

## Standardless Analysis of Gold Alloys by X-Ray Fluorescence

### Introduction

The traditional methods determining Gold in precious metal alloys, preferably jewellery alloys, are carried out by the Touchstone test or by the Cupellation. But these methods are destructive and time consuming. Therefore since many years the X-ray Fluorescence Spectrometry has been introduced to solve this problem.

In absence of certified reference samples the no standard analysis based on fundamental parameter model is the power means for sufficiently precise determination of alloy composition and concentrations of Au or Ag.

**Alloy system Au-Ag-Cu-Zn-Pd-Ni**

### The analytical instrument

The instrument *Xray ComPact 5/PIN* offered by Röntgenanalytik Messtechnik GmbH has been especially developed for the analysis of jewellery alloys made of gold, silver or platinum.

A low power tube is used in either instrument in excitation mode. A special collimator reduces the exciting beam down to 0.6 mm in diameter. In this way a local analysis of several parts of the jewellery object and its filigree zones with irregular geometry, as usual for jewellery manufacturing, can be achieved.

Energy dispersive measurement is made with a PIN-diode. Thanks to the high resolution of this type of detector, the small amount of elements in complex composition can be determined. Good statistical measurement guarantees high reproducibility.

The following figure 1 shows a typical spectrum of AuAgCuCd alloy.

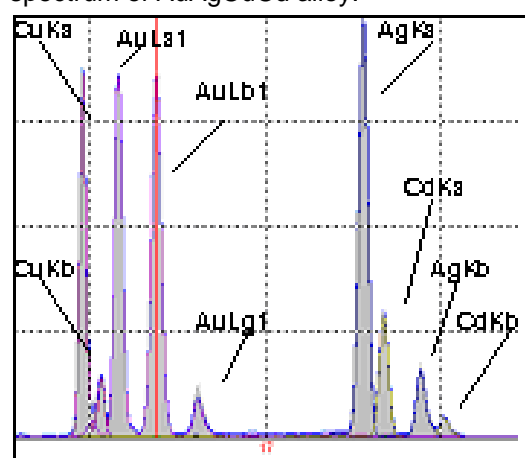


Figure 1: spectrum of AuAgCuCd alloy

### Sample preparation

The surface of the samples should be thoroughly cleaned free of contaminants. This will enable the irradiated area to be representative of the whole.

Further preparation is not necessary as the very small excited area and the use of normalized intensities reduce the geometric influence of the signal.

### Excitation conditions

Tube	W-Microfocus-glass-window
Voltage	40 kV
Power	approx. 30 W
Collimator	0.4 mm in diameter
Measuring time for analysis	60-120 s

### Program Parameters

Program	XMaster Vers. 2.0.2.3
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### Analytical Features

#### Limits of detection

Traces in alloys higher than 0.1% can be analysed. In most cases this sensitivity is more than sufficient for jewellery analysis.

# Application Note

# XRF Application

## Accuracy of analysis

The accuracy of the X-ray spectrometric determination of Gold and Silver shall be validated by certified standards of jewellery

alloy samples. The following table enables to compare X-ray measured values with these of Gold and Silver standards.

Goldalloy	Au		Ag		Cu		Zn		Ni	
	given	is	given	is	given	is	given	is	given	is
Au4	37.06	38.53	20.00	21.54	10.53	9.36			32.43	30.57
Au9	57.81	58.70			15.31	14.24	9.74	10.18	16.87	16.89
Au10	74.83	76.55			9.64	8.72	2.60	2.46	12.89	12.27
Au13	91.67	93.16	2.76	2.33	5.28	4.44				
Au15	98.60	98.50			1.40	1.46				
Au16	99.99	100.0								

## Reproducibility

For determination of reproducibility repeated measurements with a measuring time of 60 s have been realised within 25 min on a coin with 22 carat gold. The following table present the measurement results, the figure 2 shows the corresponding spectrum.



Reproducibility of measurement  
Concentration in [%]

No of meas.	Au	Ag	Cu
1	915.4	1.3	83.3
2	916.1	1.1	82.8
3	915.0	1.5	83.5
4	914.0	1.3	84.6
5	915.1	1.4	83.5
6	915.4	1.3	83.3
7	914.4	1.7	83.9
8	915.8	1.4	82.8
9	914.4	1.9	83.7
10	915.3	1.3	83.4
Mean	915.1	1.4	83.5
SD [%]	0.63	0.22	0.52

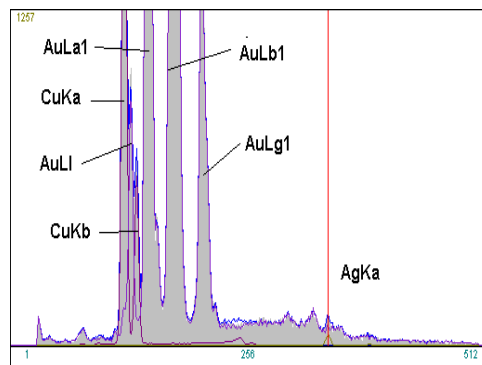


Figure 2: spectrum of the 22 carat gold coin

These results are showing the performance of the spectrometer delivering sufficiently accurate values of Gold.

## Conclusion

The analytical results demonstrate that the standardless X-Ray fluorescence analysis is a most important alternative method for the analysis of jewellery alloys. The X-ray spectrometer **Compact 5/PIN** allows the determination of Gold in jewellery alloys with high accuracy and high precision. Other present precious and non-precious metals can be determined as well. Also other technical alloys can be analysed such as Cu-alloys (brass, bronze), thermo couple materials and steel. Analytical performance is comparable to that for jewellery alloys. The elemental range is limited for elements with  $Z > 17$ .

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