

Gas Chromatography-Mass Spectrometry with Cold EI: Leading the Way to the Future of GC-MS

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Abstract

Gas chromatography-mass spectrometry (GC-MS) with supersonic molecular beams (SMB) (also named GC-MS with Cold EI) is based on GC and MS interface with a SMB and on the electron ionization (EI) of vibrationally cold analytes in the SMB (hence the name Cold EI) in a contact-free fly-through ion source. Cold EI improves all the central GC-MS performance aspects and brings a broad range of important benefits thereby leading the way to the future of GC-MS. Cold EI provides enhanced molecular ions combined with effective library-based sample identification. Sample identification is further improved by the use of powerful TAMI software that is based on isotope abundance analysis and improved quadrupole mass accuracy for the provision of the sample elemental formula from its molecular ion group of isotopologues. The range of low volatility, polar and thermally-labile compounds amenable for analysis is significantly increased via the use of a contact-free fly-through ion source and the ability to

lower sample elution temperatures through the use of high column carrier gas flow rates. Effective fast GC-MS is enabled particularly due to the possible use of high column flow rates, column flow programming and improved system selectivity in view of the enhancement of the molecular ions. GC-MS with Cold EI is characterized by low limits of detection (LOD) and identification (LOI) that are superior to that of GC-MS with standard EI, particularly for sample compounds that are difficult to analyze. Cold EI is further characterized by uniform compound independent response for improved quantitation and it can serve as a non-targeted full-scan alternative to MS-MS since the selectivity on the molecular ion is improved. The ion source of GC-MS with Cold EI is inherently inert and further characterized by fast response and vacuum background filtration capability. The same ion source offers four modes of ionization including Cold EI, Low eV Soft Cold EI, Classical EI and Cluster Chemical Ionization. Mode changing is via a simple method change without any hardware change and requires only several seconds. Thus, with Cold EI there is no need for any other ion source. The GC separation of GC-MS with Cold EI can be improved with pulsed flow modulation GCxGC-MS. Electron ionization LC-MS with Cold EI can also be combined with the GC-MS with Cold EI in one MS system, with fast and easy switching between these two modes of operation. A range of applications is described with emphasis on those that are unique to or that are much better analyzed by GC-MS with Cold EI.

Keywords

GC-MS, Supersonic Molecular Beams, Electron Ionization, Cold EI,
Fast GC-MS, GCxGC-MS, Isotope Abundance Analysis,
Thermally Labile Compounds Analysis, Isomer Distribution Analysis,
Electron Ionization LC-MS