

Analyzer cell operating principle

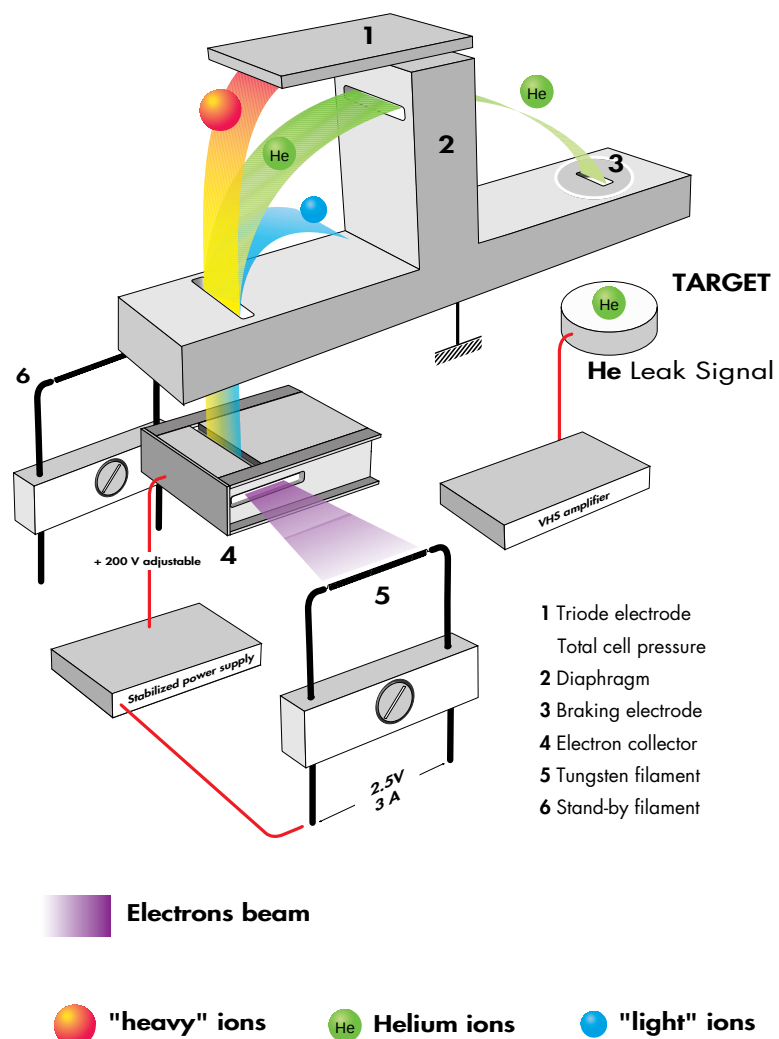
Description

The analyzer cell works on the principle of mass spectrometry and is set to the mass of helium ($m/e = 4$).

m/e = atomic mass of the particle/number of electrons lost on ionization

The principle of magnetic deflexion spectrometry is as follows:

The neutral molecules of the gas being analyzed pass into an ionization chamber (or source of ions) where they are bombarded by an electron beam generated by a heated tungsten filament. A large number of the molecules are transformed into ions.



Analyzer cell - functional diagram

Analyzer cell operating principle

Description (continued) These ionized particles are accelerated by an electrical field.

The entire analyzer cell is subject to a magnetic field which has the property of deflecting the trajectories of the ions along different curves according to the masses of those ions (to be more precised, according to their m/e ratios). Thus the ions beam, which contained ions with different masses, is divided into several beams, each containing only ions with the same m/e ratio. The helium ions ($m/e = 4$) are separated from the lighter (H_2^+ or H^+ , smaller beams) or heavier ions (N_2^+ or O_2^+ , small beams).

Because there is a constant magnetic field (permanent magnet), the accelerator electrical field is adjusted so that the helium ions ($m/e = 4$) follow a pre-determined trajectory (passing through diaphragms) and arrive on the target at the input to a direct current amplifier.

The current of helium ions is proportional to the partial pressure of helium in the installation and by measuring it we can find the flow rate of the leak that has been detected.

It is essential that the total pressure in the analyzer cell is less than 10^{-4} mbar, so that the trajectories of the electrons and the ions are not disturbed by residual molecules. Around 10^{-3} mbar there is a risk of damaging the heated filament.

In order to separate the helium ions from "noise" caused by "stray ions", an electrode located in front of the target eliminates the secondary ions with low energies. This electrode is called the "braking electrode".

There is an auxiliary electrode at the top of the cell, shaped like a plate, which collects the ions that are heavier than helium. This electrode thus measures the total pressure in the analyzer. This electrode serves as the plate for a triode gauge, hence its name of "triode electrode".

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Design and manufacture

Great care has been taken with the design and manufacture of the cell in order to repeatedly obtain the same characteristics and to achieve excellent stability:

- the metal parts are made of stainless steel,
- the filament holder is made of machined aluminium,
- there is an integral amplifier.

The cell assembly is composed of:

- a vacuum chamber or deflection chamber,
- an optics holder flange,
- a permanent magnet,
- an amplifier.

▲ The vacuum chamber:

The analysis cell vacuum chamber is made of light alloy. It is hollow with a rectangular opening into which the electrodes, (that are installed on the "optics holder" flange) are placed.

▲ The optics holder flange:

The optics holder flange supports all the electrodes and electrical connections in the cell. They include:

- the sealed power supply socket, mounted on a metal gasket,
- the amplifier, mounted on an elastomer gasket,
- the supporting block which screens the target and on which the source of ions is mounted,
- the source of ions, which is made up of 2 parts:
 - . a filament holder,
 - . an ionization chamber with a stainless steel electron collector and a mass ion emitter.

The filament holder mechanically positions the tungsten filament with respect to the ionization chamber.

The electron collector and the filament have been designed and positioned so that the temperature of the electron collector stabilizes at 400 °C under bombardment and radiation from the filament. The cell is thus rendered immune to contamination from the pieces being tested without the need of any special heating system.