Heating of a thermo-ionization source using an electron beam perpendicular to the ion trajectories

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A new generation of secondary ion mass spectrometer, which combines high spatial resolution with parallel detection of several atomic masses [1], opens the use of stable isotope ratio measurements in biomedical research. Although our MIMS (Multi Isotope Mass Spectrometer) instrument capabilities constitute a breakthrough for biomedical applications of secondary ion mass spectrometry, any gain in resolution would be beneficial. In a secondary ion mass spectrometer with a scanning primary ion beam, a brighter primary ion source translates directly to higher spatial resolution and/or shorter acquisition time. Our goal is to attempt to increase the brightness of the thermo-ionization caesium ion source [2] used on our instrument. In the present caesium source, the ionizer plate is heated by electron emission from a filament around the periphery of the ionizer assembly. When heated by this method, the ionizer plate cannot be the hottest part, and caesium ions are certainly produced on different parts of the ionizer assembly. We are testing a new heating system in which the ionizer is directly heated – in its centre – by an electron beam. This system has been mounted on a vacuum bench specially designed to characterize both positive and negative thermo-ionization sources by measuring the primary ion current and the source crossover size. In the bench, the source ionizer can be heated directly with an electron gun positioned perpendicular to the ion beam axis and focussed with an optical system including slit lenses and a magnetic sector. Using the vacuum bench with a caesium carbonate source, we measured a 35 µm minimum crossover size and calculated a brightness of 165 $A.cm^{-2}.sr^{-1}$.

The vacuum bench is used to compare the effect of the heating mode of the ionizer (indirect by filament electron emission or direct by electron beam) on the brightness of the caesium source and to develop a thermo-ionization iodine negative source.

[1] G. Slodzian, B. Daigne, F. Girard, F. Boust, Proceedings of the 6th SIMS Conference, Versailles (2007) 189
[2] G. Slodzian, B. Daigne, F. Girard, F. Boust, F. Hillion, proceedings of the 8th SIMS Conference, Amsterdam (2010) 227