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Editor's Address

INSTITUTE OF ARCHAEOLOGY
RZESZÓW UNIVERSITY
ul. Moniuszki 10, 35-015 Rzeszów, Poland
e-mail: iarch@univ.rzeszow.pl
Home page: www.archeologia.rzeszow.pl

THE UNIVERSITY OF RZESZÓW
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Beata Miazga[1], Dawid Grupa[2], Małgorzata Grupa[3]

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[1] Institute of Archaeology, University of Wrocław, Szewska 48, 50-139 Wrocław, Poland;
e-mail: beata.miazga@uwr.edu.pl; ORCID: 0000-0003-3714-1889

[2] (private);
e-mail: d.m.grupa@gmail.com; ORCID: 0000-0002-6393-8528

[3] Institute of Archaeology, Nicolaus Copernicus University in Toruń, Szosa Bydgoska 44/48, 87-100 Toruń, Poland;
e-mail: m.grupa@wp.pl; ORCID: 0000-0001-5128-9754

Results of Archaeometrical Studies on a Kontush Sash from Piaseczno (Pomorskie Province, Poland)

Abstract

Miazga B., Grupa D., Grupa M. 2023. Results of Archaeometrical Studies on a Kontush Sash from Piaseczno (Pomorskie Province, Poland). *Analecta Archaeologica Ressoviensia* 18, 205–215

Archaeometric studies on silk thread wound around with metal strips are still rarely undertaken in Poland. Their popularization seems to be necessary, however, as there are many problems to solve. In the case of a *kontush* sash manufactured in Gdańsk as archaeological finds, the main question is whether they used metal strips prepared by local craftsmen, what raw material was employed, and what methods of gilding were implemented. Only future regular studies and analyses can answer these questions. The article presents the results of tests on metal strips wound around silk threads coming from a *kontush* sash manufactured by Besch, excavated in the crypt under the presbytery of the church of the Nativity of the Blessed Virgin Mary in Piaseczno (Pomorskie voivodeship, Poland).

Keywords: silk thread with metal, *kontush* sash, crypt, Piaseczno, Poland, X-rays, SEM

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Introduction

Studies on fabrics decorated with metal thread, which were initiated in the second half of the 20th century, stem from various motivations, both cognitive and conservation-based. As a result, we can observe technological and material variety in threads with metal braiding. Textiles are made of thread combined with metal wire or flat tins and bands (Rezic *et al.* 2010; Balta *et al.* 2015; Miazga *et al.* 2018, 68–76; Grupa and Łukaszewicz 2019, 141–151; Miazga and Grupa 2023, 165–169). The first were made completely of metal, while tin ones can have a metal or animal product base (leather, parchment) or vegetable (paper). The metals employed also vary, e.g. they can have an external coating of gold or silver (Enguita *et al.* 2002; Járó 2009). Techniques for making this type of thread were already known in China before they were employed in Europe, with gold ribbons being used to decorate textiles from at least the 2nd century BC. The earliest examples were found in Han tombs at Man-Ch'eng in China (Karatzani 2012, 4). In European sites, fabrics with metal braided threads can be dated to the late 5th century AD (Crowfoot and Chadwick Hawkes 1967, 44–57; Grupa 2016, 179). However, it is difficult to establish the time at which they began to be produced in Byzantium. However, the turn of the 7th/8th century seems to be acceptable in the history of the production of these luxury wares. The Byzantine Empire's trade contacts with Europe allowed peoples from the North to become familiar with silk fabrics. In Poland, silk fabrics (both plain and patterned) appeared at the turn of the 10th/11th century (Maik 1988, 86; 1991, 69; Grupa 2013, 304). They were mostly silk ribbons with a pattern shaped with thread in a metal braid found in the grave furnishings of representatives of the elite of the time (Bielniak *et al*. 1961, 1–100; Grupa 2007a; 2009, 215–217; 2018a, 245–253; 2020, 367–375; Cybulska *et al*. 2018, 735–799; Grupa and Kozłowski 2022, 88–94). It is assumed that most of these were delivered overland via Rus by the Vikings (Grupa 2007b, 278; 2023, 226).

The most probable and frequently used route in southbound journeys and back was the land one known as the *Northern Arc*, leading from the caliphates through the Khazaria Khaganate, southern and northern Rus (with Old Ladoga as the main emporium), the Gulf of Finland and farther within the Baltic Sea basin, both north and southbound (Frankopan 2015, 136–152; Bogucki 2018, 179). Along these routes, so-called hoards were recorded in many places which included silver Arabian coins – dirhams (Bogucki 2018, 162–163; Grupa 2020, 375). The southeastern borders of the Polish-Lithuanian Commonwealth have always been the gateway to Eastern styles. Around the end of the 15th century, the typical Polish nobleman's costume began to take shape, one in which belts made of various raw materials (leather, metal, textiles) played no small role. However, it was silk belts that became the main accessory of this outfit. They were imported from Persia and Turkey, among others, and in the 2nd half of the 18th century began to be produced in the Polish-Lithuanian Commonwealth. The value of a single belt was influenced by the amount of metal thread in the silk fabric. Therefore, they were valued based on their weight (Grupa 2005, 92–94). The brilliance of these items of clothing was the best showcase of wealth and membership in the highest social group in the Polish-Lithuanian Commonwealth. Archaeometric analyses need to be carried out prior to conservation treatments in order to adopt appropriate cleaning procedures and ensure the adequate protection of corroded metal elements and textile thread cores.

Both research objectives were completed by applying physicochemical methods, often used while examining historical objects due to their non-destructive and non-invasive character. The first group includes microscopic observations with the use of stereo microscopes, or metallographic or X-ray fluorescence spectrometers (Janssens *et al*. 2000, Fitzgerald 2008; Kylafi *et al*. 2017). The same methods have been applied for many years to studies of various textiles (Good 2001; Brandt and Allentoft 2019; Suomela *et al*. 2022, Vanden Berghe *et al*. 2023). Other analytical techniques, limited by the sizes of tested samples, generally require taking about 5 mm of thread from a tested textile and frequently its further processing (e.g. plunging it in resin) (Járó 2009; Balta *et al*. 2015). Low invasive methods include observations in scanning electron microscope, SEM (thread cross sections), PIXE analyses (analyses of proton induced X-rays) or X-ray microprobes (induced by X-rays combined with SEM).

Samples and the goal of the tests

The present article describes the non-destructive measuring devices applied while studying a historical *kontush* sash from Piaseczno, Pomorskie voivodeship, in order to estimate the type of material used to wind around silk threads which shaped the pattern on the object, as well as the method of manufacturing. The aim of our research was a technological study connected with the identification of the raw materials used as well as further consideration on a number of topics, e.g. the skills of the ancient craftsman in question, past fashion, trade contact and the provenance of the *kontush* sash.

The sash was excavated during archaeological-architectonic explorations in the crypt under the presbytery of the church of the Nativity of the Blessed Virgin Mary in Piaseczno (Pomorskie voivodeship, Poland). It was found in mixed layers in the crypt pugging (human remains, fragments of clothes made of silk, wooden coffins and their metal handles, soil) (Grupa 2018b, 33–36; 2022, 157–161). The sash was probably made in the Besch tapestry workshop in Gdańsk, which operated from 1770 to 1790. The workshop differed in its production from other Polish sash ornaments, since it placed in the sash heads an image of a window divided with a vertical slat, decorated from above with a ruffled curtain (Fig. 1). The windowsill was equipped with two flower bunches in vases (Kałamajska-Saeed 1987, 42–43; Majorek 2013, 206, 208). A large part of the sash has been preserved, with particular fragments having lengths of 97, 66, 32 cm and a width 29.5 cm (Grupa 2022, 157).

Research method

Spectroscopic tests were made using a table X-ray fluorescence spectrometer with energy dispersion (ED-XRF), in a Spectro Midex device, with a molybdenum X-ray tube and semiconducting detector (SDD with Peltier cooler). The device works in the air. Excited state energy is 44.7 kV, amperage – 0.4 mA. Semi-quantitative analyses were made using analytical procedure of Fundamental Parameters and microscopic

Fig. 1. The Piaseczno *kontush* sash. Digits 1–4 mark the tested fragments (photo by B. Miazga).

observations using metallographic microscope Nikon Eclipse LV100, with magnification of 50×. Software NIS Elements makes possible to register picture and analytical procedures (thread length and diameter) (Miazga 2017, 85–88; 2018, 162).

Research results

The *kontush* sash was divided into four analytical spheres, where the first was its head with an ornament shaped with silk thread wound around a metal strip which was golden in color on a dark olive textile. The present colors can be misinterpreted, as this sash part could have originally been blue (Grupa *et al.* 2014, 60). The second – the same ornamented sash end, but clearly brighter part and very damaged textile (olive – beige color at present). The third – tassels fastened to one end and the fourth – the sash part without any decoration (Fig. 1).

In the first tested area (Tab. 1), metal braid was made of material with nearly 95% silver content (average 94.6%), with comparable amounts of gold (1.7%) and copper (1.3%). The minor participation of zinc (0.3%) and nearly 1% of iron were also identified. XRF spectrum also revealed traces of lead and no signals of mercury (Fig. 2). For threads chosen randomly in that area extra tests were made to define the method of gilding. A 5 mm strip was removed under a microscope from the thread fragment (Fig. 3). The microscopic picture presents two strip fragments, one seen from the external part and the other from the internal part. The internal part of the second fragment is magnified 200×. We identified the internal part as an arched concave surface with textile fibers attached to it. The area seen in Figure 3a–c was tested spectrally, which resulted only in qualitative data, caused by the small braid size seen in Figure 3 (on average 100-120 μm, i.e. 0.1 mm) and the volume of the X-ray beam being 0.7 mm. Spectrum picture interpretation ED-XRF certifies the presence of silver and gold, and these signals are well readable (Fig. 4), indicating two-sided strip gilding.

Table 1. Metal contents in tested sample no 1 from the *kontush* sash

Elements	Ag	Au	Cu	Zn	Fe	Other	Total
%	94.6	1.7	1.3	0.3	1.0	1.1	100

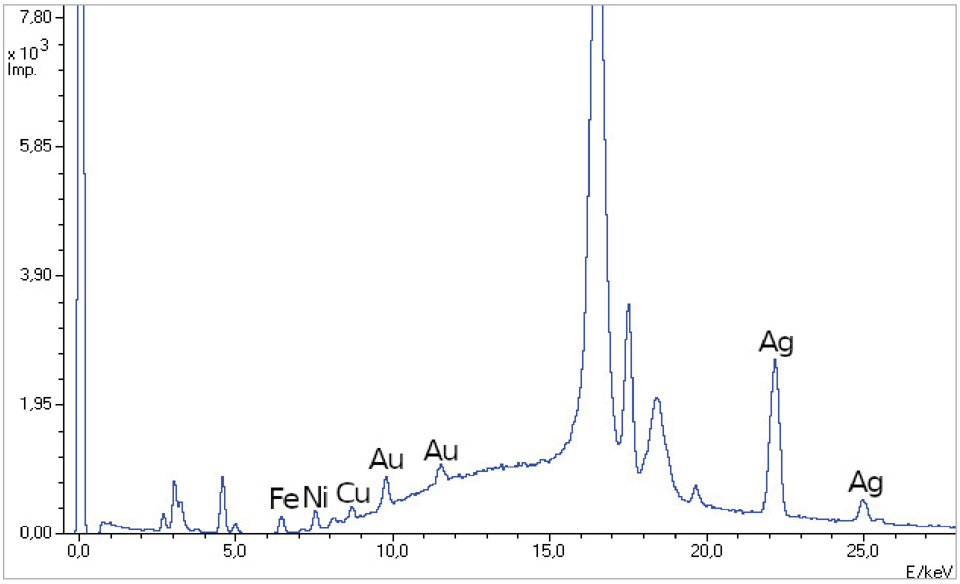

Fig. 2. ED-XRF spectrum of the metal thread ornamenting in the *kontush* sash, section no. 1 (photo by B. Miazga).

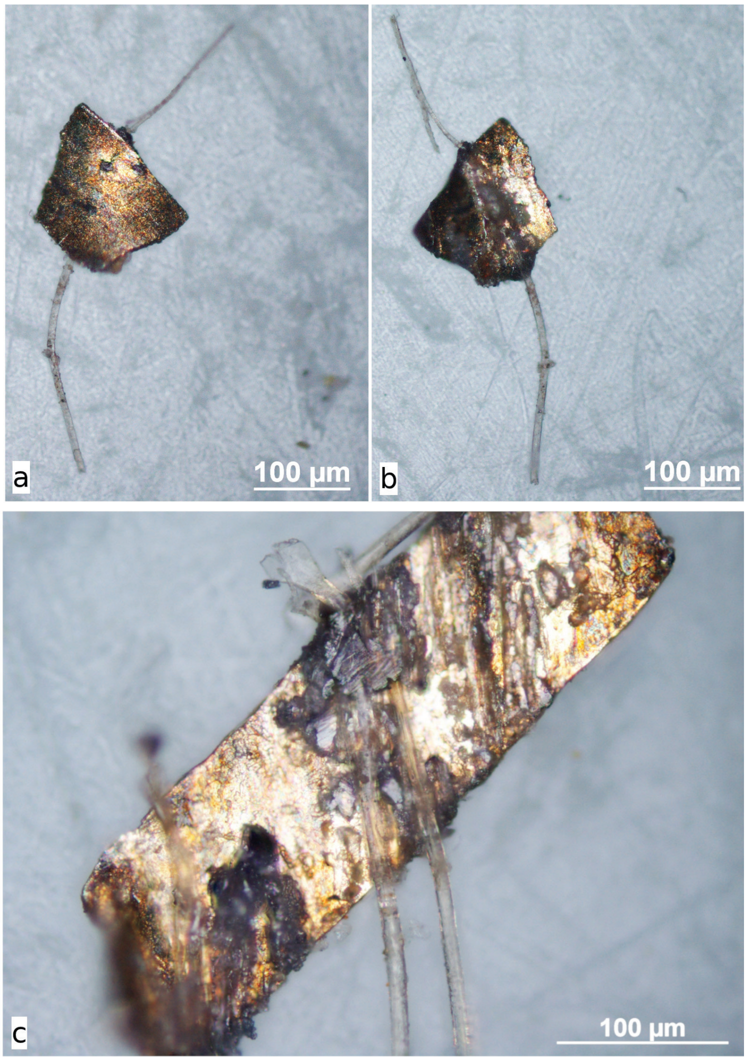

Fig. 3. Microscopic picture of the thread fragments: external (a) and internal (b, c) surface (photo by B. Miazga).

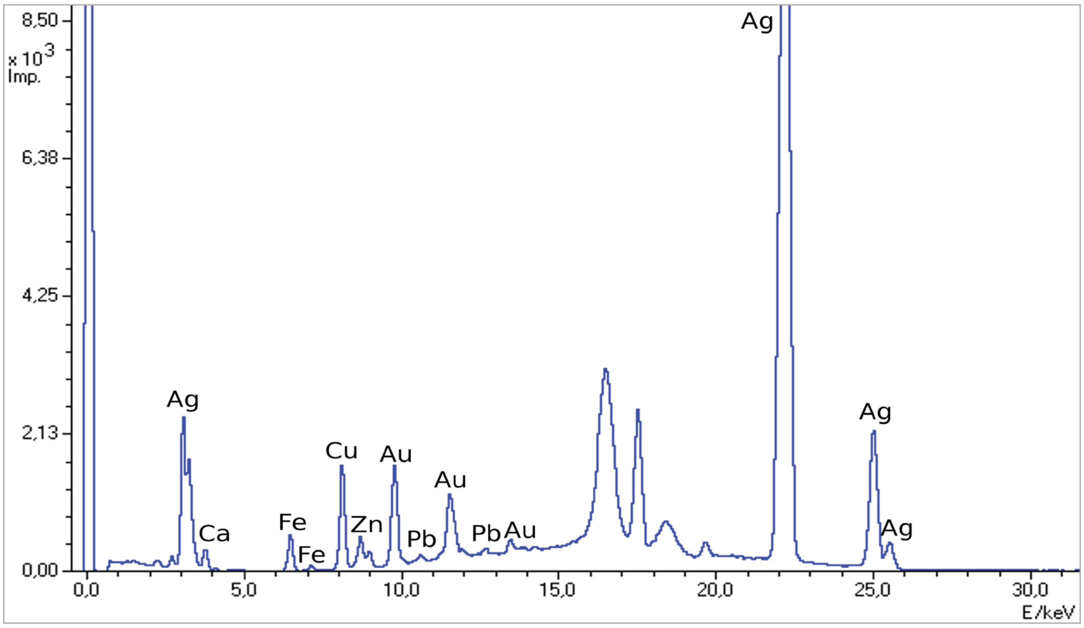

Fig. 4. ED-XRF spectrum of the metal thread (the area seen in fig. 4a–c) (photo by B. Miazga).

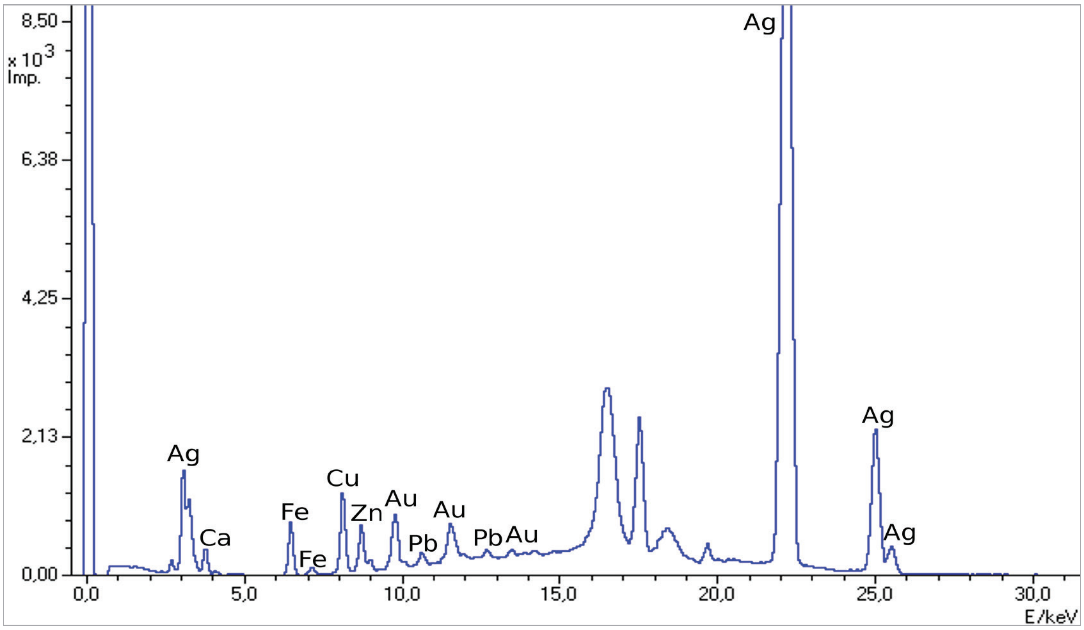

Fig. 5. ED-XRF spectrum of the metal thread ornamenting the *kontush* sash, section no. 2 (photo by B. Miazga).

Analyzing the data collected from the second section examined (Tab. 2, decoration on the bright damaged section of the textile) we obtained confirmation of the difference in the material used. Figures indicate 94.9% of silver, with 1.1% of copper contents, 0.5% of zinc, 1.3% of iron and only 0.6% of gold (Fig. 5). The comparison of the signal intensity of both tested ornaments confirms univocally semiquantitative data results: gold peaks in decoration on the thick dark olive textile are over twice that of the Kα 1line with 9.7 keV (Fig. 6). This clearly lower gold concentration was also identified by means of microscope analysis. Figure 7 compares microscopic pictures of metal wound around threads in both tested sections. When observed carefully, we can see a golden glow on the band from section 1, in particular on the thread adjacent surfaces, while metal threads ornamenting the thinner textile have a silver reflection along all the strip. Metrical exams of the strips indicated differences in metal threads from areas no 1 and 2. Average braiding width

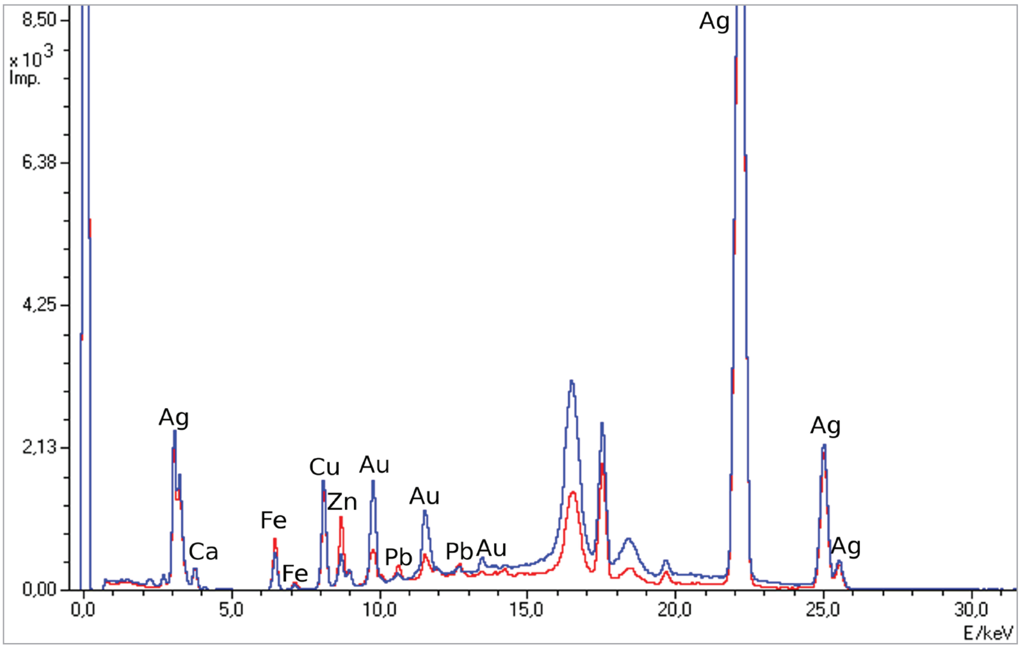

Fig. 6. Comparing ED-XRF spectra of metal threads from section no. 1 (blue line) with section no. 2 (red line). Visible differences in signals of gold and zinc intensity (photo by B. Miazga).

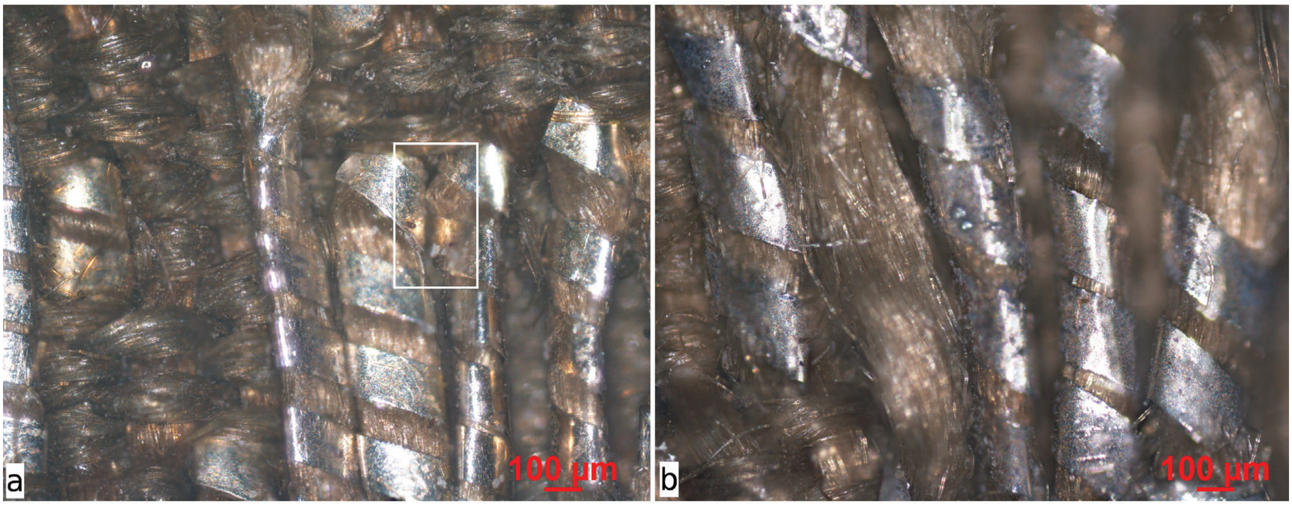

Fig. 7. Comparing thread metal braiding. The white frame matches the golden glow preserved on thread braiding in section no. 1 (a) and no. 2 (b) (photo by B. Miazga).

in fragment no 1 was 125.6 µm. Conducting analyzes of five neighboring threads, we collected the following data 134.3; 131.1; 145.8; 127.3 and 136.4 µm. Similarly, the average braid shift for the same five threads was marked, obtaining different numbers: 109.2; 43.5; 79.9; 119.5; 96.6 µm. Medium thread width was 247.3 µm (we cannot speak about thread diameter in this case, because they were rolled in a mangle and do not have a circular cross-section). Studying the second area, due to the poor state of preservation, we were not able to make analyzes of five neighboring threads (Fig. 8). Collected data was averaged: braiding width – 213 µm; braiding shift – 75.9 µm (for threads without braid loss) and 136.9 µm (for threads with two braids loss identified). The width of thread with braiding was 189.4 µm.

Table 2. Metal contents in tested sample no 2 from the *kontush* sash

Elements	Ag	Au	Cu	Zn	Fe	Other	Total
%	94.9	0.6	1.1	0.5	1.3	1.6	100

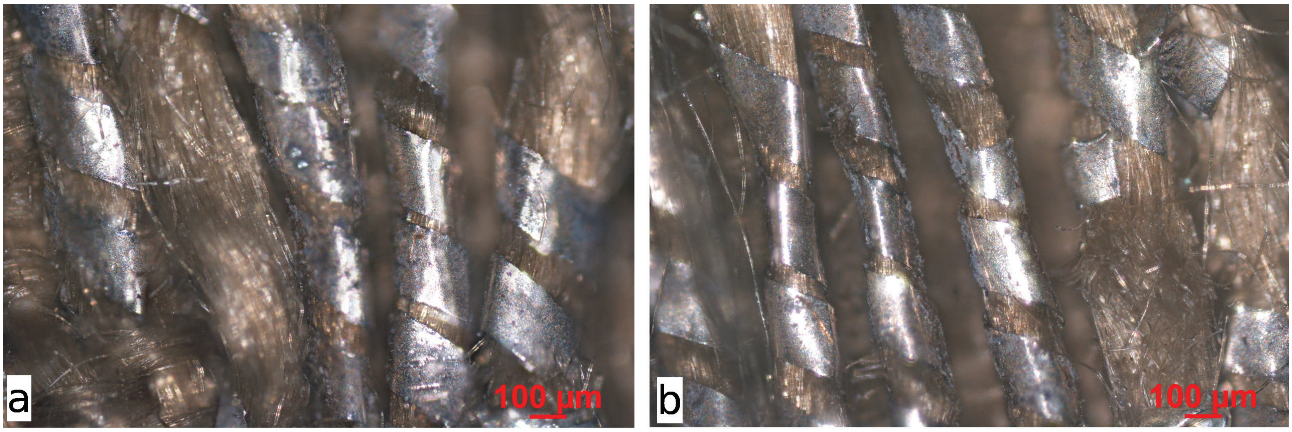

Fig. 8. Microscopic picture of metal threads (section no. 2), showing the best condition of braiding: its loss (a) and the tape damages and folds (b) (photo by B. Miazga).

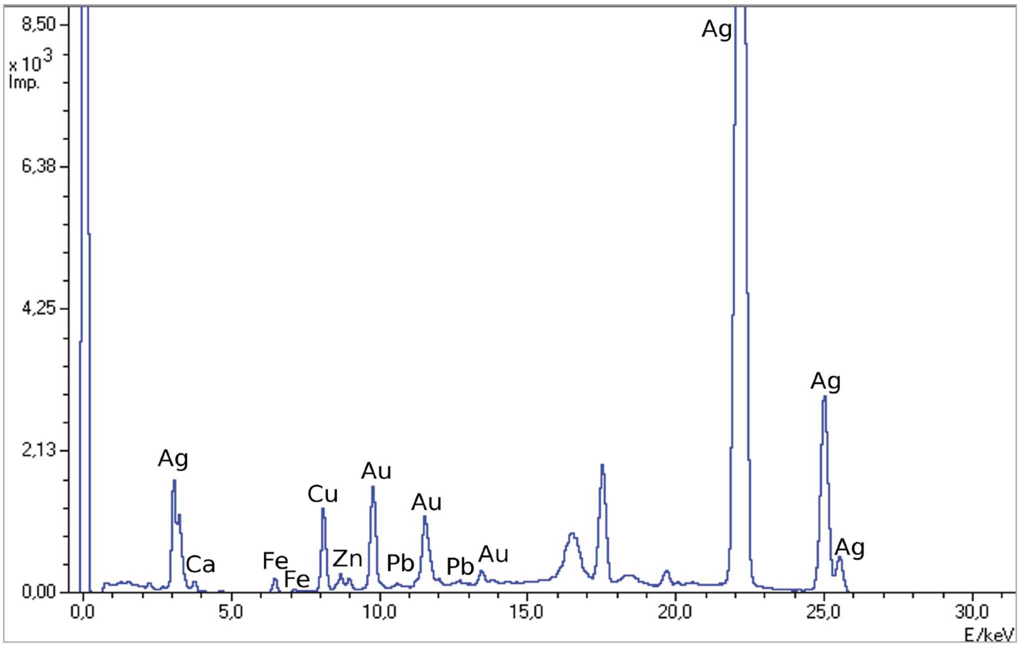

Fig. 9. ED-XRF spectrum of tassels from the sash (section no. 3) (photo by B. Miazga).

The examined tassels were fastened to short sash ends (section no 3 in Fig. 1; Tab. 3) indicating that they were made of material containing silver (95.7%) and 1.6% of gold, nearly 1% of copper, 0.4% of iron and 0.1% of zinc (Fig. 9). Spectrum analysis also shows the minor participation of lead, reported as weak peaks. Neither mercury (characteristic for fire-gilding), nor bromine (silver corrosion product) were identified in the spectrum. The microscopic picture of tassel threads confirms their relatively good condition, braid preservation, and their metal glow with a silver-golden color. The golden glow is particularly clear in places that were not exposed to mechanical damage (rubbing out of the gold layer during the object's use), as presented in Figure 10. Metrical analysis for this sash section shows an average braiding tin width of 209.1 µm in the tassel fastening place and 201.3 µm in their loose threads. Average braiding shift is respectively: 66.8 µm and 100.4 µm. The estimation of the diameter of the textile thread core gave results as follows: 150 µm (tassel fastening) and 240 µm (loose thread). It indicates that probably two different threads were used to make the tassels.

Table 3. Metal contents in tested sample no 3 from the *kontush* sash

Elements	Ag	Au	Cu	Zn	Fe	Other	Total
%	95.7	1.6	1.0	0.1	0.4	1.2	100

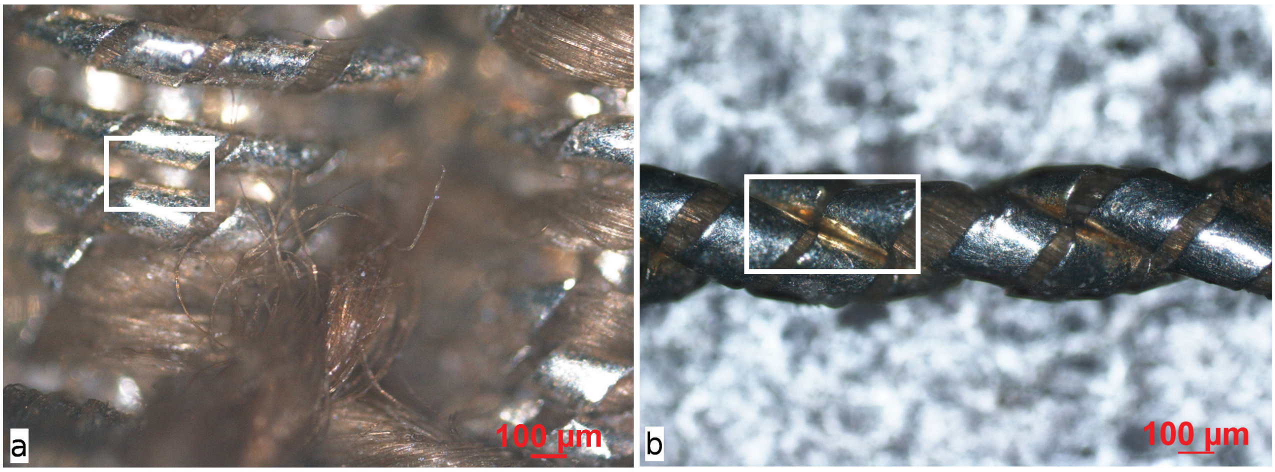

Fig. 10. Microscopic picture of tassels metal threads. The white frame matches the golden glow visible on the metal braiding of the tassels where they were fastened to the sash (a) and loose threads (b) (photo by B. Miazga).

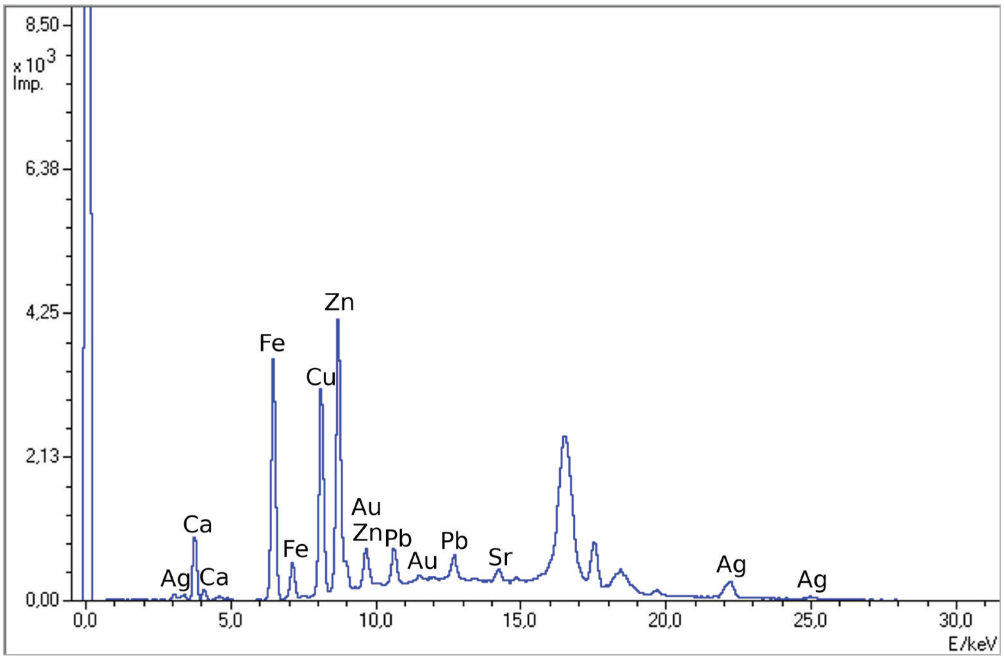

Fig. 11. Spectrum ED-XRF of textile not decorated with metal thread (section no. 4) (photo by B. Miazga).

The textile fragment deprived of any decorations was the last examined section (Fig. 1 – place no 4), analyzed to define the background (base elements level in textile) for metal threads and their contamination. The highest spectrum intensity signals were registered for iron and calcium, followed by copper, zinc, lead, and silver (Fig. 11). It confirms the hypothesis of textile contamination with these metals from objects deposited in the crypt. Metals from braiding oxidizing selectively gained in volume, thus contaminating the textile. Elements present in the textile deposition environment, such as iron and calcium, were also deposited on fibers.

Conclusions

Archaeometric studies of textiles are still rare and are usually conducted on single objects, hence it is difficult to make general conclusions about both Polish and European production (Grupa *et al.* 2014, 60). However, even single analyses provide important data on the production of objects. Archaeometric (spectral and microscopic) studies have shown that the thread braid is entirely of metal, being made of gilded silver. They also demonstrated the use of various materials in different parts of the sash.

The thread condition was relatively good (with the exception of the decoration on the bright part of the textile – area marked no 2), and a metallic glow was readable in all of the tested places. Natural silver ore was probably used, as confirmed by the lack of lead. Because the artefact comes from the end of 18th century, the manufacturers were able to employ advanced technologies of obtaining pure silver, without the admixture of lead from intermediate processes (Nord and Tronner 2000; Tronner *et al.* 2002; Miazga 2018, 162–165; Miazga *et al.* 2018, 68–76). The analyzed material did not reveal any mercury signals, thus rather excluding the fire-gilding method (we use "rather" than "certainly", because gold signals are not the strongest, and minor traces of mercury accompanying gold can be placed beyond spectrometer detection). Gold coated the metal strip surfaces and it was rubbed out systematically during the use of the sash, as can be observed in the unevenness of the surface color of the metal. Metal strips used to wind threads, both in the basic sash part and in the tassels, was made of complete metal element – tin band – which can be obtained by wire flattening (Járó2009).

The iron might have come from other artefacts present in the crypt layers, something which was also mentioned in other publications (Balta *et al.* 2015; Miazga 2018, 161–165). In this case, other materials (metal, organic), which can often be identified in threads of similar construction, were eliminated. Non-invasive textile tests did not enable the estimation of whether the gilding was one-sided or coated on both sides of a silver core. Analyses of silk threads from the Piaseczno sash confirms that threads gilded on both sides are much more frequent finds than only one-sided ones in 17th and 18th centuries examples (Tronner *et al.* 2002). The gold coating technique might be related to the use of gold foil covering a silver base with/without the use of integrating agents and the mechanical fastening both foils by flattening them.

Using x-ray fluorescence spectrometer with excitation energy of over 40kV helped not only to examine the gilded surface, but also the silver base. The rather poor condition of the gilding, being a result of the long use of the sash, was sufficient enough to identify the base of metal coating.

As remarked earlier, the sash was produced in the Besch workshop in Gdańsk. Silk yarn was imported, but its combination with metal braid could have been of local Gdańsk production, as the city was inhabited by craftsmen manufacturing silver and gold wire, making decorative strings, galloons, laces, artificial flowers (silk and paper) with metal constructions (Grupa 2014, 18; 2015, 48–51; Grupa and Grupa 2013, 50; Dudziński *et al.* 2015, 91–92, 94). The masters of drawing and flattening gold and silver wire belonged to the wealthiest citizens of Gdańsk. City authorities passed sumptuary laws (1714, 1736), regulating the excessive demonstration of their wealth (Grupa 2005, 91). The exploration of the other site in Szczuczyn also revealed another two sashes coming from Gdańsk tapestry workshops (Grupa 2012, 119; Majorek 2013, 206, 208), which future studies will confirm or negate their material similarities.

Based on the information resulting from archaeometric studies of the Piaseczno belt, it would be appropriate to verify the information of art historians about the fabrication methods employed in the Besch workshop in Gdańsk. Until now, these belts were thought to be of inferior quality, since the surface of the metal threads (compared to, for example, Słuck, Persian or Turkish belts) was dull. In fact, this is the case for most of the known relics in museum collections (Grupa 2022, 161), but the dullness of the metal webbing arose as a result of the gold rubbing off the surface during the belt's use. Analyses of the belt showed the presence of gold at the border of two metal threads (weft and warp) in contact with each other. So, the surface of the metal belt, which was exposed to abrasion, was originally covered with gold. These findings are confirmed by the observations of the Besch belt from Szczuczyn, on the surface of which the gold layer of interest was not fully wiped off. In view of these findings, it would be necessary to verify the data obtained in the previous century, which would fundamentally change the approach to the history of belts made in the Gdańsk *persiarium*.

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