tion process may occur within the ion trap before analysis in the time-of-flight spectrometer, obtaining MS/MS spectra. Time-of-flight mass spectrometers have the advantage of high mass range, good mass resolution, and fast spectrum acquisition. The transfer of ions to ion cyclotron resonance (ICR) mass spectrometers is also possible with ion guides according to this invention. ICR spectrometers operate with similar filling and investigation periods as RF quadrupole ion traps and, thus, the storage capability of the ion guides can greatly increase the duty cycle. Thermalization of ions is even more important here than with RF ion traps. The ion guide normally does not reach directly up the ICR cell, and the strong magnetic field takes over a part of the ion guidance.

In an additional embodiment, the double helix **8** is used to collect all ions above a certain cut-off limit, and double helix **12** is used for further mass-to-charge ratio preselection. This kind of operation is particularly interesting if ions of an electrophoresis substance peak are stored in helix **8**, and different kinds of ions are to be transferred to the ion trap in subsequent mass spectroscopic investigations. In a first primary spectrum acquisition, all kinds of ions may be detected and measured and, in subsequent phases, daughter spectra of all those primary ions may be acquired.

Ion sources which are located inside the vacuum system may also be connected to the mass spectrometer via ion guides according to this invention. There are many advantages of such a design, among them the advantage that ion peaks from separation devices may be temporarily stored, or that ions may be prefiltered. The advantage of ion guides according to this invention is not restricted to ion trap mass spectrometers. Other types of mass spectrometers, e.g. quadrupole mass filters, or magnetic sector field mass spectrometers, can benefit from the use of these ion guides. Specifically the thermalization, but also the sheer transfer of ions, provided by the ion guides of the present invention can have positive effects on these mass spectrometers.

The invention is also not restricted to the production of ion guides. Many types of enclosures for ions can be designed with this invention. Ions may be embottled in such devices for many purposes, e.g. optical experiments or reaction experiments, such as catalytic reactions in moderate vacuum. Such bottles may be easily produced, for instance, by two conical double helices put together with their wide ends facing each other. Furthermore, the invention can be used to build large-area gating grids for ions of both polarities.

While the invention has been shown and described with reference to a preferred embodiment thereof, it will be understood 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.

What is claimed is:

1. An ion reflection surface for reflecting charged particles of both positive and negative polarities, the surface comprising:

a plurality of electrically conducting grid elements spaced in a substantially regular manner in at least a first direction along the surface;

a first high-frequency electrical signal supplied to alternating grid elements along the first direction; and

a second high-frequency electrical signal supplied to alternating grid elements interspersed between the grid elements which are supplied with the first signal, the second electrical signal having the same frequency as the first electrical signal at a different relative phase.

2. An ion reflection surface according to claim **1** wherein the second electrical signal has a phase substantially opposite to that of the first electrical signal.

3. An ion reflection surface according to claim **1** further comprising a DC electrical signal which is superimposed on at least one of the high-frequency signals.

4. An ion reflection surface according to claim **3** further comprising an additional DC signal which is supplied to at least one of the grid elements such as to establish an electric field component along the first direction.

5. An ion reflection surface according to claim **1** wherein the grid elements are metal wire tips oriented perpendicularly to the reflection surface.

6. An ion reflection surface according to claim **1** wherein the high-frequency signals are radio frequency (RF) signals.

7. An ion reflection surface according to claim **1** wherein the alternating grid elements supplied with the first high-frequency signal comprise a metal mesh and the alternating grid elements supplied with the second high-frequency signal comprise isolated metal tips within cells formed by the mesh.

8. An ion reflection surface according to claim **7** wherein at least one of the high-frequency signals is superimposed by a DC electrical signal.

9. An ion reflection surface according to claim **8** further comprising an additional DC signal which is supplied to at least one of the grid elements such as to establish an electric field component along the first direction.

10. An ion reflection surface according to claim **1** wherein the grid elements are metal wires.

11. An ion reflection surface according to claim **1** wherein the grid elements comprise windings of two metal wires wound to a double helix, the first wire being supplied with the first electrical signal and the second wire being supplied with the second electrical signal.

12. An ion reflection surface according to claim **11** where the diameter and pitch of the double helix are selected to provide a predetermined potential distribution within the helix.

13. An ion reflection surface according to claim **11** further comprising a DC electrical signal supplied to at least one of the wires such that a DC field is generated along the cylinder axis which influences the injected ions.

14. An ion reflection surface according to claim **13** wherein the DC field is such that it influences the ions so as to filter charged particles within a predetermined range of mass-to-charge ratios.

15. An ion reflection surface according to claim **11** further comprising reflecting electric DC potentials of identical sign applied to both ends of the double helix so as to store ions within the double helix by reflection from the inner reflective surface and from the electric DC potentials at the ends of the double helix.

16. An ion relfection surface according to claim **15** wherein at least one of the electric DC potentials is switchable.

17. An ion reflection surface according to claim **11** further comprising a vacuum source which maintains a vacuum pressure within the double helix in the range of 10^{-4} to 10^{-2} millibar so as to thermalize kinetic energies of ions by collisions with gas molecules.

18. An ion reflection surface according to claim **1** wherein the reflection surface is an inner side of a cylindrical structure.

19. An ion reflection surface according to claim **18** wherein the ion reflection surface comprises an ion guide for guiding ions within the cylindrical structure in a general direction corresponding to an axis of the cylindrical structue.