

flame ionization detector (FID), standard in gas chromatography, can for example be used. However a double ion source may also particularly be used, whereby a partial ion current is branched off for the detection of substance peaks. A part of the ion current can also be branched off and measured after transfer of the ions into the vacuum.

Nor do the substance peaks need to be supplied by physical-chemical separation methods. Substance peaks can also originate from pulsed pyrolyses, for example the known Curie point pyrolyses, or from desorptions which have been induced by laser pulses. In this case detection of the substance peaks is not necessary since the times for the appearance of the substance peaks are already known. Also, for these types of analysis, fewer temporary stores are required since the clock-pulse rate can be controlled by the method itself. If the thermalization should continue to take place in its temporary store, a total of two temporary stores are sufficient, one for the thermalization and one to supply the mass spectrometer. For pyrolysis though, very large temporary stores are generally required since pyrolysis mixtures are very complex and many successive analyses are required, often with selective storage of rare ion types.

This invention is particularly helpful for the analysis of ions from pyrolysis procedures. The substances from pyrolysis vapors can attain very high molecular weights. These molecules cannot be subjected to any wall collisions since they otherwise immediately condense out into the form of the known pyrolysis tar. Rather they must be immediately ionized, for example by chemical ionization at atmospheric pressure (APCI). As ions, they can be better guided without collision than in the form of neutral molecules. Long-lasting storage for several successive analyses is actually only possible in the form of ions.

Instead of electrospray, chemical ionization at atmospheric pressure (APCI) can also be used for the ionization of substances. This type of ionization is especially favorable for pyrolysis vapors and desorption vapors, but also for substances which were separated by gas chromatography.

The introduction of ions into a vacuum can also proceed in a different manner, as shown in FIG. 4. Simple, nozzle-like openings, for example ones with 30 micrometer diameters, have been used very successfully, although they require much larger pumps than the above-described input capillaries.

The input capillary (13) can also be designed much shorter, but also with a smaller inside diameter. The gas current into the vacuum system is then much more reduced, and the differential pump stage (14) can be completely dispensed with. The input capillary (13) then leads the ions directly into the first temporary store (16) of the differential pump chamber (17). The most favorable method of introducing the ions into the vacuum—aperture, wide capillary, narrow capillary—is dependent upon how narrow the space is in which the ions are formed and how many ions are formed.

The number of temporary stores in the main vacuum chamber (19) can of course be suited to the measurement problem. There can only be one temporary store there, for example for the analysis of pyrolysis vapors or desorption ions, although there could also be four or more temporary stores installed if primarily complex mixtures are being analyzed with rapid separation. Since the ions can be transferred from one store to the next with relatively little loss, the number of temporary stores is freely selectable.

Even the ion trap mass spectrometer (21, 22, 23) can be replaced by other types of mass spectrometer. For the

scanning of highly resolved mass spectra of primary ions or secondary (daughter) ions, ion cyclotron resonance mass spectrometers (ICR or FTMS) are particularly well suited. Since the scanning of mass spectra can last especially long with the ICR spectrometer, according to the requirements for mass range and mass resolution, the invention is particularly advantageous for the ICR mass spectrometer.

However other types of mass spectrometer, in particular all types of tandem mass spectrometer, can also be used. Since these mass spectrometers must be supplied with a continuous current, the switchable lens of the temporary store (20) can be controlled here in such a way that there is continuous outflow over a long period of time.

The mass spectrometry expert, with the knowledge of his specialized area within mass spectrometry, can easily find further examples for the advantages of using this invention.

We claim:

1. Method for the mass spectrometric characterization of ions from substances which are delivered peakwise by a substance supply unit, comprising the following steps:

- (a) delivering a peak of substances to an ion source and forming substance ions thereof,
- (b) transferring the ions to each of a plurality of temporal ion stores and storing the ions therein,
- (c) extracting a fraction of the ions from one of the ion stores into the mass spectrometer for a specific investigation, and
- (d) repeating step (c) with different types of investigations, until either the ions of the substance peak are sufficiently characterized, or the ions in the stores are exhausted.

2. Method as in claim 1, wherein the temporary stores are arranged in series.

3. Method as in claim 2, wherein the temporary stores collect the ions from further substance peaks as necessary and pass them on as necessary to the next respective temporary store.

4. Method as in claim 1, wherein multipole RF ion guidance systems are used as temporary stores, being closed for the ions at both ends by reflecting potential distributions, from which however at least one potential distribution is switchable to ion passage.

5. Method as in claim 4, wherein an RF multiple rod system is used as at least one of the temporary stores.

6. Method as in claim 5, wherein at least one of the temporary stores comprises a conically formed interior, so that there is a permanent thrust of ions in an axial direction.

7. Method as in claim 5, wherein an electrical DC field is generated at least temporarily along the axis of at least one of the temporary stores.

8. Method as in claim 4, wherein a system made up of rings arranged perpendicular to an axis, which are connected in alternating sequence with the phases of an RF voltage, is used as at least one of the temporary stores.

9. Method as in claim 4, wherein at least one of the temporary stores comprises a double or multiple helix operating with both opposing phases of an RF voltage.

10. Method as in claim 1, wherein a RF quadrupole ion trap or ICR ion trap is used as a mass spectrometer.

11. Method as in claim 10, wherein the ion trap is only filled to the space charge limit, and the filling process is controlled by the filling rate of the preceding filling, by the known decrease of ion density in at least one of the temporary stores and by the effective rate of a ion filter which may be switched on.

12. Method as in claims 1, wherein the mass spectrometer concerned is a spatial tandem mass spectrometer.