The sixteenth-century glass jewellery collection of Archduke Ferdinand II – a great challenge for semi-quantitative XRF investigations

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Introduction

The glass jewellery collection of Archduke Ferdinand II, now on display in the Collection of Sculpture and Decorative Arts (Kunstkammer) of the Kunsthistorisches Museum Vienna, is very unique in many ways. First of all, it is a rare example of a bigger collection of early modern lampworked glass. Secondly, although it was produced at the glasshouse of the Innsbruck ducal court, operating between 1570 and 1591, Venetian glassblowers were engaged for limited periods, bringing with them the whole material needed for the production of these outstanding fragile works of art. Considering the conservation state 32 objects could be analysed with the aim of achieving semi-quantitative results for description and comparison of the glass materials used.

Method and problem statement

In the course of the examination of this collection X-ray fluorescence (XRF) analysis, using the self-constructed PART II (Portable Art Research) system, was performed. This method was chosen because of its non-destructiveness and the non-portability of the objects. Nevertheless, analysing glass using XRF has to cope with some general problems:

- Absorption of the radiation of light elements (especially Na) in air - although the air path is only about 1 mm using the PART II
- Corrosion of glass-surfaces, leading to a depletion of Na (visible on several items of the collection, especially some hues of blue)

Regarding the glass jewellery collection there were additional problems:

- Extremly varying thicknesses of the glass parts
- Complex shapes of the objects, complicating the access for analysis

Comparative measurements on fragments not assignable to specific items could be carried out using SEM/EDX* (energy dispersive microanalysis in a scanning electron microscope).

Approaches

For the evaluation of the XRF data two software packages were available:

- XRF-PE of Amptek: It showed difficulties when Ca was evaluated in the presence of Sr, leading to an extreme overestimation of Ca. As the opacifier in all opaque glasses is PbO and SnO2 this program was not suitable for the analysis of the glass jewellery items.

- WinAxil of Canberra: Here all components could be evaluated semi-quantitatively by using “Compare Mode”.

The measurements could not be done in the form of oxides – the conversion has to be done in an additional step using Excel, complicated by the output format of the program (both % and ppm is used).

Method: choice of:

- Evaluation showed that, although surfaces without visible corrosion were chosen, a depletion of Na was present.
- For thin glasses the sum of analysed elements was much less than 100 %.

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Conclusions

Quantitative analysis of items like the glass jewellery collection of Archduke Ferdinand II is not possible using portable XRF in situ. Nevertheless, to be able to compare the different glass parts and colours a semi-quantitative approach was successfully applied. Glass types could be identified with a higher certainty than with earlier approaches** and specific characteristics of different glass types specified.

Further studies of the results may lead to characteristic groupings of the items, according to the craftsmen creating them.

Results

The examples shown will focus on colourless and blue glass. Blue glass existed in several different hues. Three of them could be investigated using SEM/EDX and XRF.

SEM/EDX

The elaborated method could be tested on the SEM/EDX results of real samples and proved to provide valuable information concerning glass type, colouring elements and comparison of the samples.

XRF

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References


* SEM/EDX measurements were performed at:
- LAMMA, Università IISI di Venezia, Italy, with a Philips XL30 instrument equipped with an EDAX, XL30 X-ray microanalyser and EPMA with a microprobe Cameca SX-50 equipped with three wavelength-dispersive spectrometers and PET, LiF, and TAP crystals.

** Literature: