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Atmosphere-Induced Interference Reduction Device (AIRD) for Improved Accuracy in ICP-MS Analysis

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The Atmosphere-Induced Interference Reduction Device (AIRD) demonstrates significant potential in mitigating interferences in inductively coupled plasma-mass spectrometry (ICP-MS) analyses. This study evaluates the efficacy of AIRD in reducing interferences caused by atmospheric gases, including H, C, N, and O, by employing argon (Ar) and helium (He) as shielding gases due to their inert properties. Krypton (^{82}Kr) was utilized as an internal standard to monitor and correct instrumental sensitivity drift. Through gas dynamics simulations, the shielding gas flow rate was optimized, identifying a threshold of 10 L min^{-1} for optimal interference reduction. The results highlight the superior performance of He in reducing interferences, achieving reductions of 32% for $^{12}C^{+}$, 51% for $^{15}N^{+}$, 56% for $^{16}O^{+}$, 54% for $^{16}O^{1}H^{1}H^{+}$, 51% for $^{40}Ar^{14}N^{+}$, and 42% for $^{40}Ar^{16}O^{+}$ compared to Ar. Additionally, AIRD maintained low oxide yields, with oxide yield remaining at approximately 0.03% for 24 hours post-shielding gas cessation. LA-ICP-MS analyses coupled with AIRD revealed a reduction in ThO/Th from 0.92% to 0.15% compared to standard analyses without AIRD. Further experimental investigations indicated that AIRD influenced elemental sensitivity, particularly when He was used as the shielding gas, resulting in an ~25.7% enhancement in the signal intensity of ^{82}Kr. These findings underscore the potential of AIRD in enhancing the accuracy and reliability of ICP-MS analyses by significantly reducing atmospheric interferences and improving signal intensity.