

Hidden DLS-1 QMS

Threshold Ionisation Quadrupole Mass Spectrometer
Specifically for the Analysis of
Hydrogen, Hydrogen Isotopes and Light Gases

Introduction

The Hiden DLS-1 QMS is a quadrupole mass spectrometer specifically designed for the analysis of Hydrogen, Hydrogen Isotopes and light gases.

The DLS-1 QMS includes a Hiden Single Filter Quadrupole designed for maximum performance.

The mass filter design is a micron precision assembly using the finest precision machined components.

The DLS-1 QMS has a pole diameter of 6mm.

A high stability RF supply provides the Pole Voltages.



Overview

Fusion is widely considered the golden-standard alternate energy source.

Challenges in fusion research based on the classical torus design include the mass separation of deuterium (D_2) and helium (4He).

The Hiden DLS series systems are designed for applications in fusion where analysis of hydrogen isotopes and deuterated compounds are of interest.

The DLS-1 mass spectrometer is for real time quantitative analysis of complex gas and vapour mixtures in fusion applications, using templates developed for analysis of deuterium in helium and deuterated compounds.

This makes it one of the best-in-class solutions for validating fuel purity in fusion research applications.



Fusion Research and TIMS Operational Mode

The Quadrupole Filter separates species by mass difference. But if the difference is very small, such as exists between He and D₂, separation is not possible.

Hiden's DLS-1 offers a complementary mode of operation which separates species by their difference in Ionisation Threshold. This separation takes place within the Ionizer.

This mode is termed **Threshold Ionization Mass Spectrometric, or TIMS**. It can be used when one species can be ionized at an Electron Energy setting that is too low to ionize the other.

At lower Electron Energy partial pressure of the first species can be measured. Subsequent measurement with a higher Electron Energy will be of the combined species. Deconvolution using a Binary-Encounter-Bethe (BEB) model can then identify the individual partial pressures.

The DLS-1 is able to make this de-convolution in real time.

During measurement the Quadrupole mass setting is fixed to transmit both species.

TIMS Operational Mode

Chart showing the sensitivity of the ionizer for D₂ and He with electron energy. The difference in Ionization Thresholds is significant at 9.9V. Hence a Partial Pressure measured at 23V Electron Energy will be of D₂ and measurements at 40V will be of He and D₂ combined.

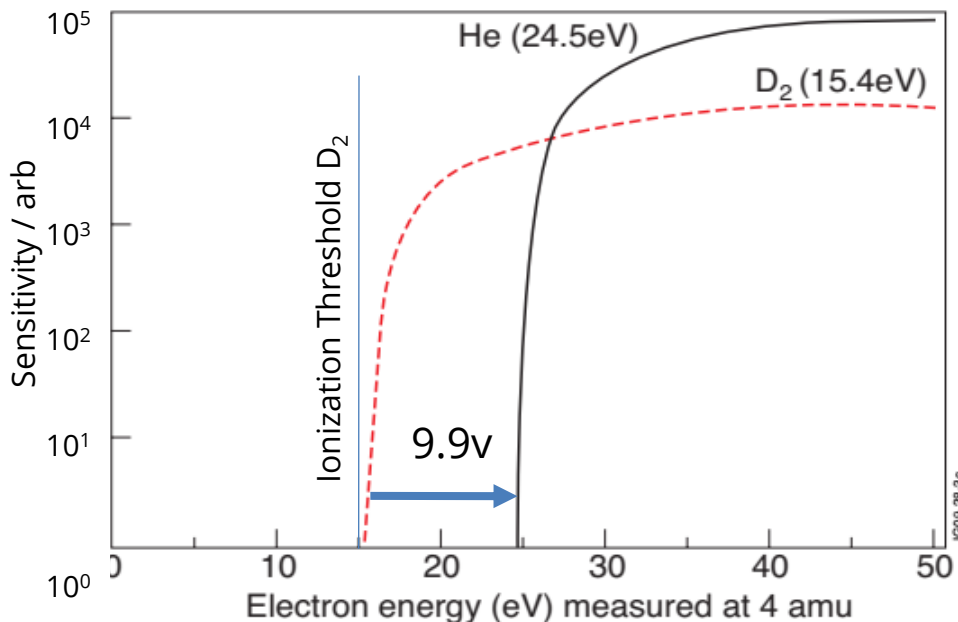
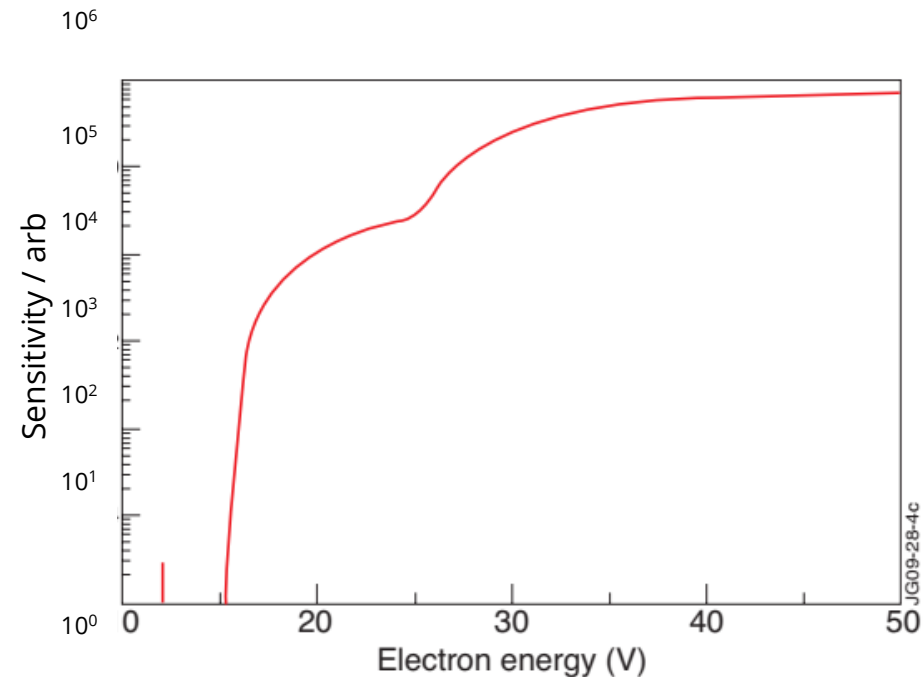


Chart showing the measurement of partial pressure with increasing electron energy for a sample gas mix of D₂ and He. Deconvolution will reveal the individual partial pressures.



TIMS De-convolution of $4\text{He}/\text{D}_2$

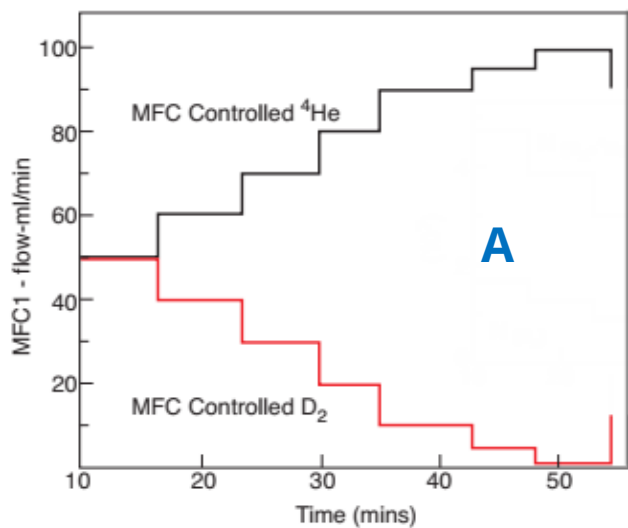


Chart A shows in real time a mass flow controlled ratio of $4\text{He}/\text{D}_2$ gas mixture.

Chart B shows the corresponding raw DLS-1 data [at 4amu] taken as a function of time. The two traces represent $N(\text{D}_2)$ and $N(\text{D}_2 + \text{He})$ at 19eV and 31eV respectively.

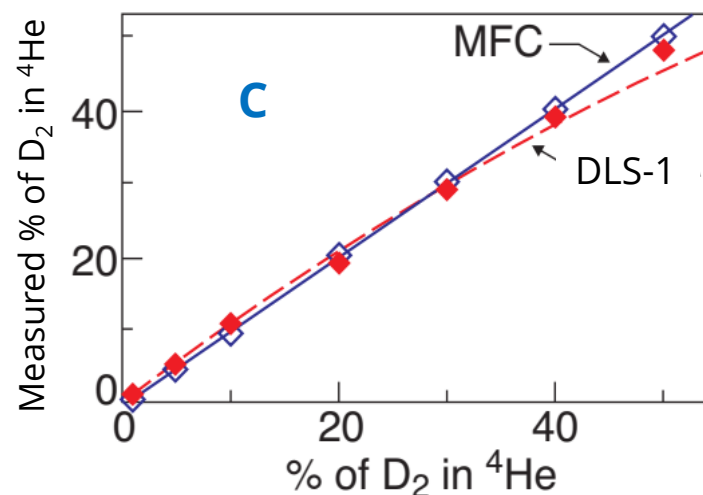
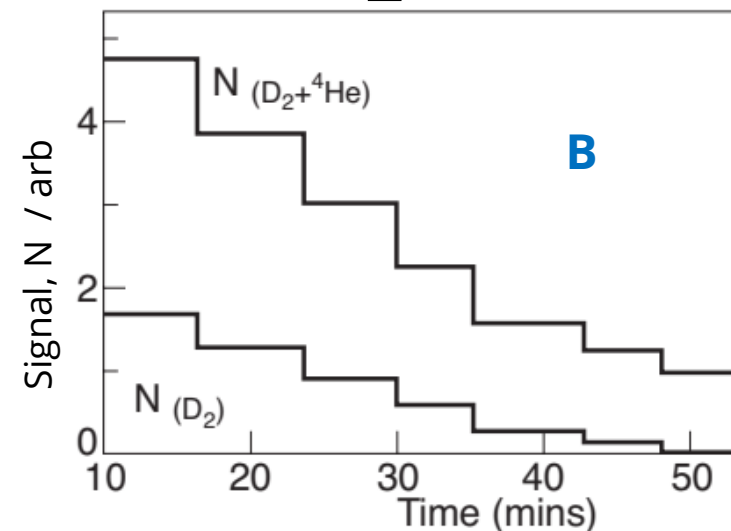
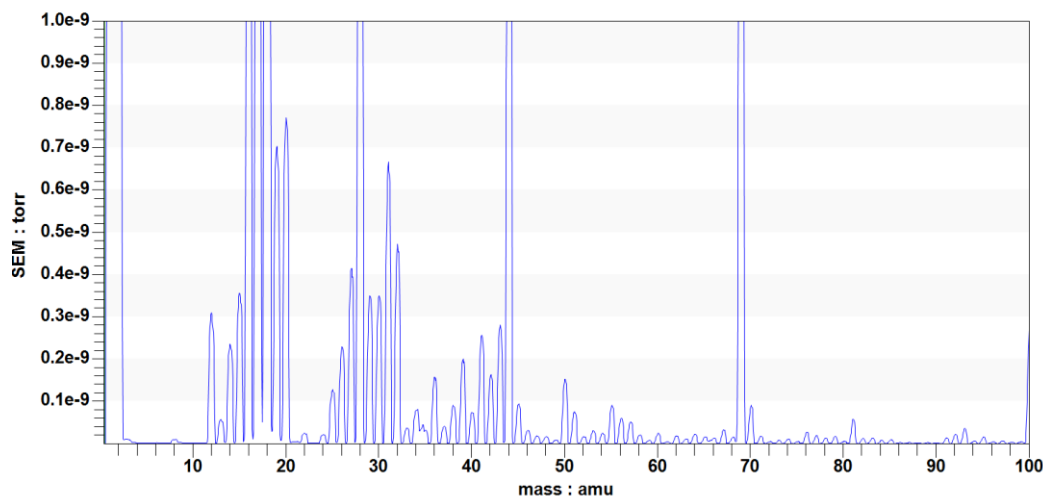


Chart C shows real time deconvolution of the DLS-1 signal data to reveal the true $4\text{He}/\text{D}_2$ abundance ratio $n(\text{D}_2)/n(\text{He})$ after applying BEB theory in Hiden's software

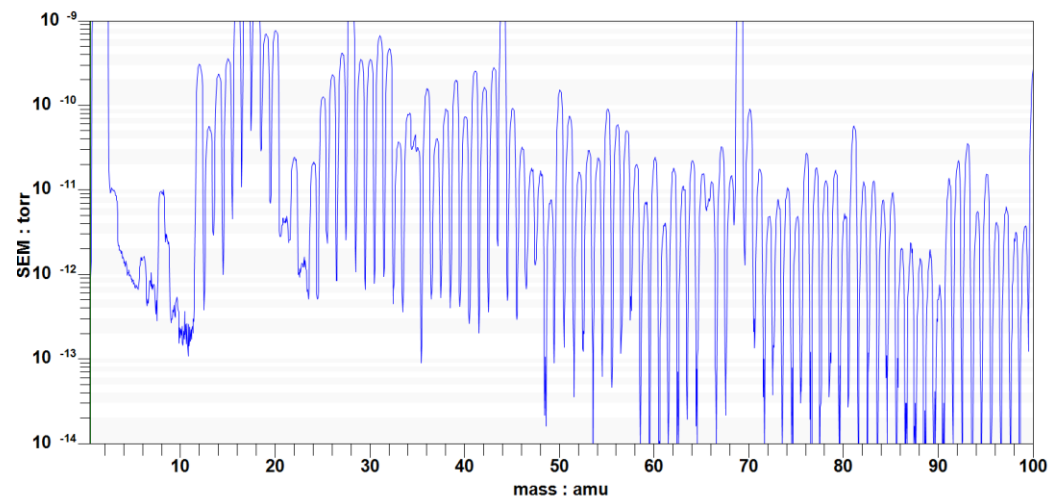
Quantitation of Gas Species from 1 – 100 amu

The DLS-1 also offers real-time quantitation of gas species across a mass range of 1 – 100 atomic mass units (AMU). The unique spectral fingerprints of gases critical to fusion research parameters can subsequently be detected with ease.

Linear y axis



Log y axis



DLS-1 Summary

- Real time quantitative gas analysis in a mass range 1-100 amu
- Sub PPM detection levels
- DLS-1 operates in both conventional mass analysis and TIMS modes
- 0.5 eV electron energy resolution over the range 0-150 eV
- Low cost multi unit solution with radiation and magnetic shielding solutions

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- A photograph of a modern, two-story office building with a grey facade and large glass windows. The building has a prominent entrance on the left side. A large, semi-transparent white circle is overlaid on the left side of the image, containing a list of bullet points. The sky is clear blue, and there are some trees and bushes in the foreground.
- www.HidenAnalytical.com
 - The Hiden website is an excellent resource with product pages, brochures, catalogues, product pages with some application notes, presentation and other information.
 - Contact +44 1925 445225 for direct support.