transfer conduit **60** back to the controller **58**. It is to be understood that a plurality of sensors may be placed at different positions to obtain a temperature profile. Thus, the sensor(s) may be connected to the ion transfer conduit **60** for detecting a reduction in heat as gas is pumped through the plurality of passageways **140** in the sidewall of the ion transfer conduit **60**.

[0087] In an alternative arrangement, shown in FIG. **9***a*, the conduit **60** may be surrounded by an enclosed third vacuum chamber **150**. This may be employed to draw gas through the passageways **140** in the walls of the differential pumping arrangement **130**. It may equally however be utilized to introduce a flow of gas through the passageways **140** and into the channel **115** of the ion transfer conduit **60** instead of removing the background gas, as described above. This may be achieved by adjusting the pressure in the third vacuum chamber **150** to be between atmospheric pressure and the pressure in the channel **115**. By introducing a flow of gas through passageways **140** into the channel **115**, more turbulent flow conditions may be created in which sample droplets are disrupted. The more turbulent flow conditions may thus cause the sample droplets to be broken up into smaller droplets. This disruption of the droplets is an external force disruption, as opposed to a coulomb explosion type disruption which also breaks up the droplets. In the embodiment of FIG. **9***a*, an optional additional pumping port **56** is also shown, entering expansion chamber **40**. Pumping port **45** has been located towards the front of the plate electrodes **48** whilst pumping port **56** pumps the region between plate electrodes **48** and the entrance to the third vacuum chamber **150**.

[0088] In an application of both external force and coulomb explosion disruption, both removal and addition of gas may be applied in one ion transfer tube. For example, as shown in FIG. **9***b*, the third vacuum chamber **150** is shortened and only encloses a region of the second vacuum chamber **50**. By this means gas could be added to either portion of the second vacuum chamber **50**, via an inlet **156** or an inlet **156**. Thus, an alternating series of external force and coulomb explosion disruptions can be implemented to break up the droplets of the sample.

[0089] The wall of the differential pumping arrangement **130** in the embodiments of FIGS. **1** and **9***a*, **9***b*, **9***c* and **9***d*, may be formed from a material that includes one or more of a metal frit, a metal sponge, a permeable ceramic, and a permeable polymer. The passageways **140** may be defined by the pores or interstitial spaces in the material. The pores or interstices in the material of the sidewalls may be small and may form a generally continuous permeable element without discrete apertures. Alternatively, the passageways may take the form of discrete apertures or perforations formed in the sidewalls of the differential pumping arrangement **130**. The passageways may be configured by through openings that have one or more of round, rectilinear, elongate, uniform, and non-uniform configurations.

[0090] As a further detail FIG. **9***c* shows provisions to improve ion flow in the critical entrance region. The expansion zone **90** in the orifice **30** provides a simple form of jet seperation, preferentially transmitting heavier particles relatively close to the axis whilst lighter particles diffuse to the circumference and are not accepted by the subsequent apertures whilst the acceleration plates act to collect the ions. FIG. **9***d* shows an embodiment in which the nozzle plates **48** are reversed in orientation and themselves create the expansion zone, following a very thin entrance plate. With sufficient pressure reduction, heavy (i.e. heavier than the carrier gas) charged particles will easily enter the conduit region with a great deal of the carrier beam and lighter (solvent) ions being skimmed |away|.

[0091] The multiple pumping arrangement shown in FIGS. **9***a, c* and *d* (and which can also be applied to the embodiment of FIG. **9***b*) can help cutting interface cost, as an early reduction of the gas load reduces the pumping requirements for the next stage. Especially the very first stage **45** could reduce the gas load of the following stages by more than 2 even when it is a mere fan blower.

[0092] FIG. **10** shows simulated ion trajectories (r, z) using SIMION® software. The ID of the channel defined by the DC electrodes **120** is 0.75 mm, the long DC electrode segments **210** are 0.36 mm, the short electrode segments **205** are 0.12 mm, and the gaps between are 0.03 mm. The gas flow speed is 200 m/S, and the voltages applied to the sets of the segments are +/−100V|. |ions move from left to right. The simulation shows that the ions that are inside of ⅓ of the channel diameter defined by the DC electrodes are confined and focused along the channel. The maximal radial coordinate of oscillated ions is decreased from 0.16 mm at the start to the 0.07 mm at the exit along the length of about 20 mm. It is observed in FIG. **10** that ions that are not within ⅓ of the radius of the channel are lost because they do not move fast enough to overcome the opposite directed DC electrical field close to the channel walls. The simulations confirm that this ion confinement depends on the pressure inside the conduit **60**, and on the gas flow velocity. The effect is quite weak at atmospheric pressure (focusing from 0.174 mm to 0.126 mm) and a velocity corresponding to this pressure (approximately 60 m/s). However, much larger improvements in ion confinement are seen when employing the DC electrode arrangement **120** described above, at lower pressures (a few times lower than atmospheric pressure), with a gas flow velocity of ~200 m/s. This is because the maximal gas flow into MS**1 80**, where the pressure is about 1 mbar, is limited.

[0093] Thus, although there is some improvement in ion confinement in Region **2** when employing only the DC electrode arrangement **120**, and although, separately, there is an improvement when using the differential pumping arrangement **130** without radial electrostatic confinement with the DC electrode arrangement, both are in preferred embodiments employed together so as to create the optimal pressure regime (below about 300-600 mbar) whilst radially confining the ions electrostatically.

[0094] It will be noted from the introductory discussion above that the various parts of the ion transfer arrangement seek to keep the gas flow velocity upon exit from the conduit **60** to below supersonic levels so as to avoid shock waves. One consequence of this is that a skimmer is not necessary on the entrance into MS**1 80**—that is, the exit aperture **70** from Region **2** can be a simple aperture. It has been observed that the presence of a skimmer on the exit aperture can result in a reduction in ion current so the subsonic velocity of the gas leaving the conduit **60** in fact has a further desirable consequence (a skimmer is not needed).

[0095] Though most of the embodiments described above preferably employ ion transfer conduits of circular cross-section (i.e. a tube), the present invention is not limited to tubes.

[0096] Other cross-sections, e.g. elliptical or rectangular or even planar (i.e. rectangular or elliptical with a very high aspect ratio) might become more preferable, especially when