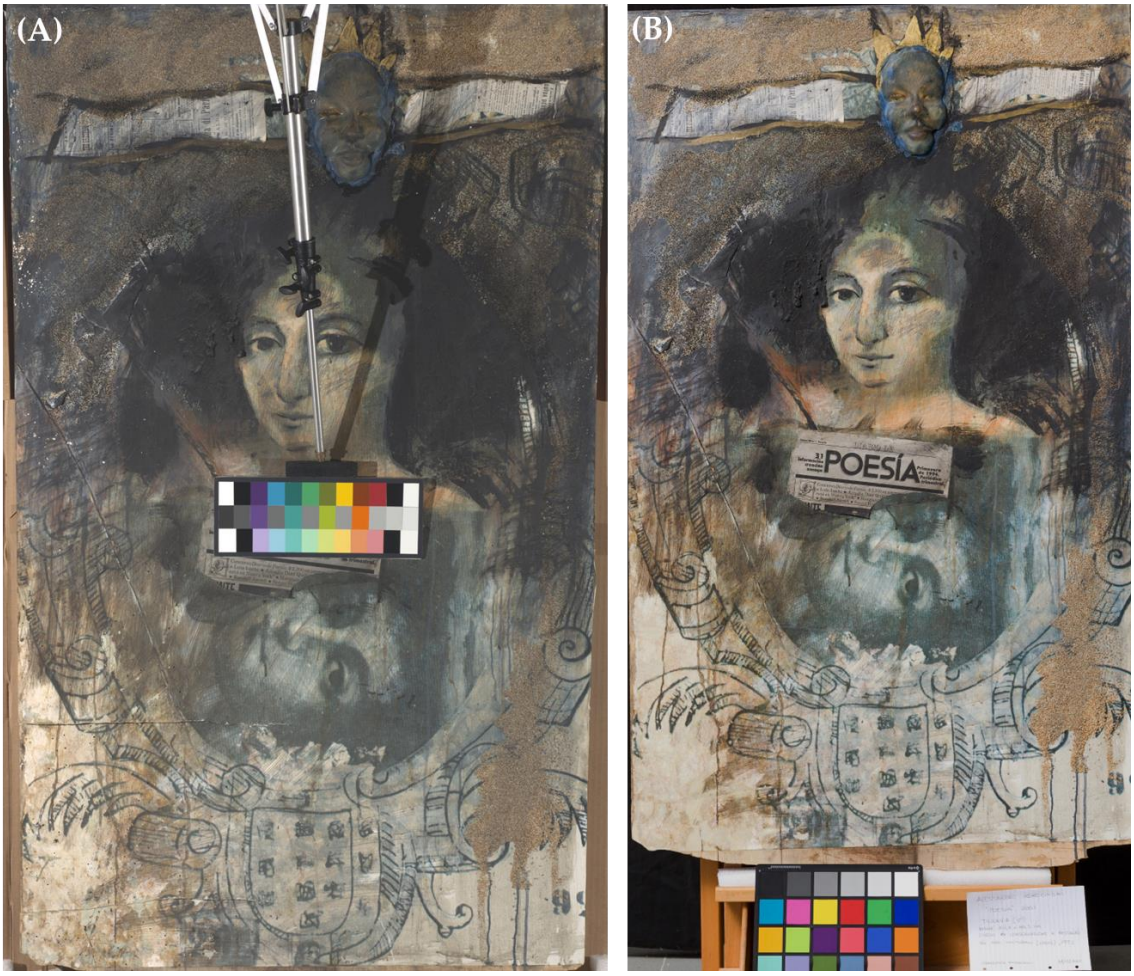

Figure S2. Photographs of the artwork with the colorckecher: (A) the RGB image obtained through HMI system before the restoration; (B) the RGB image obtained through a professional camera after the restoration.

S.2 Points of XRF analysis

XRF analysis was performed on eight points in order to characterize pigments and other materials.

In the Figure S3 the points of XRF analysis are shown in the artwork image.

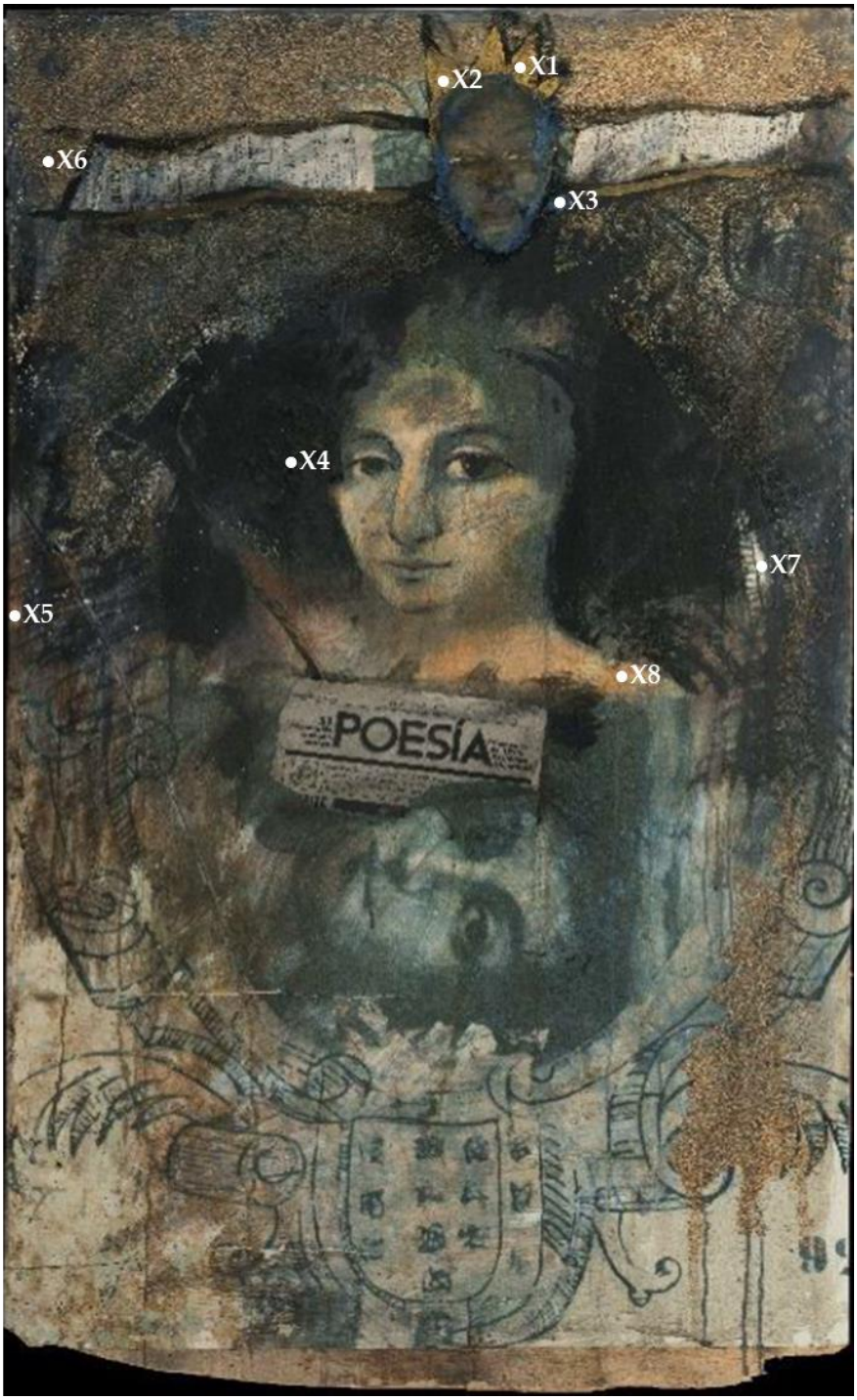

Figure S3. Photograph of the artwork with the points of XRF analysis whose results are reported in the main document.

S.3 Enzymatic tests on microbial strains

For enzymatic treatments, lipases and chitinases were used. Lyophilized powders of lipases by *Candida rugosa* (Antares S.r.l®) and chitinases by *Trichoderma viride* (Sigma Aldrich®) were suspended in 50 mM potassium phosphate buffer (pH 7.0) and preserved at -80 °C. Enzymes

concentrations were 4 mg/mL for lipases and 1U/mL (maximum solubility limit) for chitinases. *Cladosporium* sp. 2 (strain CCFEE6674) was selected for the enzymatic tests due to its high pigmentation, which is generally associated with fungal resistance to stresses. Tests were carried out in triplicate, with fungal mycelium suspended in the enzymatic solutions, both singly and in combination, at concentrations of 170 mg/mL. Solutions were inoculated at 37 °C and the occurrence of damages recorded after 30 min, 1h, and 2h (decay time of enzymes activity according to the manufacturer) and compared with controls at the same mycelium concentrations in saline solution (NaCl 0.9%).

Damages were assessed by both microscopic observations and cultural tests. For the cultural tests, 100 µL of fungal suspensions were spread on MA plates (malt extract 30%; agar 15%), in number of five for each exposition time and enzyme, incubated at 22°C for 2 weeks and observed daily.

Lipases and chitinases, both singularly and in combination, did not produce effects on *Cladosporium* sp. 2, as observed by both microscopic observations and cultural tests, even after 2 hours of treatment (Figure S4).

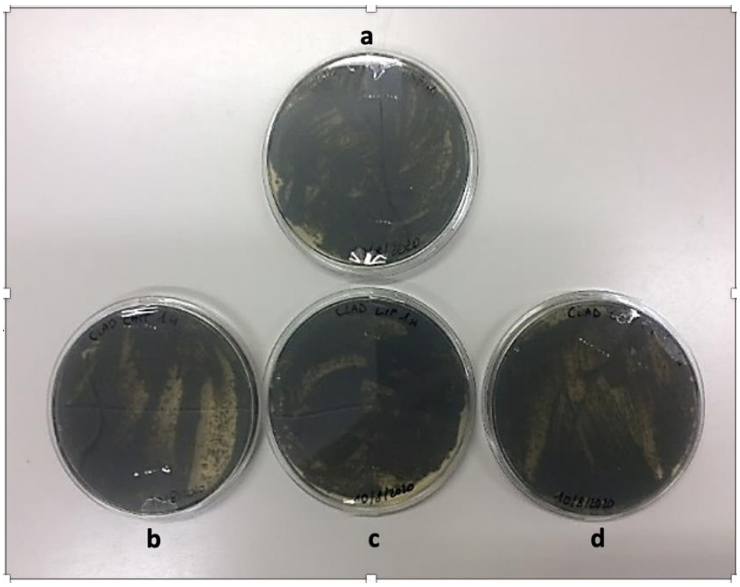

Figure S4. Results of culture tests after 2 h treatments of *Cladosporium* sp. 2 with lipases and chitinases, alone and in combination. (a) control; (b) lipase treated plate; (c) chitinase treated plate; (d) lipase and chitinase treated plate.

S.4 Chromatograms of adhesives and colour binder

The chromatograms obtained using analytical pyrolysis coupled with gas chromatography and mass spectrometry (Py-GC/MS) for the surface adhesive, the adhesive of the paper, that of the mask in fiberglass and the painting binder are shown in figures S5, S6, S7 and S8, respectively.

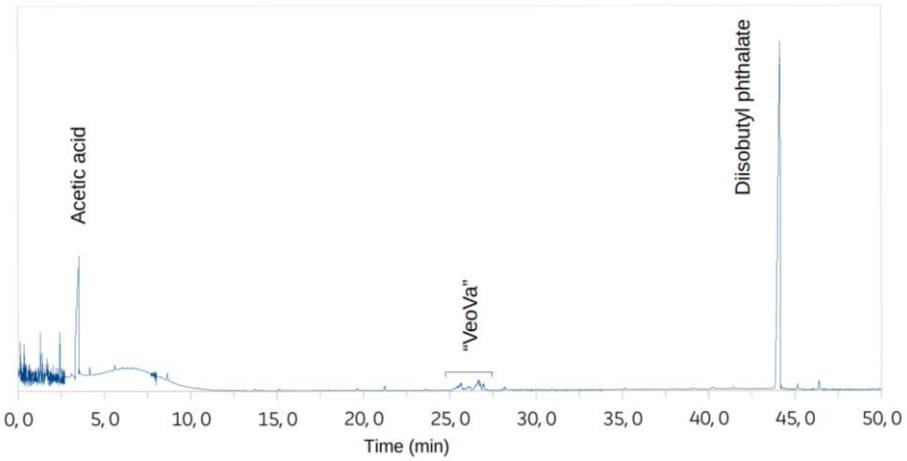

Figure S5. Chromatogram of the surface adhesive.

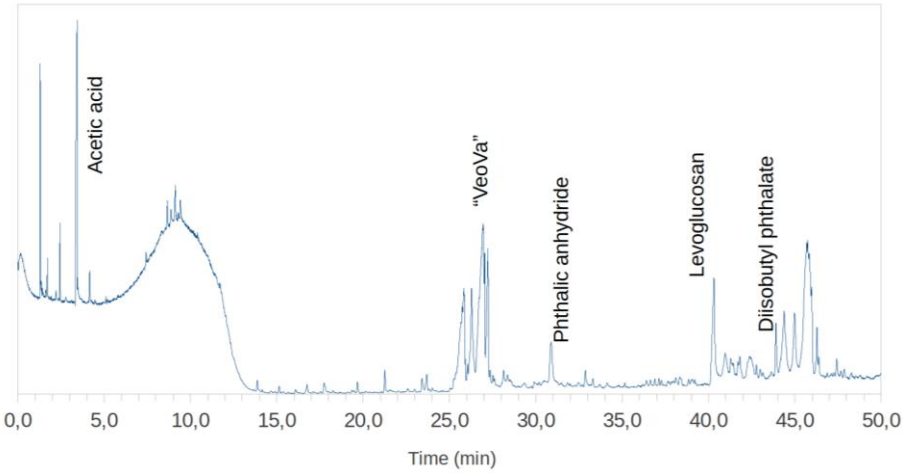

Figure S6. Chromatogram of the paper adhesive.

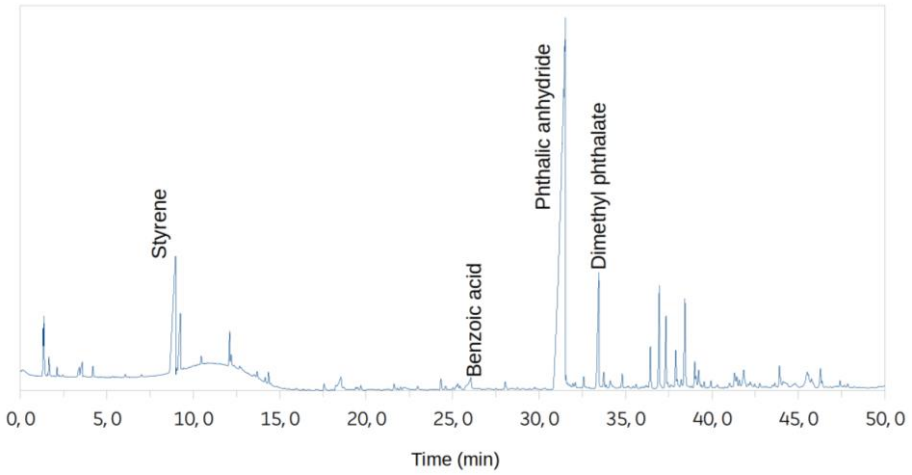

Figure S7. Chromatogram of the fiberglass mask adhesive.

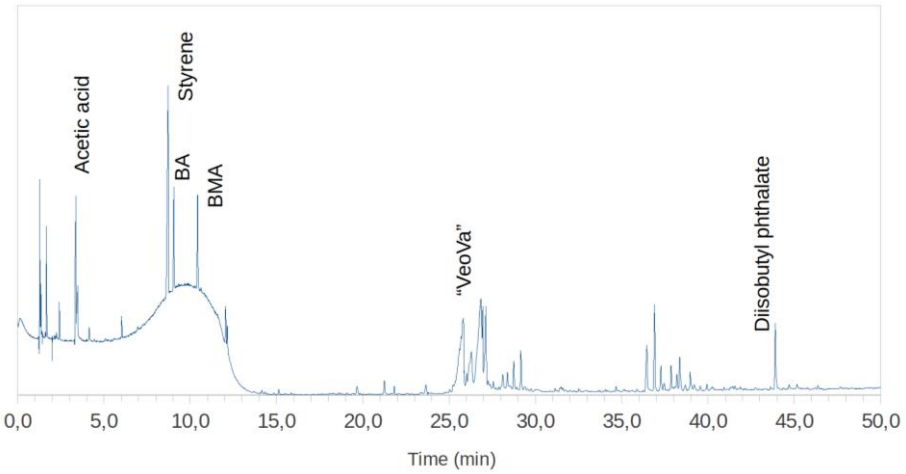

Figure S8. Chromatogram of the black colour binder.

S.5 Points of pH measurements on the college and colour measurements before and after ageing

pH measurements were taken on the front and back of the artwork to evaluate the effect of biological attack, in five points for each side.

The measurements points are shown in the figure S9 and the relative pH values in the Table ST1.

Figure S9. Points of superficial pH measurements before restoration, on front and back sides.

Table S1. pH values measured on front and back sides of *Poesia*, in the points shown in the Figure S7.

Measured point	pH value
1	6.48
2	6.50
3	6.48
4	6.58
5	6.93
6	4.56
7	5.64
8	5.29
9	5.36
10	4.53

Stratigraphic samples were artificially aged in order to simulate the artwork naural ageing. To evaluate the effect of artificial ageing colour was measured before and after the process.

The differences between the chromatic coordinates before and after the ageing time and the total colour difference (ΔE*) are reported in the Table ST2.

Table S2. Chromatic differences before and after artificial ageing on the three replicates of test sample 1.

Layer	ΔL*	Δa*	Δb*	ΔE*
		SAMPLE 1A		
Paper	-4.61	0.29	5.79	7.41
Paper + velatura	-6.10	0.52	4.41	7.55
Paper + velatura	-2.46	0.39	5.21	5.77
Paper + velatura	-1.03	0.32	5.05	5.16
Painting layer	0.64	0.11	0.72	0.97
Painting layer	0.03	0.85	0.39	0.94
		SAMPLE 1B		
Paper	-3.03	0.34	5.79	6.54
Paper + velatura	-3.96	0.27	4.05	5.67
Paper + velatura	-2.73	0.92	6.11	6.76
Paper + velatura	0.59	0.13	6.53	6.56
Painting layer	-0.40	0.65	0.05	0.76
Painting layer	-0.44	0.26	-0.19	0.55
		SAMPLE 1C		
Paper	-3.08	0.16	5.39	6.21
Paper + velatura	-3.48	0.03	6.92	7.75
Paper + velatura	-1.20	0.36	5.18	5.33
Paper + velatura	2.82	0.14	4.26	5.11
Painting layer	-0.12	0.37	0.09	0.40
Painting layer	-0.46	0.33	0.19	0.60