European Commission

European Reference Materials

JOINT RESEARCH CENTRE
Institute for Reference Materials and Measurements

CERTIFICATE OF ANALYSIS

ERM®- AE647

Cu in 1 M subboiled nitric acid			
		Certified value [1]	Uncertainty [2]
amount content	mol (^{63}Cu) · g^{-1} (solution)	1.349 74 · 10^{-4}	0.000 73 · 10^{-4}
amount ratio	$n(^{65}Cu)/n(^{63}Cu)$	0.445 60	0.000 74

1) The values reported in this certificate result from measurements performed at IRMM. The isotope amount content value is traceable to the SI via the values of the BAM A-primary material, the value of the isotope amount ratio is traceable to SI via the values of the Cu isotope ratio of the isotopic reference material NIST SRM 976.

2) Estimated expanded uncertainty U with a coverage factor k=2, corresponding to a level of confidence of about 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement (GUM), ISO, 1995.

This certificate is valid for three years after purchase.

Sales date:

The material can be regarded as a homogenous solution.

Accepted as an ERM®, Geel, June 2004,
Latest revision: November 2013

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NOTE

European Reference Material ERM®-AE647 was originally certified as IRMM-647. It was produced and certified under the responsibility of the IRMM according to the principles laid down in the technical guidelines of the European Reference Materials® co-operation agreement between BAM-IRMM-LGC. Information on these guidelines is available on the Internet (http://www.erm-crm.org). A detailed technical report on the certification procedure can be found in IRMM Internal Report GE/R/IM/41/00, available from IRMM on explicit request.

DESCRIPTION OF THE SAMPLE

The Spike Isotopic Reference Material ERM®-AE647 is supplied with a certified isotope amount content of ^{63}Cu and certified amount ratios of Cu. The samples are supplied in flame-sealed glass ampoules containing about 0.78 mmol of copper in 4 mL of nitric acid solution.

From the certified values, the following amount and mass contents, the isotopic composition of Cu and the molar mass Cu in this Reference Material are derived:

		Certified value	Uncertainty [1]
amount content	mol (Cu) · g^{-1} (solution)	$1.951\,18 \cdot 10^{-4}$	$0.000\,26 \cdot 10^{-4}$
mass content	g (^{63}Cu) · g^{-1} (solution)	$8.493\,8 \cdot 10^{-3}$	$0.004\,6 \cdot 10^{-3}$
	g (Cu) · g^{-1} (solution)	$1.239\,89 \cdot 10^{-2}$	$0.000\,16 \cdot 10^{-2}$
isotope amount fractions of Cu (·100)	$n(^{63}Cu)/n(Cu)$ $n(^{65}Cu)/n(Cu)$	69.175 30.825	0.036 0.036
isotope mass fractions of Cu (·100)	$m(^{63}Cu)/m(Cu)$ $m(^{65}Cu)/m(Cu)$	68.505 31.495	0.036 0.036
molar mass Cu in this sample		63.545 54 g·mol^{-1}	0.000 71

[1] Estimated expanded uncertainty U with a coverage factor k=2, corresponding to a level of confidence of about 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement (GUM), ISO, 1995

Atomic masses used for calculation of the derived values:[*]

[*] G. Audi and A.H. Wapstra, The 1993 atomic mass evaluation, *Nucl Phys* A565 (1993) 1-65.

Isotope	g · mol^{-1}	*U* (*k*=2)
^{63}Cu	62.929 600 7	0.000 003 0
^{65}Cu	64.927 793 8	0.000 003 8

ANALYTICAL METHOD USED FOR CERTIFICATION

The copper mass fraction and the isotopic composition were determined by gravimetrical preparation

PARTICIPANTS

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SAFETY INFORMATION

The usual laboratory safety measures apply.

INSTRUCTIONS FOR USE

Using this spike isotopic reference material, the copper content in an unknown sample can be determined by Species-Specific Isotope Dilution, through a measurement of the isotope amount ratio $R(B)$ = $n(^{63}Cu)/n(^{65}Cu)$ in a blend. It should be calculated with the aid of the following equation, which enables an easy quantification of the uncertainty sources in the procedure:

$$c(Cu,X) = \frac{R(Y)-R(B)}{R(B)-R(X)} \cdot \frac{\sum R_i(X)}{\sum R_i(Y)} \cdot \frac{m(Y)}{m(X)} \cdot c(Cu,Y)$$

where:

$R(X)$	=	amount ratio $n(^{63}Cu)/n(^{65}Cu)$ in the unknown sample material X
$R(Y)$	=	amount ratio $n(^{63}Cu)/n(^{65}Cu)$ in the spike material Y
$\sum R_i(X)$	=	sum of all amount ratios in the unknown sample material X
$\sum R_i(Y)$	=	sum of all amount ratios in the spike material Y
$m(X)$	=	mass of unknown sample used in the measurement
$m(Y)$	=	mass of the sample of spike solution used in the measurement
$c(Cu,X)$	=	amount content of Cu $\cdot$ g^{-1} sample material
$c(Cu,Y)$	=	amount content of Cu $\cdot$ g^{-1} spike solution

STORAGE

The material can be stored at 18 °C in the dark.

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