flexibility in the positioning of the ionization source. A number of embodiments use different sample holders which contain the sample for ionization. A rotatable sample holder for sequential sample ionization is another embodiment. Alternatively, a moving belt sample holder may be used. Preferably, the sample holder is positioned orthogonally to the drift cell axis.

[0025] The invention described herein has the goal of improving the general instrumental design and, as a result, the analytical performance of ion mobility instruments. This aspect of the present invention is focused on enhanced analytical performance, which results from using the improvements in the components of the instrumentation. These improvements primarily lie in the various electrode configurations and conformations. In a specific embodiment of the present invention, an apparatus and method for performing ion mobility spectrometry uses an ionization source, a drift cell and a detector. It also uses a parallel electrode assembly comprising a component of at least one field correcting ring electrode or at least one movable cylindrical electrode or at least one radius of curvature electrode. Preferably, matrix-assisted laser desorption ionization is used to ionize samples. Alternatively, electrospray ionization, a laser ionization, a photoionization, electron ionization, chemical ionization, an electric field ionization, surface ionization, radioactive ionization, discharge ionization and/or a multiphoton ionization may be used to ionize sample.

[0026] In a specific embodiment, a mass spectrometer is used as a detector and preferably it is a TOFMS and more preferably, it is a TOFMS having a flight tube positioned orthogonally with respect to the drift tube of the ion mobility cell. Alternatively, an IMS detector consisting of an ion collector and an amplifier may be used. In the TOFMS embodiment, TOFMS ion sources may include surface-induced ionization, collision-induced ionization, or photo-induced ionization. The interface between the drift cell and the mass spectrometer may be, for example, a microchannel plate aperture or a radio frequency focusing interface. In the preferred radio frequency focusing embodiment, the interface uses a combination of a radio frequency electric field and a direct current electric field. In the preferred microchannel aperture plate embodiment, a bundle of capillaries is used.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] **FIG. 1**: Prior art Mobility-TOFMS as published by Young et al.

[0028] **FIG. 2**(*a*) is a prior art ion mobility spectrometer. **FIG. 2**(*b*) is a periodic field focusing device with thick rings described in the simultaneously filed application which is incorporated by reference herein.

[0029] **FIG. 3**: Field lines in a drift tube of a hyperbolic (nonperiodic) instrument.

[0030] **FIG. 4**: Field lines in a drift tube of the periodic instrument described in the application simultaneously filed and incorporated by reference herein.

[0031] **FIG. 5**: Field lines in a drift tube of a periodic hyperbolic instrument.

[0032] **FIG. 6**(*a*): Instrumental embodiment incorporating a superposition of hyperbolic field focussing and periodic field focussing with cone shaped electrodes.

[0033] **FIG. 6**(*b*): Sealed version of the mobility drift cell of **FIG. 6**(*a*).

[0034] **FIG. 7**(*a*): Embodiment incorporating superposition of hyperbolic focusing and periodic field focusing with cone shaped holes in thick plates.

[0035] **FIG. 7**(*b*): Sealed version of the mobility drift cell of **FIG. 7**(*a*).

[0036] **FIG. 8**(*a*): Embodiment using pairs of thin electrode plates in which the electrodes forming the pair have unequal hole diameter.

[0037] **FIG. 8**(*b*): Similar to **FIG. 8**(*a*) differing in that the holes of each pair are equal.

[0038] **FIG. 9**(*a*) and **9**(*b*): Adjustable embodiment of that illustrated in FIGS. **8**(*a*) and **8**(*b*).

[0039] **FIG. 10**(*a*): Embodiment using the superposition of periodic field focusing and hyperbolic field focusing.

[0040] **FIG. 10**(*b*): Purely periodic (non-hyperbolic) field focusing analog of **FIG. 10**(*a*).

[0041] **FIG. 11**: Detailed illustration of insulation and sealing embodiment between in which o-rings surround the insulator gaps.

[0042] **FIG. 12**: Detailed illustration of insulation and sealing embodiment between in which o-rings abut the insulator gaps in the direction of the drift cell.

[0043] **FIG. 13**(*a*) is an instrumental embodiment capable of hyperbolic field focusing similar to the prior art instrument of **2**(*a*) but differing in that the electrode is slidably adjustable.

[0044] **FIG. 13**(*b*) illustrates an instrument capable of serial (as opposed to superimposed) hyperbolic and periodic field focusing.

[0045] **FIG. 14**: Embodiment having external ionizing beam and camera a rotatable sample holder; this embodiment uses mirrors to redirect the ionizing beam to the sample.

[0046] **FIG. 15**: Embodiment having a moving belt sample holder allowing for manual or automatic sample deposition.

[0047] **FIG. 16** is schematic view of an IMS-TOFMS spectrometer.

[0048] **FIG. 17** is a plot of equipotential lines of typical prior art devices.

[0049] **FIG. 18** is a plot of equipotential lines of a linear field produced by applying a voltage drop across tow parallel discs.

[0050] **FIG. 19** illustrates the equipotential lines obtained using a radius of curvature electrode and a flat disc electrode.

[0051] **FIG. 20** illustrates the equipotential lines obtained using a field correcting ring and a flat disc electrode.

[0052] **FIG. 21** illustrates the equipotential lines in another embodiment having a flat electrode and a second movable electrode.