

Comparison between Hiden EQS and EPIC instruments for secondary ions

A 5 KeV Argon primary ion beam (10 nA beam current) was used to excite secondary ions from an Aluminium surface.

The Hiden EQS and Hiden EPIC were positioned as shown in Figure 1. Both instruments can mass analyse positive and negative ions from the surface but the EQS also has a 45° sector field ion energy analyser incorporated in it. This can be used to energy analyse (energy filter) the ions.

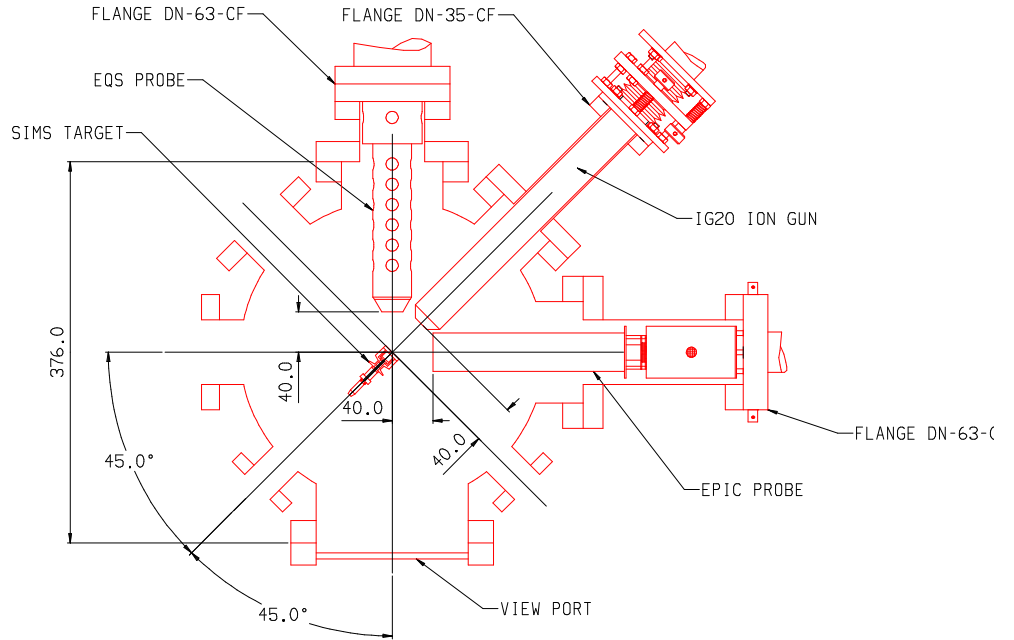


Fig 1

Figure 2 shows the ion energy distribution of the secondary Al⁺ ions measured with the EQS. The maximum in the distribution is at 2 or 3 eV. Note that most of the secondary ions appear to have energies below ~30 or 40 eV though there are a small number of higher energy ions with a wide spread of energies.

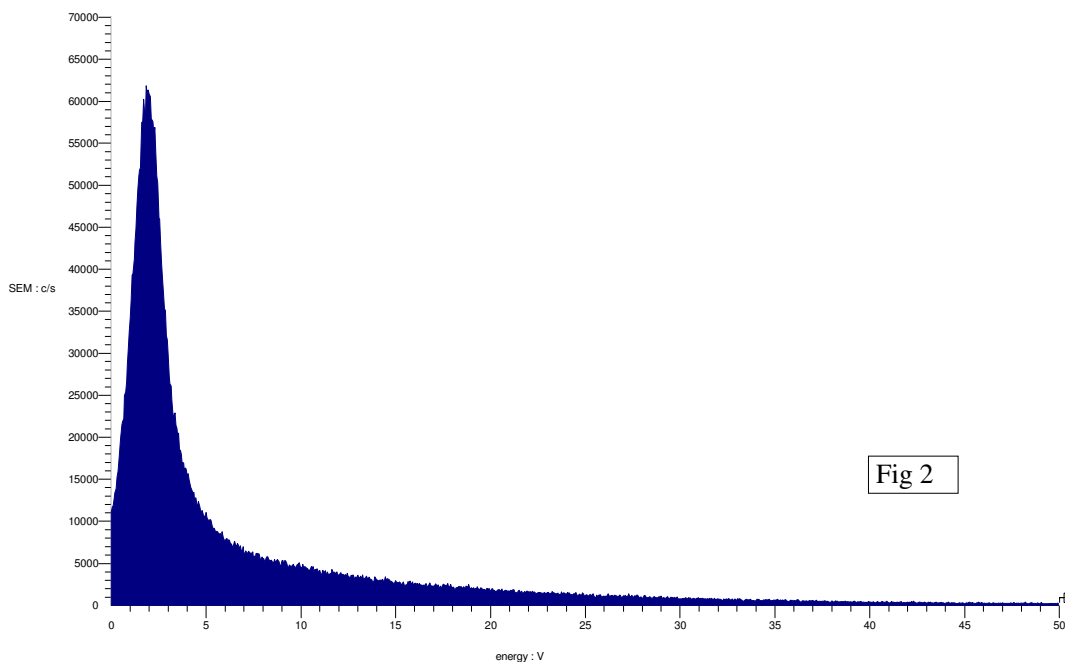


Fig 2

Figure 3 shows the energy filtered mass spectrum of ions of energies $\sim 2.5 \pm 0.5$ eV. The mass peaks are well resolved. The intensity of the Al^+ (27 amu) peak is $\sim 60,000$ cps.

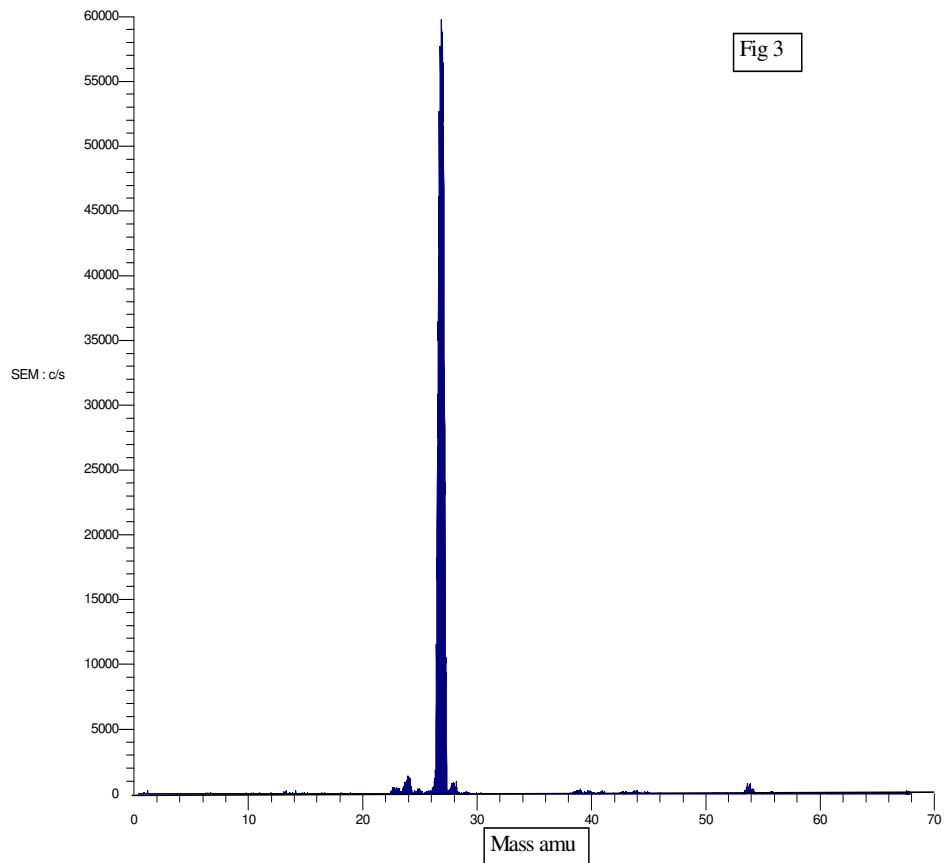


Fig 3

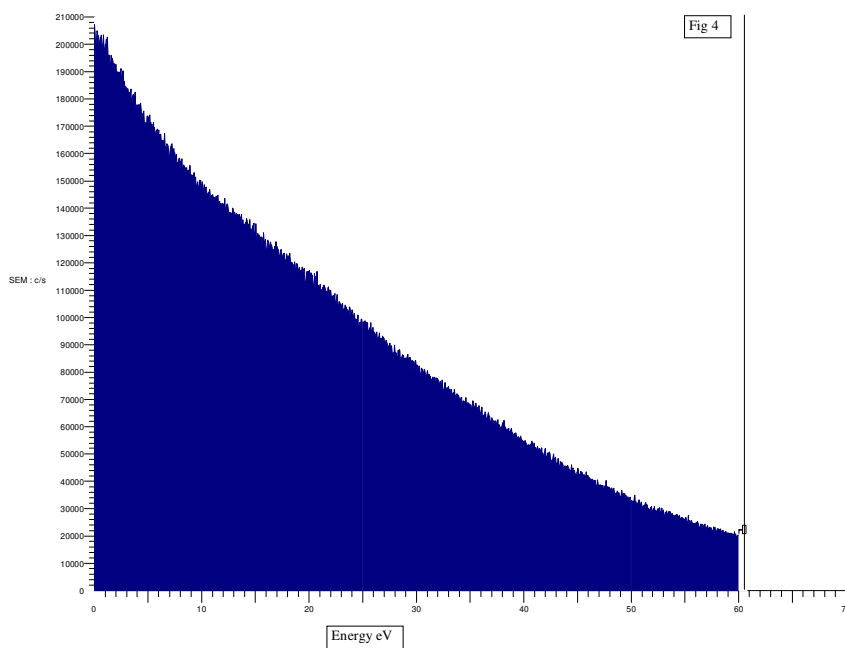
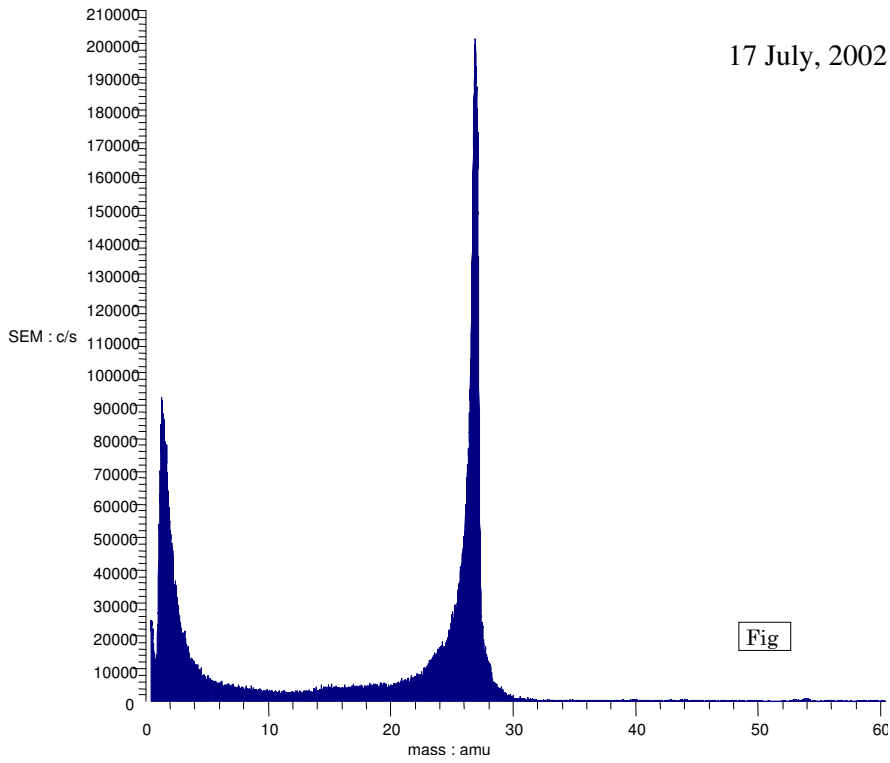


Fig 4

The EPIC has no energy filter, but the mid axis potential (pole bias) facility can be used to bias the mass filter to progressively more positive potentials thereby rejecting more and more of the low energy ions. This is illustrated in Figure 4.

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With the mid axis potential set to zero the mass spectrum is that shown in Figure 5. Note that the resolution of the mass peaks is very poor, due to the wide spread of ion energies entering the quadrupole field. However the signal intensity at 27 amu is large 200,000 cps since no energy filtering is taking place and no transmission losses are incurred.

Fig

The same spectra is shown in Figure 6 but with the signal axis plotted on a log scale. It is clear that it would be impossible to measure some of the minor peaks in the spectra which are swamped by the under-resolved Al⁺ peak.

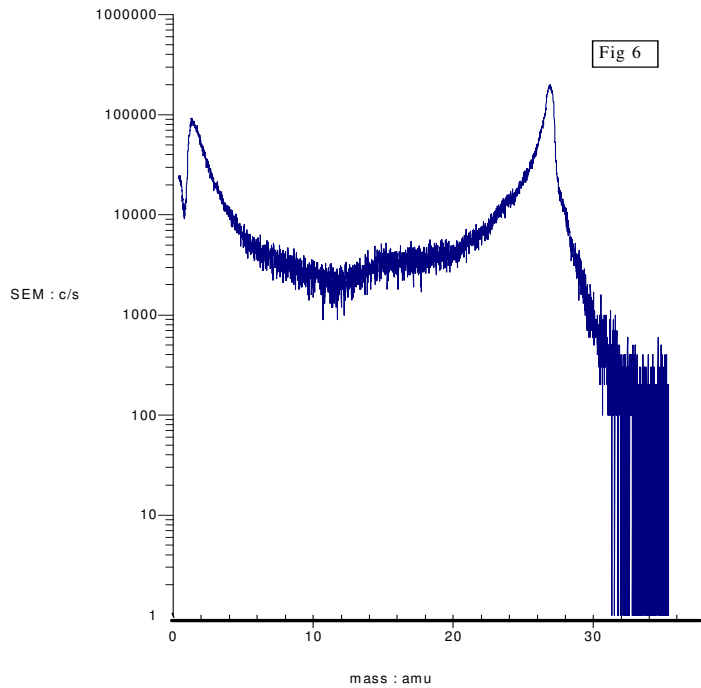


Fig 6

Fig 7

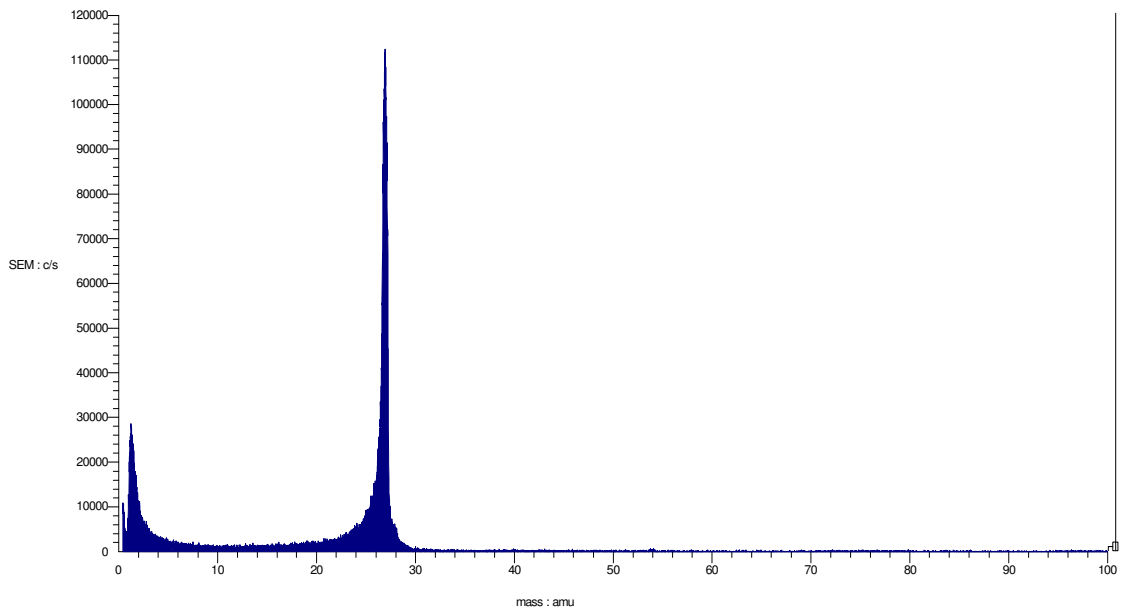


Fig 8

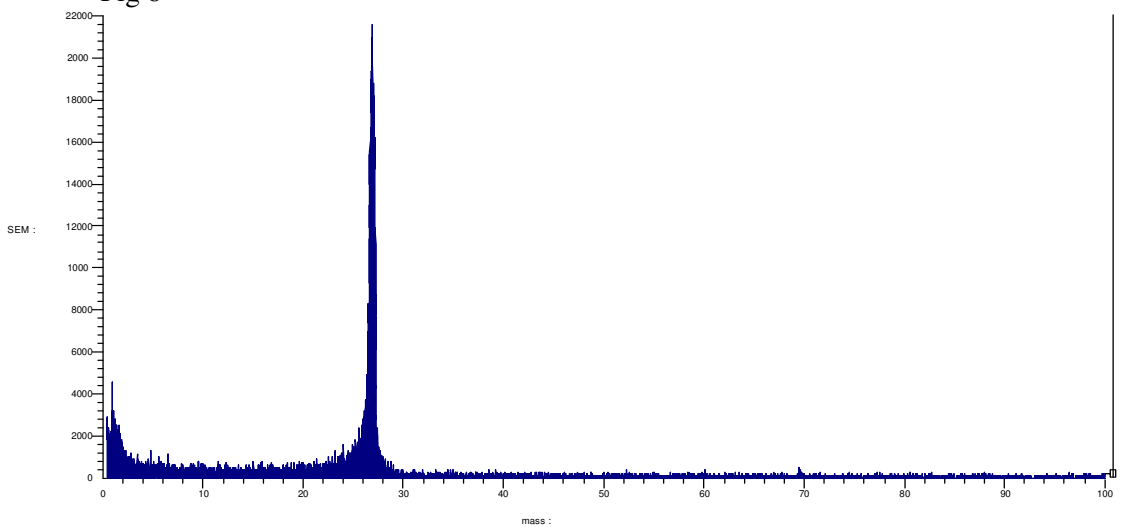
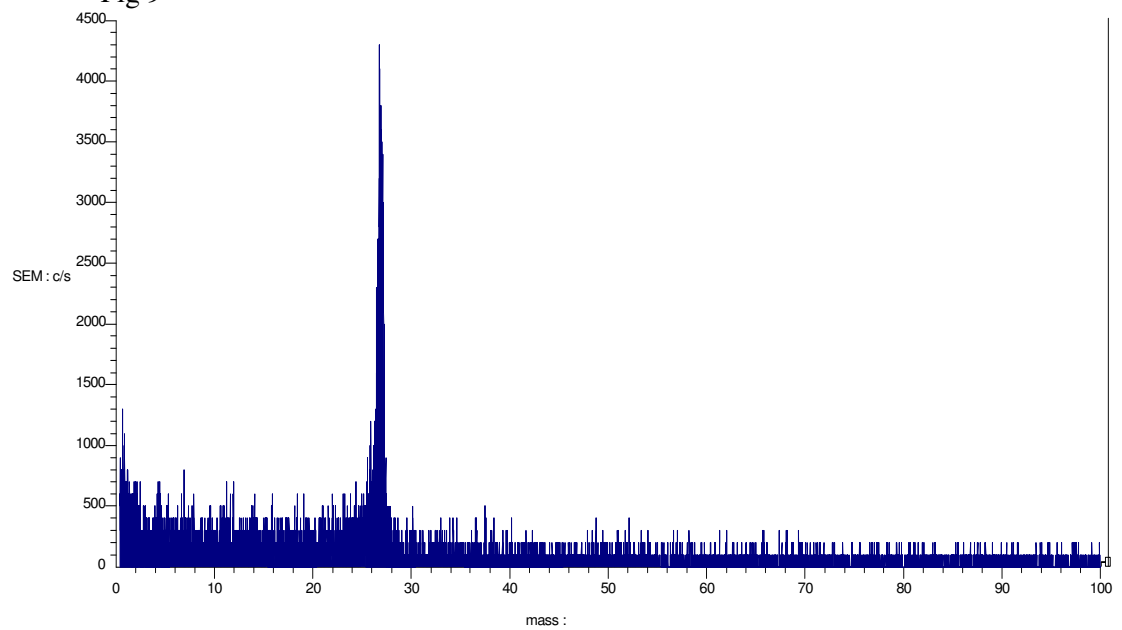


Fig 9



Figures 7, 8, 9 show the same spectra but with the mid axis potential of the EPIC set to 20, 60, 100 Volts. Progressively, low energy ions are rejected and the effective spread of ion energies is reduced. Thus the mass resolution is improved. The mass resolution in Figure 9 is approaching that shown in Figure 2 (the EQS spectra). However, the signal intensity significantly reduces as mid axis potential is increased. It has decreased from 200,000 cps in Figure 5 (3 times greater than the intensity of the EQS signal) to 4,000 cps in Figure 9 (15 times less than the intensity of the EQS signal).

Conclusion:- The mass analysis of ions with a broad ion energy distribution should be done with an instrument like the EQS with its integral mass and energy filters. The mass analysis of mono-energetic ions can be done with the EPIC (refer to Technical Data Sheet 141). The transmission losses associated with the 45° sector field energy analyser are minimal.

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