

在以 Cs_2BO_2^+ 离子进行硼同位素测定时, 由于所测定的两种离子 $^{133}\text{Cs}_2^{11}\text{B}^{16}\text{O}_2^+$ (m/z 309) 和 $^{133}\text{Cs}_2^{10}\text{B}^{16}\text{O}_2^+$ (m/z 308) 具有极小的相对质量差 (0.032%), 一般的商业同位素热电质谱计无法实现对这两种离子的同时全接收。为此, 一些学者对某些商业仪器进行了改造或采用zoom技术, 基本实现了对硼同位素高精度测定。本实验利用特制的Triton热电质谱仪, 以 Cs_2BO_2^+ 离子流的自动静态双接收进行硼同位素组成的测定。研究了不同离子流强度和不同带电流对250 ng标准样品NIST 951 H_3BO_3 测定值及测试精度的影响, 结果表明, 当带电流在1 150~1 350 mA之间变化或者离子流稳定在0.1~10 V之间时, 标准样品的硼同位素比值在4.052 63~4.053 38区间变化。导致二者一致的实验现象是由带电流强度造成的, 当带电流越高时, 产生的离子流相应也越高, 因此可以采用相同的带电流控制不同样品的测试值和测试精度。在此基础上通过优化测试条件, 摸索出硼同位素自动测试程序, 并用该程序对标准样品及实际样品进行测定, 无论是测试结果还是测定精度均能达到手动测试效果, 节省了人力, 提高了工作效率。

Due to the small relative mass difference between m/z 308 and m/z 309, simultaneous data collection was not possible using conventional multi-collection mass spectrometers. To conduct multi-collector measurements of m/z 308 ($^{133}\text{Cs}_2^{10}\text{B}^{16}\text{O}_2^+$) and m/z 309 ($^{133}\text{Cs}_2^{11}\text{B}^{16}\text{O}_2^+$), the Faraday cups were configured to measure m/z 308 and m/z 309 array with zoom optics. We utilize thermal ionization mass spectrometry (Trion) to perform automatic and high-precision determination of boron isotope using static multicollection of Cs_2BO_2^+ ions. The research has been performed to investigate the impact of ion current and filament current on the accuracy and reproducibility of boron isotope measurements for NIST 951 Standard, giving values of $^{11}\text{B}/^{10}\text{B}$ were in the range of 4.052 63—4.053 38, when ion current varied 0.1—10 V and filament current varied 1 150—1 350 mA. The phenomenon of this study was filament current. With the higher of filament current, the ion current was corresponding to be higher. Based on this discovery, we have established the conditions for precise boron isotopic measurement using the multicollection technique by automatic mode. The proposed method was used for the determination of NIST 951 H_3BO_3 and natural samples. The results show that the automatic mode and manual mode has same precision and accuracy. And this technique enables us to do speedy analysis of boron isotopes and greatly improve the efficiency.



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自动静态双接收高精度热电质谱法测定硼同位素

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Automatic and High-Precision Determination of Boron Isotopic Ratios Using Thermal Ionization Mass Spectrometry with Static Multi-Collection

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[摘要](#)

[图/表](#)

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