IRMM

Institute for Reference Materials and Measurements

CERTIFICATE
SPIKE ISOTOPIC REFERENCE MATERIAL IRMM-611

4.025(40) · 10^{-6} mol (^{11}B) · g^{-1} (solution)

The Spike Isotopic Reference Material is supplied with an isotope amount content of ^{11}B certified as above.

The amount of other boron isotopes present are related to the ^{11}B content through the following certified amount ratio**:**

$n(^{10}B)/n(^{11}B)$:	**0.247 26(32)**

This corresponds to an isotopic composition with the following abundances **:**

amount fraction (·100)		mass fraction (·100)	
$n(^{10}B)/n(B)$	19.824(21)	$m(^{10}B)/m(B)$	18.360(19)
$n(^{11}B)/n(B)$	80.176(21)	$m(^{11}B)/m(B)$	81.640(19)

The molar mass of the boron in this sample is 10.811 78(20) $g \cdot mol^{-1}$

From the certified values, the following amount and mass contents are derived:

5.020(50) ·10^{-6}	mol (B) · g^{-1} (solution)
5.428(54) · 10^{-5}	g (B) · g^{-1} (solution)
4.431(44) · 10^{-5}	g (^{11}B) · g^{-1} (solution)

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NOTES

1. All uncertainties indicated are expanded uncertainties $U = k \cdot u_c$ where u_c is the combined standard uncertainty estimated following the ISO/BIPM Guide to the Expression of Uncertainty in Measurement. They are given in parentheses and include a coverage factor k=2. They apply to the last two digits of the value. The values certified are traceable to the SI.

2. IRMM-611 consists of flame-sealed quartz glass ampoules containing about 5 mL of a chemically stable solution of boric acid (H_3BO_3) in sub-boiled water.

3. The atomic masses, used in the calculations, are[1]

^{10}B : 10.012 937 1(6) g·mol^{-1}
^{11}B : 11.009 305 5(8) g·mol^{-1}

4. Using this Spike Isotopic Reference Material, the ^{10}B and B content in an unknown sample can be determined by Isotope Dilution, through a measurement of the isotope amount ratio $R(B) = n(^{10}B)/n(^{11}B)$ in a blend. It should be computed with the aid of the following equation which enables an easy quantification of the uncertainty sources in the procedure:

$$c\left(^{10}B,X\right)=\frac{R_Y-R_B}{R_B-R_X}\cdot R_X\cdot\frac{m_Y}{m_X}\cdot c\left(^{11}B,Y\right)$$

$$c\left(B,X\right)=\frac{R_Y-R_B}{R_B-R_X}\cdot\frac{1+R_X}{1+R_Y}\cdot\frac{m_Y}{m_X}\cdot c\left(B,Y\right)$$

where:

$R(X)$	=	amount ratio $n(^{10}B)/n(^{11}B)$ in the unknown sample material X
$R(Y)$	=	amount ratio $n(^{10}B)/n(^{11}B)$ in the spike material Y
$c\left(^{10}B,X\right)$	=	amount content of $^{10}B \cdot kg^{-1}$ sample material
$c\left(^{11}B,Y\right)$	=	amount content of $^{11}B \cdot kg^{-1}$ spike solution
$m(X)$	=	mass of the unknown sample used in the measurement
$m(Y)$	=	mass of the sample of spike solution used in the measurement
$c\left(B,X\right)$	=	amount content of $B \cdot kg^{-1}$ sample material
$c\left(B,Y\right)$	=	amount content of $B \cdot kg^{-1}$ spike solution.

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

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5. The values of this Spike Isotopic Reference Material are traceable to the SI in the shortest possible way. Measurements calibrated against these Isotopic Reference Materials have therefore the potential of being traceable to the SI.

The isotopic measurements by Thermal Ionisation Mass Spectrometry were carried out by V Holland.

Metrological aspects involved in the preparation and certification were performed by F Hendrickx. The ampoulation of this Isotopic Reference Material (Spike) was accomplished by A Verbruggen and A Alonso-Muñoz.

The purity of H_3BO_3 was determined by Spark Source Mass Spectrometry by W Lycke.

The co-ordination of the preparation of this Isotopic Reference Material (Spike) was accomplished by A Verbruggen.

The overall co-ordination of the establishment leading to the certification and issuance of this Isotopic Reference Material (Spike) was performed by A Lamberty.

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Revised July 1993
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IRMM Isotope Measurements