

Desorption Electrospray Ionization Publications As of September 2008

Technology Overviews

Mass spectrometry sampling under ambient conditions with desorption electrospray ionization

Takats, Z.; Wiseman, J. M.; Gologan, B.; Cooks, R. G., Mass spectrometry sampling under ambient conditions with desorption electrospray ionization. *Science* **2004**, 306, 471-473.

Abstract

A new method of desorption ionization is described and applied to the ionization of various compounds, including peptides and proteins present on metal, polymer, and mineral surfaces. Desorption electrospray ionization (DESI) is carried out by directing electrosprayed charged droplets and ions of solvent onto the surface to be analyzed. The resulting mass spectra are similar to normal ESI mass spectra in that they show mainly singly or multiply charged molecular ions of the analytes. Changes in the solution that is sprayed can be used to selectively ionize particular compounds, including those in biological matrices. In vivo analysis is demonstrated.

Ambient mass spectrometry using desorption electrospray ionization (DESI): instrumentation, mechanisms and applications in forensics, chemistry, and biology

Takats, Z.; Wiseman, J. M.; Cooks, R. G., Ambient mass spectrometry using desorption electrospray ionization (DESI): instrumentation, mechanisms and applications in forensics, chemistry, and biology. *J Mass Spectrom* **2005**, 40, (10), 1261-1275.

Abstract:

Analytical characteristics of DESI are summarized. Examples of applications to small and large molecules, to in situ analysis, and to high-throughput analyses are presented. Evidence is provided for both a heterogeneous charge-transfer mechanism and a droplet pick-up mechanism of ionization. The speed, lack of the need for sample preparation, selectivity, and sensitivity of DESI are all demonstrated and discussed. Instrumentation is also discussed. Forensic applications as well as emerging areas of application including tissue imaging are given emphasis.

Ambient mass spectrometry

Cooks, R. G.; Ouyang, Z.; Takats, Z.; Wiseman, J. M., Ambient mass spectrometry. *Science* **2006**, 311, (5767), 1566-1570.

Abstract:

A recent innovation in mass spectrometry is the ability to record mass spectra on ordinary samples, in their native environment, without sample preparation or pre-separation by creating ions outside the instrument. In desorption electrospray ionization (DESI), the principal method described here, electrically charged droplets are directed at the ambient object of interest; they release ions from the surface, which are then vacuumed through the air into a conventional mass spectrometer. Extremely rapid analysis is coupled with high sensitivity and high chemical specificity. These characteristics are advantageously applied to high-throughput metabolomics, explosives detection, natural products discovery, and biological tissue imaging, among other applications. Future possible uses of DESI for in vivo clinical analysis and its adaptation to portable mass spectrometers are described.

Imaging mass spectrometry: fundamentals and applications to drug discovery

Rubakhin, S. S.; Jurchen, J. C.; Monroe, E. B.; Sweedler, J. V., Imaging mass spectrometry: fundamentals and applications to drug discovery. *Drug Discovery Today* **2006**, 10, (12), 823-837.

Abstract

Imaging mass spectrometry (IMS) encompasses a variety of techniques that enable the chemical imaging of analytes, which range in size from atoms and small molecules to intact proteins, directly from biological tissues. IMS is transforming specific areas in biological research with its unique combination of chemical and spatial information. Innovations in instrumentation and imaging protocols will make this approach invaluable at many stages of the drug discovery process, including pharmacological target screening and evaluating the distribution of drug and drug metabolites in cells and tissues. The fundamentals and unique methodology of IMS are discussed, along with exciting new applications to drug discovery science.

New approaches for quantitative analysis in biological fluids using mass spectrometric detection

Hopfgartner, G.; Varesio, E., New approaches for quantitative analysis in biological fluids using mass spectrometric detection. *TRAC-Trend Anal Chem* **2005**, 24, (7), 583-589.

Abstract

Quantitative analysis with mass spectrometric detection is no longer limited to small molecules. A new focus of research is to understand biological processes at the molecular level and this requires more quantitative data for a large range of biomolecules, including low molecular weight compounds, peptides and proteins. On-line approaches such as liquid chromatography (LC) mass spectrometry are restricted to atmospheric pressure ionization (API) in combination with LC while off-line approaches can be performed either with API or matrix-assisted laser desorption ionization (MALDI). Selected reaction monitoring quantitation remains the favorite mode of detection for small molecules as well as for proteins and peptides. The potential of quantitative analysis without any chromatographic separation based on chip-based infusion or MALDI has been

demonstrated. For the quantitation of small molecules, the use of an internal standard (IS) is well established with structural or isotopically labeled analogs. For proteins, the use of an IS remains more challenging and will need some further optimization. New ionization techniques, such as desorption electrospray ionization, may also open up some new opportunities for quantitative analysis.

Ambient Desorption Ionization Mass Spectrometry

Andre Venter, Marcela Nefliu, R. Graham Cooks, Ambient Desorption Ionization Mass Spectrometry, *Trends in Analytical Chemistry*, **2008**, 27, 284-290.

Abstract

Ambient desorption ionization mass spectrometry (MS) allows for the direct analysis of ordinary objects in the open atmosphere of the laboratory or in their natural environment. Analyte desorption usually accompanies the ionization step and these processes are often concerted, multi-step processes. Ambient desorption ionization methods typically require little or no sample preparation, offer a much simplified work flow and deliver unprecedented ease of use to MS analyses.

Since the introduction of desorption electrospray ionization (DESI [Z. Takats, J.M. Wiseman, B. Gologan, R.G. Cooks, *Science* (Washington, D. C.) 306 (2004) 471]) in 2004 and the direct analysis in real time (DART [R.B. Cody, J.A. Laramée, H.D. Durst, *Anal. Chem.* 77 (2005) 2297]) in 2005, this new field of MS has developed rapidly. Numerous permutations of the various options for analyte desorption and ionization have been demonstrated. Desorption steps, such as momentum transfer, dissolution into ricocheting droplets and thermal desorption, have been combined with ionization steps, including ESI, atmospheric pressure chemical ionization and photo-ionization. The large number of possible combinations of desorption and ionization components that have already been applied is creating a proliferation of techniques and acronyms that is becoming ever more complex.

Here, we provide a logical framework for the classification of these related experiments, based on the desorption and ionization processes involved in each.