

Bundesanstalt für Materialforschung und -prüfung (BAM)

in cooperation with the Committee of Chemists of the GDMB
Gesellschaft der Metallurgen und Bergleute e.V.

Certified Reference Material

BAM-M397

CuSn4Zn2PS

Certified Values

Element	Mass fraction ¹⁾ in %	Uncertainty ²⁾ in %
Zn	1.96	0.05
Pb	0.229	0.008
Sn	3.99	0.08
Ni	0.336	0.006
Sb	0.097	0.004
S	0.459	0.029

¹⁾ Unweighted mean value of the means of accepted sets of data (consisting of at least 5 but usually 6 single results), each set being obtained by a different laboratory and/or a different method of measurement.

²⁾ Estimated expanded uncertainty U with a coverage factor of $k = 2$, corresponding to a level of confidence of approx. 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement, (GUM, ISO/IEC Guide 98-3:2008).

This certificate is valid until 08/2049.

Values for information

Element	Mass fraction ¹⁾ in mg/kg	Uncertainty ²⁾ in mg/kg
As	2.9	0.3
Se	< 1	---
Te	< 1	---

¹⁾ Unweighted mean value of the means of accepted sets of data (consisting of at least 5 but usually 6 single results), each set being obtained by a different laboratory and/or a different method of measurement. Value was not certified, but given for information, because the uncertainty from the inter-laboratory certification was too large and the number of datasets too low.

²⁾ Estimated expanded uncertainty U with a coverage factor of $k = 2$, corresponding to a level of confidence of approx. 95 %, as defined in the Guide to the Expression of Uncertainty in Measurement, (GUM, ISO/IEC Guide 98-3:2008).

Sample description

The Reference Material is available in the form of discs (approx. 40 mm diameter and 30 mm height).

Recommended Use

The reference material is intended for establishing or checking the calibration of spark optical emission and X-ray spectrometers for the analysis of samples of similar matrix composition. The minimum sample size for wet chemical analysis is 0.2 g.

Instructions for Use

Before use, the surface of the material must be prepared by milling or turning on a lathe. For wet chemical analysis chips have to be prepared by turning or milling of the sample surface.

Transport and Storage

The material has to be stored in a dry and clean environment at room temperature. Transport has to be done under normal ambient conditions.

Means of Accepted Data Sets

Certified values
mass fraction in %

values for information
mass fraction in mg/kg

Line-No.	Zn	Pb	Sn	Ni	Sb	S		As	Te	Se
1	1.89	---	3.85	0.322	0.089	---		2.67	< 0.10	0.32
2	1.91	---	3.90	0.324	0.089	0.408		2.72	0.10	0.38
3	1.92	0.217	3.91	0.330	0.095	0.415		3.02	< 1	< 1
4	1.93	0.222	3.96	0.333	0.096	0.453		3.06	< 10	< 10
5	1.94	0.224	3.96	0.334	0.097	0.465		< 10		
6	1.96	0.225	4.01	0.336	0.097	0.483				
7	1.98	0.230	4.07	0.338	0.097	0.491				
8	1.98	0.230	4.07	0.341	0.099	0.500				
9	1.98	0.235	4.14	0.343	0.100					
10	2.03	0.236		0.344	0.101					
11	2.04	0.240		0.347	0.103					
12					0.103					
<i>M</i>	1.96	0.229	3.99	0.336	0.097	0.459		2.87	< 1	< 1
<i>s_M</i>	0.05	0.008	0.10	0.009	0.005	0.037		0.20		
<i>s_i</i>	0.03	0.005	0.04	0.003	0.002	0.009		0.29		

The laboratory mean values have been examined statistically to eliminate outlying values. Where a " --- " appears in the table it indicates that an outlying value has been omitted (Grubbs 95 %). A data set consists of at least 5 but usually 6 single values of one laboratory.

M : mean of laboratory means

s_M : standard deviation of laboratory means

s_i : averaged repeatability standard deviation (square root of the mean of laboratory variances)

Analytical Method used for Certification

Element	Line Number	Method
Zn	1	ICP-OES, dissolution with HCl/HNO ₃ /H ₃ BO ₃ /HF
	2, 3, 8, 9, 10	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	4	ICP-OES, dissolution with HCl/H ₂ O ₂
	5	ICP-OES, dissolution with HNO ₃ /HF
	6	ICP-OES, dissolution with HNO ₃ /HCl (3:1)
	7	FAAS, dissolution with HCl/HNO ₃ (2:1)
	11	ICP-OES, dissolution with HNO ₃ /HF/HCl
Pb	3, 9, 11	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	4	ICP-OES, dissolution with HNO ₃ /HCl (3:1)
	5	ICP-OES, dissolution with HNO ₃ /HF/HCl
	6	ICP-OES, dissolution with HCl/H ₂ O ₂
	7	ICP-OES, dissolution with HCl/HNO ₃ /H ₃ BO ₃ /HF
	8	FAAS, dissolution with HCl/HNO ₃ (2:1)
	10	ICP-OES, dissolution with HNO ₃ /HF
Sn	1, 2, 4, 6, 7	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	3	ICP-OES, dissolution with HNO ₃ /HF
	5	ICP-OES, dissolution with HCl/HNO ₃ /H ₃ BO ₃ /HF
	8	ICP-OES, dissolution with HCl/H ₂ O ₂
	9	ICP-OES, dissolution with HNO ₃ /HF/HCl
Ni	1	ICP-OES, dissolution with HCl/HNO ₃ /H ₃ BO ₃ /HF
	2, 4, 9, 10, 11	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	3	ICP-OES, dissolution with HNO ₃ /HF
	5	ICP-OES, dissolution with HNO ₃ /HCl (3:1)
	6	ICP-OES, dissolution with HNO ₃ /HF/HCl
	7	FAAS, dissolution with HCl/HNO ₃ (2:1)
	8	ICP-OES, dissolution with HCl/H ₂ O ₂
Sb	1	ICP-OES, dissolution with HNO ₃ /HCl (3:1)
	2, 4, 8, 9, 12	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	3	ICP-OES, dissolution with HNO ₃ /HF
	5	Spectrophotometry, dissolution with HCl/H ₂ O ₂
	6	ICP-OES, dissolution with HCl/HNO ₃ /H ₃ BO ₃ /HF
	7	ICP-MS, dissolution with HCl/HNO ₃ (3:1)
	10	ICP-OES, dissolution with HNO ₃ /HF/HCl
S	11	ICP-OES, dissolution with HCl/H ₂ O ₂
	2, 8	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	3	Titration after combustion
	4	ICP-OES, dissolution with HNO ₃ /HF/HCl
	5	ICP-OES, dissolution with HCl/HNO ₃ /H ₃ BO ₃ /HF
	6	ICP-OES, dissolution with HNO ₃ /HCl (3:1)
	7	Combustion, infrared-absorption
As	1	GD-MS
	2, 5	ICP-OES, dissolution with HCl/HNO ₃ (3:1)
	3	ICP-OES, dissolution with HNO ₃ /HCl (3:1)
	4	ETAAS, dissolution with HNO ₃

Element	Line Number	Method
<i>Te</i>	1	<i>GD-MS</i>
	2, 4	<i>ICP-OES, dissolution with HCl/HNO₃ (3:1)</i>
	3	<i>ETAAS, dissolution with HNO₃</i>
<i>Se</i>	1	<i>GD-MS</i>
	2, 4	<i>ICP-OES, dissolution with HCl/HNO₃ (3:1)</i>
	3	<i>ETAAS, dissolution with HNO₃</i>

Abbreviations: ETAAS – Electrothermal atomic absorption spectrometry
FAAS – Flame atomic absorption spectrometry
ICP-OES – Inductively coupled plasma – optical emission spectrometry
ICP-MS – Inductively coupled plasma – mass spectrometry
GD-MS – Glow discharge mass spectrometry

Metrological Traceability

The values are traceable to the SI (Système International d'Unités) via calibration using pure metals or substances of known stoichiometry or carefully checked standard solutions.

Participating Laboratories

Allgemeine Gold- und Silberscheideanstalt AG, Pforzheim, Germany
Aurubis AG, Hamburg, Germany
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
Diehl Metall Stiftung & Co KG, Röthenbach, Germany
Institut für Materialprüfung Glörfeld GmbH, Willich, Germany
KME Germany GmbH & Co. KG, Osnabrück, Germany
Montanwerke Brixlegg AG, Brixlegg, Austria
RIO GmbH, Siegen, Germany
VDM-Metals GmbH, Werdohl, Germany
Wieland-Werke AG, Vöhringen, Germany

Technical Report

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify BAM-M397 is available on request or can be downloaded from BAM website (www.bam.de).

Accepted as BAM-CRM on

Bundesanstalt für Materialforschung und -prüfung (BAM)



Dr. S. Richter
Committee for Certification

Dr. S. Recknagel
Project Coordinator

BAM holds an accreditation as a reference material producer according to ISO 17034. This accreditation is valid only for the scope as specified in the certificate D-RM-11075-01-00.

DAkkS is a signatory of the multilateral agreement (MLA) between EA, ILAC and IAF for mutual acceptance.



Deutsche
Akkreditierungsstelle
D-RM-11075-01-00

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