

National Certified Reference Material (NCRM)

Code: GBW04506

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## Reference Material Certificate

Enriched  $^{100}\text{Mo}$  Isotopic Reference Solution



Batch Number: 201901

Certification Date: Dec. 2018

Period of Validity: Dec. 2023



Reference Material Producer: National Institute of Metrology

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Version: 1.0



This CRM is intended for the calibration of instruments, and evaluation of analysis methods for the determination of isotope ratios of molybdenum, which is widely used in geochemistry, geological, environmental, and biology researches.

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## 1. Sample Preparation

The material used to prepare this CRM is enriched  $^{100}\text{Mo}$  material with high purity (99.99%). After the material was weighed with balance, it was dissolved with high purity ammonia and diluted to 100 mg/kg by 2% nitric acid. Finally, the CRM solution was sealed in 5 mL ampoule bottles.

## 2. Traceability and Characterization Methods

The Mo isotope ratios in this CRM were analyzed and certified by means of calibrated mass spectrometry. The collision cell MC-ICP-MS in NIM was used to determine Mo isotope ratios in this CRM. The correction solutions were gravimetrically prepared with enriched  $^{92}\text{Mo}$ 、 $^{94}\text{Mo}$ 、 $^{95}\text{Mo}$ 、 $^{96}\text{Mo}$ 、 $^{97}\text{Mo}$ 、 $^{98}\text{Mo}$  and  $^{100}\text{Mo}$  isotopic materials, whose purities and isotopic compositions had been accurately measured. By using these calibration solutions, the correction factors for mass bias were obtained, and then the CRM sample was analyzed by the calibrated mass spectrometer.

The traceability of the certified values is guaranteed by using the primary measurement method – calibrated mass spectrometry. Through the utilize of the enriched isotopic materials with accurate purities and isotopic compositions, and the calibrated balance for gravimetrically preparing calibration solutions, the certified values of this CRM are traceable to SI unit kg and mole.

## 3. Property Values and Uncertainties

The uncertainty evaluation considered sources from characterization, between-unit homogeneity and stability. The measurement uncertainty of the certified values of this CRM included uncertainty of purity analysis of each isotopically enriched material, random errors and potential systematic errors in weighing operations, measurement precisions of isotope ratios of isotopically enriched materials, natural sample and calibration mixtures. The certified values and expanded uncertainties of molybdenum isotope ratios are as follows. The coverage factors were chosen to obtain an approximate 95% level of confidence.

$^{92}\text{Mo}/^{100}\text{Mo}$	$^{94}\text{Mo}/^{100}\text{Mo}$	$^{95}\text{Mo}/^{100}\text{Mo}$	$^{96}\text{Mo}/^{100}\text{Mo}$	$^{97}\text{Mo}/^{100}\text{Mo}$	$^{98}\text{Mo}/^{100}\text{Mo}$
0.0003220±0.0000024	0.0002175±0.0000012	0.0003906±0.0000007	0.0004801±0.0000010	0.0004020±0.0000018	0.004586±0.000005

## 4. Homogeneity and Stability Assessment

According to national technical specification of JJF1343 (equivalent to ISO Guide 35), the CRM homogeneity was assessed based on the results from randomly selected bottles by using the collision cell MC-ICP-MS. According to the homogeneity test results, no statistically significant heterogeneity was found based on the variance analysis method.

The evaluation of the CRM stability has been performed based on the determination of molybdenum isotopic ratios by the calibrated mass spectrometry, and no statistically significant

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instability was found.

The period of validity of this CRM is 5 years since the date of certification. The stability of this CRM is regularly monitored by NIM, during this period the customer will be informed of any change of the certified values just-in-less-time.

## 5. Packaging, Storage and Use

**Packaging:** This CRM is packaged in glass ampoule bottles. Each bottle contains 2 mL solution.

**Storage:** The CRM should be kept in fridge.

**Use:** The vials of the CRM should be opened just before use.



## Statement

1. The reference material is only for lab study and analytical testing. In case of any complaint due to the improper use or storage by the user, the institute will bear no responsibility.
2. After receiving it, please immediately check variety, quantity and packaging. Relevant compensation is only limited to the reference material itself.
3. The institute is only responsible for the complete certificate affixed with the “Dedicated Seal for Reference Material of National Institute of Metrology”. Please properly keep this certificate.
4. To obtain more application related information, please contact the Department of Technical Consultation.

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