Detection Principles

THERMIONIC SURFACE IONIZATION - Samples form gas phase negative ions by extraction of electrons from a hot, catalytically active solid surface. Key parameters are the surface composition, surface temperature, gas composition around the surface, and polarization of the surface relative to a surrounding ion collector. Multiple detection modes are obtained through systematic changes in these four parameters. Some modes combine reactive gas phase chemistry to decompose incoming samples, and then ionize the decomposition products by interaction with the surface. In other modes, intact sample molecules are ionized by direct impact with the surface with no intervening reactive gas phase chemistry. Some modes are non-destructive so that sample aromas can be sensed at the detector exit, and series combinations with other detectors are possible. Several modes use Air as the main detector gas, so that stand-alone applications involving selective detection of samples in ambient Air streams is possible.

FLAME IONIZATION - Samples decompose and form ions in gas phase reactions with radical species such as H, O, and OH that are present in self-sustained flames. A polarizer voltage and ion collector located near the flame effectively measures ions formed by combustion of most organic compounds. Polarizer and collector electrodes located more remotely downstream of the flame selectively measure only long-lived ion species.

REACTOR THERMIONIC IONIZATION ANALYSIS (RTIA) - In a non-GC implementation of thermionic detection, a thermionic ionization transducer is preceded by a heated reactor chamber. The transducer detects selective vapors thermally evolved from liquid or solid samples placed in the reactor. When the gas flowing through the reactor and transducer is Air or Oxygen, detected vapors include volatilized sample constituents as well as products of oxidation of the sample constituents.

CATALYTIC COMBUSTION IONIZATION - A hot catalytic ceramic surface operated in a detector environment containing Oxygen momentarily ignites a burst of ionization when an individual combustible compound containing a high concentration of Methylene groups elutes through the detector. The detection method provides selectivity of Alkanes vs. Alkenes, as well as saturated vs. unsaturated FAMEs, and the onset of combustion ionization is associated with the thermionic emission character of the ceramic surface.

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