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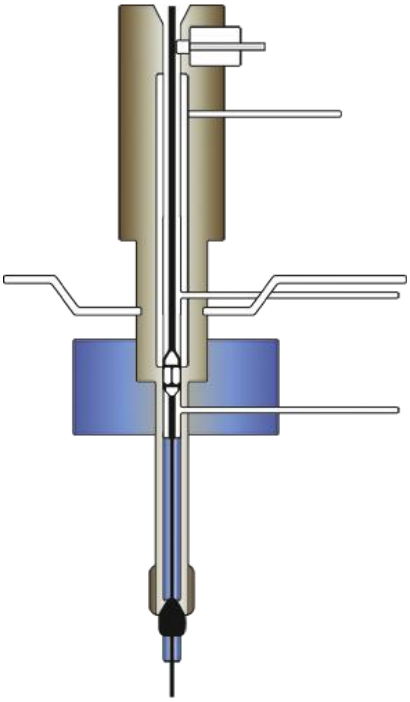
Пламенно-ионизационный детектор FID



Flame Ionization Detector - FID

The most used GC detection system measures the ions produced by organic compounds during combustion. It is extremely sensitive with a wide dynamic range of seven orders of magnitude.

The FID is the most widely used GC detector, and is an example of the ionization detectors invented specifically for GC. The column effluent is burned in a oxygen rich – hydrogen flame producing ions in the process. These ions are collected and form a current that becomes the detector signal. When no sample is being burned, there is little ionization, the small current (10-14 A) arising from impurities in the hydrogen and air supplies. Thus, the FID is a specific property-type detector with characteristic high sensitivity.
A typical FID design is shown in Figure 19. The column effluent is mixed with hydrogen and flows to a small burner tip that is surrounded by a high flow of air to support combustion. An igniter is provided for remote lighting of the flame. The collector electrode is biased at several hundred volts relative to the flame tip and the collected current is amplified by a high impedance circuit. Since water is produced in the combustion process, the detector must be heated to at least 125°C to prevent condensation of water and high boiling samples. Most FIDs are run at 250°C or hotter.

The FID responds to all organic compounds that burn in the oxy-hydrogen flame. The signal is approximately proportional to the carbon content, giving rise to the so-called equal response per carbon rule. All hydrocarbons should exhibit the same response, per carbon atom. When heteroatoms like oxygen or nitrogen are present, however, this factor decreases. Relative response values are often tabulated as effective carbon numbers, ECN; for example, methane has a value of 1.0, ethane, 2.0, etc.

For efficient operation, the detector gases (hydrogen and air) must be very pure and free of organic material that would increase the background ionization. Their flow rates need to be optimized for the particular detector design. FID response goes through a maximum as a function of hydrogen flow rate. It is critical that this optimal hydrogen flow rate be determined experimentally. The flow rate of air is less critical, and a typical value of 300 to 400 mL/min is sufficient for most detectors. For open tubular columns that have flows around 1 mL/min, make-up gas is added to the carrier gas to bring the total up to about 30 mL/min.

Compounds not containing organic carbon do not burn and are not detected by the FID. The most important ones are all the inert gases, O2, N2, CO, CO2 and water. Most significant is water, a compound that often produces badly tailed peaks. The absence of a peak for water permits the FID to be used for analysis of samples that contain water since it does not interfere in the chromatogram. Typical applications include organic contaminants in water, wine and other alcoholic beverages, and food products.

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