any ion guides, wherein the jet is generated at much lower pressures. The primary gas stream (**26**) from the entrance capillary of the electrospray ion source (**1**, **2**) is directed towards an aperture (**31**) with a skimmer, letting pass a little gas with most of the ions into pumping chamber (**7**). In chamber (**7**), the ions (**33**) are attracted by the lens system (**32**) and focused onto nozzle (**6**). The expanding gas jet (**27**) from the nozzle (**6**), containing most of the ions, passes a ring electrode (**28**). A voltage at the ring electrode (**28**) provides the field barrier at the exit of the nozzle (**6**). Passing ions (**34**) are accelerated towards the conversion dynode (**35**), and the secondary electrons (**36**) generated here are measured by the detector (**21**).

[0042] FIG. **8** schematically presents a somewhat more sophisticated ion mobility spectrometer than shown in FIG. **6**, using a Laval nozzle (**6**) at an intermediate pressure. The primary gas stream (**26**) from the entrance capillary is directed towards the Laval nozzle (**6**) surrounded by a skimmer. The ions inside the gas stream (**26**) are canalized and guided towards the center of the Laval nozzle (**6**) by the pseudopotential of an RF quadrupole rod system (**29**). The Laval nozzle is operated by the back-up pressure of the gas stream (**26**). The gas jet (**27**) formed by the Laval nozzle (**6**) here passes ring electrode (**28**) which creates the field barrier by suitable voltages. Location, size and distance of the ring electrode (**28**) are chosen such that the field barrier is built up directly at the exit of the Laval nozzle (**6**) so that all ions are pushed against the field barrier with equal force. The passing ions are collected by an ion funnel (**8**), separating the ions from the remaining gas and guiding them to the ion detector (**21**) in a separate pumping chamber pumped by pump (**24**).

[0043] In FIG. **9**, the ring electrode (**28**) of FIG. **8** is replaced by two fine grids (**30**) which span the electric field, serving as barrier, between them, or between the first grid and the nozzle (**6**).

[0044] FIG. **10** exhibits a quadrupole ion guide with wing-like rods (**41** to **44**) which can replace the ion funnel (**8**) in FIGS. **1** and **2**.

DETAILED DESCRIPTION

[0045] While the invention has been shown and described with reference to a number of embodiments thereof, it will be recognized by those skilled in the art that various changes in form and detail may be made herein without departing from the spirit and scope of the invention as defined by the appended claims.

[0046] The invention provides a method which uses an ion-containing gas jet, formed by adiabatic expansion of the gas through a nozzle, in conjunction with a field barrier to sort the ions into those which can be pushed over the field barrier and those which are held back. To make the gas expand through the nozzle, a pressure difference at both sides of the nozzle has to be maintained, e.g. by a differential pumping system. The nozzle may be formed simply as a hole in the wall between two such pumping chambers. A Laval-type nozzle helps to form a nicely directed gas jet with uniform molecule velocities across the jet. The field barrier is preferably located opposite the nozzle across the central jet region.

[0047] In contrast to the prior art presented in publication WO 2004/109741 A2, in which ions are pushed over an electric field barrier by a laminar gas flow in a tube necessarily requiring an ion guiding field to hold the ions in the axis of the laminar flow, the present invention does not use the gas flow in a tube with its parabolic velocity profile, but uses instead a gas jet which is formed by the expansion of gas freely and adiabatically through a nozzle by a pressure difference. Within a nicely formed gas jet, for instance by a Laval nozzle, the gas molecules leaving the nozzle all have the same velocity and thus show an even velocity profile across the jet. This results in a surprisingly high mobility resolution. In its simplest but highly effective embodiments, this invention does not even require any ion guide up to the field barrier, which is a prerequisite in WO 2004/109741 A2.

[0048] The invention presented here furthermore uses this sorting of ions into those which can be pushed over the field barrier and those which are held back as the basis for methods to acquire ion mobility spectra, which then, in turn, allow the absolute values of ion mobilities to be determined after a suitable calibration with high precision of much less than one percent standard deviation.

[0049] An extremely simple embodiment of the invention without any RF ion guide is exhibited in FIG. **6**, presenting a rough scheme of an ion mobility spectrometer. The arrangement (**1**, **2**) shown symbolically here is a conventional electrospray unit comprising spray capillary, housing, curtain gas supply, and electric field arrangement to generate ions and to draw a large part of the ions into the nozzle (**6**) which is used here instead of the usual entrance capillary. Nozzle (**6**) is a tiny Laval nozzle with only a few micrometers diameter at the narrowest part, sucking a few liters of curtain gas per minute. Laval nozzles of this size can be produced by electron beam drilling, or by UV-Laser beam drilling. The Laval nozzle (**6**) generates a supersonic jet (**27**) which is directed across chamber (**4**) into the pump chamber (**23**), where a significant part of the jet is completely absorbed by a turbomolecular pump. A second pump (**22**) maintains a suitably low pressure in chamber (**4**). At the exit of the Laval nozzle (**6**), all molecules of the jet have the same velocity. A voltage at the ring electrode (**28**) generates a field barrier, which can be built up tightly at the exit of nozzle (**6**) by choosing the right size and distance of ring electrode (**28**). The field barrier holds back all ions in the curtain gas not having sufficiently low mobility, and these ions are necessarily discharged at the inner surfaces of the Laval nozzle (**6**). The passing ions (**34**) are accelerated by a second ring electrode (**37**) towards the detector system, here consisting of a conversion dynode (**35**) and a channeltron plate secondary electron multiplier (**21**). The ions (**34**) generate electrons at the conversion dynode (**35**), and the electrons (**36**) are accelerated towards the detector (**21**). If the ion current from the electrospray ion source is kept constant, the integral mobility spectrum can be measured by changing the voltage at the ring electrode (**28**) generating the field barrier.

[0050] Another simple embodiment is shown in FIG. **7**, comprising a conventional inlet capillary (**3**) and generating the jet (**27**) at much lower pressure. The ions are generated by the electrospray ion source (**1**) symbolically shown with spray capillary (**2**) only, and the ions are drawn by a curtain gas through the inlet capillary (**3**). The outflow (**26**) of the inlet capillary is directed inside chamber (**4**) towards an aperture (**31**) with a skimmer that reflects the largest part of the gas stream (**26**) which is pumped away by pump (**22**). A voltage at the skimmer (**31**) attracts a large part of the ions and makes them pass through the skimmer aperture. This type of skimmer arrangement was exclusively used until the invention of the ion funnel; many commercial mass spectrometers still today incorporate this skimmer arrangement. Within chamber (**7**), the ions (**33**) passing the skimmer aperture (**31**) are attracted by the lens system (**32**) and focused into the nozzle