IRMM

Institute for Reference Materials and Measurements

CERTIFICATE
SPIKE ISOTOPIC REFERENCE MATERIAL IRMM-615

3.850(14) · 10^{-6} mol (^{6}Li) · g^{-1} (solution)

The Spike Isotopic Reference Material is supplied with an isotope amount content of ^{6}Li certified as above.

The amount of other lithium isotopes present are related to the ^{6}Li content through the following certified amount ratios:

$n(^{6}Li)/n(^{7}Li)$: 21.897(44)

This corresponds to an isotopic composition of lithium with the following abundances:

	amount fraction (·100)		mass fraction (·100)
$n(^{6}Li)/n(Li)$	95.632 6(84)	$m(^{6}Li)/m(Li)$	94.942 6(96)
$n(^{7}Li)/n(Li)$	4.367 4(84)	$m(^{7}Li)/m(Li)$	5.057 4(96)

The molar mass of Li in this sample is 6.058 835(84) g·mol^{-1}

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

2.316 0(83) · 10^{-5}	g (^{6}Li) · g^{-1} (solution)
2.439 4(87) · 10^{-5}	g (Li) · g^{-1} (solution)
4.026(14) · 10^{-6}	mol (Li) · g^{-1} (solution)

B-2440 GEEL (Belgium)
Tel.: +32-(0)14-571 608 • Fax: +32-(0)14-571 863

11/2005

NOTES

1. This Spike Isotopic Reference Material is traceable to the SI in the shortest possible way. The values of the isotope amount ratios were measured at IRMM and are traceable to the SI via the values of the isotope amount ratios of the Isotopic Reference Materials IRMM-016[1]. Measurements calibrated by this Isotopic Reference Material have therefore the potential of being traceable to the SI.

2. 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.

3. The Spike Isotopic Reference Material IRMM-615 comes in a flame-sealed quartz ampoule containing 20 µmol lithium in 5 mL of chemically stable solution of lithium carbonate (Li_2CO_3) in hydrochloric acid. The molarity is about 0.5 M HCl.

4. The atomic masses, used in the calculations, are:[2]

^{6}Li :	6.015 122 3(5)
^{7}Li :	7.016 004 1(5)

5. Using this Spike Isotopic Reference Material, the lithium content in an unknown sample with a non-natural isotopic composition can be determined by Isotope Dilution, through a measurement of the lithium isotope amount ratio $R(B) = n(^6\text{Li})/n(^7\text{Li})$ 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:

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

where:

$R(X)$	=	amount ratio $n(^6\text{Li})/n(^7\text{Li})$ in the unknown sample material X
$R(Y)$	=	amount ratio $n(^6\text{Li})/n(^7\text{Li})$ 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
$c(Li,X)$	=	amount content of Li · g^{-1} sample material
$c(Li,Y)$	=	amount content of Li · g^{-1} spike solution.

[1] S. Duta, M. Berglund, P. Taylor, Re-evaluation of the certified isotope amount ratio of IRMM-016 and re-certification of the isotope amount ratio of IRMM-015, Report EUR 21655 EN
[2] G. Audi and A.H. Wapstra, The 1993 atomic mass evaluation, Nucl Phys A565 (1993) 1-65.

6. Full details on the re-certification procedure can be found in Report EUR 21656 EN.[3]

The isotopic measurements of the re-certification by isotope dilution thermal ionization mass spectrometry were performed by S Duta.

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

The overall co-ordination leading to the establishment, re-certification and issuance of this Isotopic Reference Material was performed by M Berglund. A Verbruggen was responsible for the preparation and issuance of the certificate.

B-2440 GEEL
April 1991
Revised July 1993
Revised December1996
Revised November 2005

Dr P Taylor
Head
IRMM Isotope Measurements

[3] S. Duta, M. Berglund, P. Taylor, Re-certification of the isotopic reference material (spike) IRMM-615, Report EUR 21656 EN