

Analysis of Traces in Pure Copper

ARL ADVANT'X Series with IntelliPower™
Sequential X-Ray Fluorescence Spectrometers

Introduction



The Thermo Scientific ARL ADVANT'X sequential XRF spectrometer has been used to analyze various trace elements in pure copper samples. Analysis of trace elements in pure metals demands high sensitivity and accuracy of measurement. In

addition, the range of elements and their concentrations require flexible and versatile analytical conditions. In particular, light elements like oxygen in pure copper demand significant improvements in instrumentation. The ARL ADVANT'X has an optimized geometry and analytical configuration and offers high sensitivity, flexibility and ease of operation through the state-of-the-art OXSAS software under Windows® XP Professional.

Results

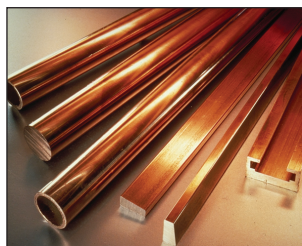


Figure 1 shows a qualitative scan on a copper sample containing oxygen. Quantitative analysis is performed on all the elements of interest using appropriate and optimum analytical conditions.

Figure 2 shows an example of a calibration curve on oxygen. Figure 3 shows the regression curve obtained for Rh in pure copper. Usage of primary beam filters improves the limit of detection for some elements although the sensitivity is reduced. All the results are summarized in Table 1. Precision data on sample A and sample B are given in Tables 2 and 3.

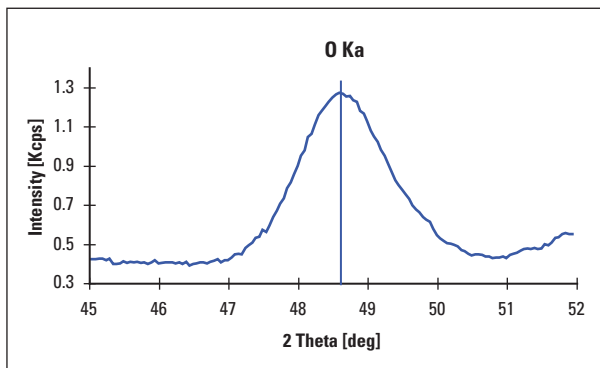


Figure 1: Scan on oxygen peak in pure copper sample

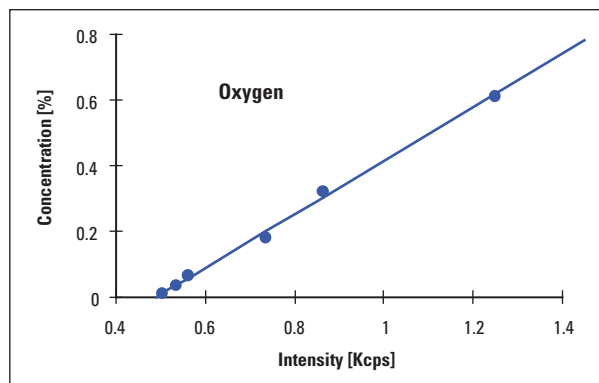


Figure 2: Calibration curve of oxygen in pure copper (3600 W)

ELEMENT	LINE	FILTER	TYPICAL LoD (PPM) INTELLIPOWER™			
			1200 W	2500 W	3600 W	4200 W
Sn	Kα	no	8.8	6.1	5.1	4.7
Zn	Kα	no	4.2	2.9	2.4	2.2
Pb	Lβ	yes	5.2	3.6	3	2.8
Fe	Kα	no	1.7	1.2	1	0.9
Ni	Kα	no	2.3	1.6	1.3	1.2
P	Kα	no	7.3	5.0	4.2	3.9
S	Kα	no	0.9	0.6	0.5	0.5
Bi	Lα	yes	4.7	3.2	2.7	2.5
Co	Kα	no	1.2	0.8	0.7	0.6
Sb	Kα	no	10.7	7.4	6.2	5.7
As	Kβ	no	12.5	8.6	7.2	6.7
Ag	Lα	no	9.7	6.7	5.6	5.2
Se	Kα	no	2.3	1.6	1.3	1.2
Rh	Kα	yes	8.7	6.0	5	4.6
Cd	Kα	yes	11.1	7.7	6.4	5.9
Cr	Kα	no	1.9	1.3	1.1	1.0
Mn	Kα	no	1.6	1.1	0.9	0.8
O	Kα	no	69.3	48.0	40	37.0

Table 1: Analytical results for 100 s counting time

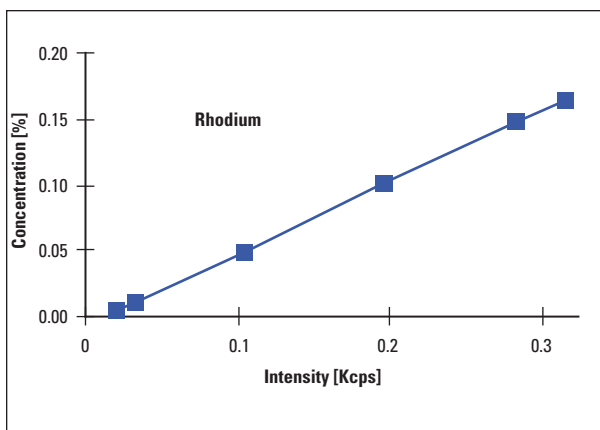


Figure 3: Calibration curve of rhodium in pure copper using a primary beam filter (3600 W)

Conclusion

From the results shown above, it can be concluded that trace and light elements in pure copper can be quite effectively measured using the ARL ADVANT'X IntelliPower™ Series XRF spectrometer. Even the analysis of low levels of Rh is feasible despite our Rh target X-ray tube by effective use of a primary beam filter (PBF).

In addition to these offices, Thermo Fisher Scientific maintains a network of representative organizations throughout the world.

ELEMENT	LINE	FILTER	SAMPLE A CONCENTRATION [PPM]	PRECISION 1 SIGMA [PPM]			
				1200 W	2500 W	3600 W	4200 W
Sn	K α	no	180	4.5	3.1	2.6	2.4
Zn	K α	no	210	3.1	2.2	1.8	1.7
Pb	L β	yes	220	4.2	2.9	2.4	2.2
Fe	K α	no	200	1.4	1.0	0.8	0.7
Ni	K α	no	180	3.3	2.3	1.9	1.8
P	K α	no	150	2.9	2.0	1.7	1.6
S	K α	no	200	2.1	1.4	1.2	1.1
Bi	L α	yes	180	2.1	1.4	1.2	1.1
Co	K α	no	150	1.0	0.7	0.6	0.6
Sb	K α	no	100	3.8	2.6	2.2	2.0
As	K β	no	190	4.8	3.4	2.8	2.6
Ag	L α	no	210	5.2	3.6	3.0	2.8
Se	K α	no	40	1.4	1.0	0.8	0.7
Rh	K α	yes	200	6.6	4.6	3.8	3.5
Cd	K α	yes	150	5.2	3.6	3.0	2.8
Cr	K α	no	270	1.4	1.0	0.8	0.7
Mn	K α	no	200	1.0	0.7	0.6	0.6
O	K α	no	4000	60.6	42.0	35.0	32.4

Table 2: Precision data on sample A for trace elements

ELEMENT	LINE	FILTER	SAMPLE B CONCENTRATION [PPM]	PRECISION 1 SIGMA [PPM]			
				1200 W	2500 W	3600 W	4200 W
Zn	K α	no	7	1.6	1.1	0.9	0.8
Pb	L β	yes	8	1.4	1.0	0.8	0.7
Fe	K α	no	50	0.9	0.6	0.5	0.5
Ni	K α	no	90	1.4	1.0	0.8	0.7
Bi	L α	yes	7	1.0	0.7	0.6	0.6
Co	K α	no	11	0.3	0.2	0.2	0.2
As	K β	no	80	5.2	3.6	3.0	2.8
Cd	K α	yes	150	5.2	3.6	3.0	2.8
Cr	K α	no	270	1.4	1.0	0.8	0.7
Mn	K α	no	200	1.0	0.7	0.6	0.6

Table 3: Precision data on sample B for trace elements

Australia
+61 2 8844 9500

Austria
+43 1 333 50340

Belgium
+32 2 482 30 30

Canada
+1 800 532 4752

China
+86 10 5850 3588

Denmark
+45 70 23 62 60

France
+33 1 60 92 48 00

Germany
+49 6103 408 1014

India
+91 22 6742 9434

Italy
+39 02 950 591

Japan
+81 45 453 9100

Latin America
+1 608 276 5659

Netherlands
+31 76 587 98 88

South Africa
+27 11 570 1840

Spain
+34 91 657 4930

**Sweden/Norway/
Finland**
+46 8 556 468 00

Switzerland
+41 21 694 71 11

UK
+44 1442 233555

USA
+1 800 532 4752

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