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A high sensitivity Nier-type gas source for noble gas mass spectrometry

Damian Tootell, Tony Jones, Zenon Palacz, and David Rousell
Isotopx Limited, MIDDLEWICH, United Kingdom (damian.tootell@isotopx.com)

The ultimate precision of isotope ratio mass spectrometry is governed by the signal/noise ratio of a measurement. This is of particular significance in applications of static vacuum noble gas mass spectrometry where sample size is often limited and thus, the signal size is constrained by the sensitivity of the source.

A Nier-type gas source uses thermionic electrons from a heated filament to cause ionisation by electron bombardment. This electron beam is often referred to as the trap current and the probability of ionisation increases with increasing trap current.

When using a standard filament, sensitivity generally increases with increasing trap current but at a cost; the filament lifetime is severely reduced and the ambient temperature of the source increases. In a static vacuum environment, this increase in temperature promotes the formation of hydrocarbon volatiles which interfere with the gas species under study.

To counter these limitations, we have developed a new Nier-type source that offers unique sensitivity performance without compromising the lifetime of the filament. Operating at 1/10th of the electrical power of traditional sources, the temperature of the source runs much lower so interfering hydrocarbon volatile species are less prevalent in the vacuum.

Our new source can comfortably achieve sensitivities of 7mA/Torr which is 7 times the specification of standard sources, whilst maintaining comparable filament lifetimes. Furthermore, as this performance is attained at lower emission temperatures, measured mass 36 backgrounds of 8E-15 ccSTP show a six-fold improvement on the standard specification.