CLAIMS

1. A mass spectrometer comprising:
a manifold having at least one reference surface that is integrally machined with the manifold;
at least one multipole ion optical assembly, wherein the multipole ion optical assembly comprises a support with two sides and a plurality of electrodes, wherein all of the electrodes are attached to one side of said support; and a mechanism that aligns the support to the at least one reference surface such that a number of interfaces between the reference surface of the manifold and the electrodes is minimised.

2. A mass spectrometer comprising a manifold and at least one multipole ion optical assembly, comprising:

the multipole ion optical assembly having a support with two sides and a plurality of electrodes, all electrodes being attached to one side of said support;

at least one reference surface that is integrally machined with the manifold; and

a mechanism that aligns the support to the at least one reference surface such that a number of interfaces between the reference surface of the manifold and the electrodes is minimised.

3. The mass spectrometer according to claim 1 or claim 2, wherein the manifold is a single machined work piece.

4. The mass spectrometer according to any one of the preceding claims, wherein the reference surface is a surface of a recess machined integrally with the manifold.

5. The mass spectrometer according to any one of the preceding claims, wherein the reference surface is a substantially planar surface at one of a post, step and plateau machined integrally with the manifold.

6. The mass spectrometer according to any one of the preceding claims, wherein the manifold comprises walls and a ground plate forming part of a housing of the mass spectrometer.

7. The mass spectrometer according to claim 6, wherein the walls of the housing have a height of less than 8 centimetres.

8. The mass spectrometer according to claim 6 or claim 7, wherein the manifold has a volume of less than 8,000 cubic centimetres.

9. The mass spectrometer according to any one of the preceding claims, wherein the reference surface is substantially planar and comprises at least one pin protruding therefrom, and wherein the support comprises corresponding recesses or openings for aligning the support in directions essentially parallel to the reference surface such that the ion optical assembly is aligned in more than one dimension.

10. The mass spectrometer according to any one of the preceding claims, wherein the ion optical assembly is an RF multipole electrode assembly, wherein the support is a substantially planar printed circuit board having two surfaces, and wherein all the electrodes are mounted on one surface of the printed circuit board and that one surface is aligned to the reference surface.

11. The mass spectrometer according to any one of claims 1 to 9, wherein the reference surface is substantially planar, wherein the ion optical assembly is a quadrupole mass filter having four rods and the support comprises insulating rings attached to and holding the rods, and wherein the rings have at least one common straight edge at an outer periphery for aligning the quadrupole mass filter to the reference surface.

12. The mass spectrometer according to claim 11, wherein the insulating rings are ceramic rings.

13. The mass spectrometer according to any one of claims 1 to 9, wherein the reference surface is substantially planar, wherein the ion optical assembly is a RF multipole rod assembly and the support comprises insulating rings attached to and holding the rods, and wherein the rings have at least one common straight edge at an outer periphery being aligned to the reference surface.

14. The mass spectrometer according to any one of the preceding claims, wherein the support is rigidly attached to the at least one reference surface by one of: adhesion, screwing and clamping.

15. The mass spectrometer according to any one of the preceding claims, wherein the shape accuracy and the position accuracy of the reference surface is better than ten micrometres each.

16. The mass spectrometer according to any one of the preceding claims, wherein a position accuracy of the ion optical assembly is better than hundred micrometres.

17. A mass spectrometer comprising:

a manifold having a reference surface machined integrally with the manifold;

at least one multipole ion optical assembly comprising a support with an adjustment surface, a plurality of electrodes, all of which are aligned to said adjustment surface; and

a mechanism that aligns the adjustment surface to the reference surface such that a number of interfaces between the reference surface and the adjustment surface is minimised.

18. The mass spectrometer according to claim 17, wherein the adjustment surface is machined at the support.

19. The mass spectrometer according to claim 17 or claim 18, wherein the support is one of an insulating ring and a circuit board.

20. The mass spectrometer according to any one of claims 17 to 19, wherein the reference surface and the adjustment surface contact each other over a surface area.

CLAIMS

1. A mass spectrometer comprising a manifold having walls and a base plate forming part of a housing of the mass spectrometer, and at least one multipole ion optical assembly, comprising:
the multipole ion optical assembly having a support with two sides and a plurality of electrodes, all electrodes being attached directly to one side of said support; and
at least one reference surface that is integrally machined with the manifold;
wherein the side of the support to which the plurality of electrodes is directly attached contacts, and thus is aligned to, the at least one reference surface.

2. The mass spectrometer according to claim 1, wherein the manifold is a single machined work piece.

3. The mass spectrometer according to claim 1, wherein the reference surface is a surface of a recess machined integrally with the manifold.

4. The mass spectrometer according to claim 1, wherein the reference surface is a substantially planar surface at one of a post, step and plateau machined integrally with the manifold.

5. The mass spectrometer according to claim 1, wherein the walls of the housing have a height of less than 8 centimeters.

6. The mass spectrometer according to claim 5, wherein the manifold has a volume of less than 8,000 cubic centimeters.

7. The mass spectrometer according to claim 1, wherein the reference surface is a substantially planar surface at one of a step and plateau machined integrally with the walls.

8. The mass spectrometer according to claim 1, wherein the reference surface is substantially planar and comprises at least one pin protruding therefrom, and wherein the support comprises corresponding recesses or openings for aligning the support in directions essentially parallel to the reference surface such that the ion optical assembly is aligned in more than one dimension.

9. The mass spectrometer according to claim 1, wherein the ion optical assembly is an RF multipole electrode assembly, wherein the support is a substantially planar printed circuit board having two surfaces, and wherein all the electrodes are mounted on one surface of the printed circuit board and that one surface contacts, and thus is aligned to, the reference surface.

10. The mass spectrometer according to claim 1, wherein the support is rigidly attached to the at least one reference surface by one of: adhesion, screwing and clamping.

11. The mass spectrometer according to claim 1, wherein the shape accuracy and the position accuracy of the reference surface is better than ten micrometers each.

12. The mass spectrometer according to claim 1, wherein a position accuracy of the ion optical assembly is better than one hundred micrometers.

13. A mass spectrometer comprising a manifold having walls and a base plate forming part of a housing of the mass spectrometer, and at least one multipole ion optical assembly, comprising:
the multipole ion optical assembly having a support with an adjustment surface, and a plurality of electrodes, all of which are attached and aligned to said adjustment surface; and
a reference surface being a substantially planar surface at a protruding feature having the shape of one of a post, step and plateau, machined integrally with the manifold;

wherein a side of the support opposing the adjustment surface contacts the reference surface and thus aliens the adjustment surface to the reference surface.

14. The mass spectrometer according to claim 13, wherein the adjustment surface is machined at the support.

15. The mass spectrometer according to claim 13, wherein the support is one of an insulating ring and a circuit board.

16. The mass spectrometer according to claim 13, wherein the reference surface and the adjustment surface contact each other over a surface area.

17. A mass spectrometer comprising a manifold having walls and a base plate forming part of a housing of the mass spectrometer, and at least one multipole ion optical assembly, comprising:
the multipole ion optical assembly having a support with two sides and a plurality of electrodes, all of which are attached to a first side of said support, a pair of said electrodes of the plurality of electrodes being directly attached to said first side of said support; and
at least one reference surface that is integrally machined with the manifold;
wherein the side of the support to which the electrodes are directly attached contacts, and thus is aligned to, the at least one reference surface.