WHAT IS CLAIMED IS:

1. A mass spectrometer comprising:

(A) a vacuum housing defining a vacuum cavity to support a vacuum of about 10^{-5} mm Hg or less;

(B) an electrode, disposed within the vacuum cavity and configured to be charged to an electrode potential, to control acceleration of a charged particle propagating through the vacuum cavity;

(C) a conversion circuit, disposed within the vacuum cavity, to convert an input voltage from a power source outside the vacuum cavity so as to provide the electrode potential for the electrode; and

(D) a feedthrough having a dielectric strength of less than or equal to about 36 V to provide an electrical connection between the conversion circuit and the power source.

2. The mass spectrometer of claim 1, wherein the charged particle is an electron.

3. The mass spectrometer of claim 2, further comprising:

(E) an electron source, disposed within the vacuum cavity, to provide the electron;

(F) a cathode to repel the electron; and

(G) an anode, disposed opposite the electrode from the electron source, to accelerate the electron toward an analyte particle to be analyzed.

4. The mass spectrometer of claim 3, wherein the conversion circuit is further configured to provide:

(i) an anode potential of about 100 V to about 5 kV for the anode; and

(ii) a cathode potential about 70 V below the anode potential for the cathode,

wherein the electrode potential is between about 0 V and about 140 V below the anode potential.

5. The mass spectrometer of claim 2, further comprising:

(H) control electronics, disposed within the vacuum cavity and operably coupled to the conversion circuit, to vary the electrode potential.

6. The mass spectrometer of claim 1, wherein the conversion circuit is configured to convert the input voltage, having a first value of about 1 V to about 36 V, to the electrode potential, having a second value of about 100 V to about 5 kV.

7. The mass spectrometer of claim 1, wherein the feedthrough is the only electrical connection between the inside and the outside of the vacuum cavity.

8. A mass spectrometry method comprising:

(A) providing a vacuum cavity evacuated to a pressure of about 10^{-5} mm Hg or less;

(B) receiving an input voltage from a power source outside the vacuum cavity;

(C) converting the input voltage to an electrode potential with a conversion circuit disposed within the vacuum cavity;

(D) charging an electrode within the vacuum cavity to the electrode potential; and

(E) accelerating a charged particle within the vacuum cavity with the electrode charged in (D).

9. The method of claim 8, wherein the input voltage is about 3 V to about 36 V and the electrode potential is about 100 V to about 5 kV.

10. The method of claim 8, wherein the charged particle is an electron, and wherein (E) further comprises:

(E1) varying the electrode potential to control acceleration of the electron.

11. The method of claim 9, wherein (E1) comprises:

controlling the electrode potential with an electronic component disposed within the vacuum cavity.

12. The method of claim 8, wherein the charged particle is an ionized analyte particle, and further comprising:

(F) determining a mass of the ionized analyte particle based on acceleration of the charged particle.

13. A mass spectrometer comprising:

(A) a vacuum housing defining a vacuum cavity;

(B) a magnet in a magnetic yoke to generate a magnetic field having a first strength in a first region and a second strength in a second region;

(C) an ion pump, positioned so as to be in the first region, to maintain a vacuum pressure of the vacuum cavity;

(D) a mass analyzer, positioned so as to be in the second region, to determine a mass of an ionized analyte particle propagating through the vacuum cavity;

(E) a control electrode, disposed within the vacuum cavity, to control acceleration of an electron that ionizes the analyte particle; and

(F) a conversion circuit, disposed within the vacuum cavity, to provide a converted voltage to the ion pump, the control electrode, and/or the mass analyzer.

14. The mass spectrometer of claim 13, wherein the magnet in the magnetic yoke is configured such that the first strength is about 0.1 Tesla and the second strength is about 0.7 Tesla when the magnetic field is generated.

15. The mass spectrometer of claim 13, wherein the mass analyzer is a magnetic sector analyzer.

16. The mass spectrometer of claim 13, further comprising:

(G) control electronics, disposed within the vacuum cavity and operably coupled to the conversion circuit, to vary a potential of the control electrode.

17. The mass spectrometer of claim 13, further comprising:

(H) signal processing electronics, disposed within the vacuum cavity and configured to be powered by the conversion circuit, to process signals provided by the mass analyzer.

18. The mass spectrometer of claim 13, further comprising:

(I) an electron source, disposed within the vacuum cavity, to provide the electron;

(J) a cathode to repel the electron; and

(K) an anode, disposed on opposite the control electrode from the electron source, to accelerate the electron toward the analyte particle.

19. The mass spectrometer of claim 18, wherein the conversion circuit is further configured to provide:

(i) an anode potential of about 100 V to about 5 kV for the anode;

(ii) a cathode potential about 70 V below the anode potential for the cathode; and

(iii) a control potential about 0 V and about 140 V below the anode potential for the control electrode.

20. The mass spectrometer of claim 18, wherein the conversion circuit is configured to provide the converted voltage, having a first value of about 100 V to about 5 kV, from an input voltage, having a second value of about 1 V to about 36 V.

What is claimed is:

1. A mass spectrometer comprising:

(A) a vacuum housing defining a vacuum cavity to support a vacuum of about 10^{-5} mm Hg or less;

(B) an electrode, disposed within the vacuum cavity and configured to be charged to an electrode potential, to control acceleration of a charged particle propagating through the vacuum cavity;

(C) a conversion circuit, disposed within the vacuum cavity, to convert an input voltage from a power source outside the vacuum cavity so as to provide the electrode potential for the electrode;

(D) a feedthrough having a dielectric strength of less than or equal to about 36 V to provide an electrical connection between the conversion circuit and the power source;

(E) control electronics, disposed within the vacuum cavity and operably coupled to the conversion circuit, to vary the electrode potential; and

(F) a heater, operably coupled to the control electronics and in thermal communication with at least one component within the vacuum cavity, to heat the at least one component in response to a signal from the control electronics so as to drive gas off the at least one component.

2. The mass spectrometer of claim 1, wherein the charged particle is an electron.

3. The mass spectrometer of claim 2, further comprising: an electron source, disposed within the vacuum cavity, to provide the electron; a cathode to repel the electron; and an anode, disposed opposite the electrode from the electron source, to accelerate the electron toward an analyte particle to be analyzed.

4. The mass spectrometer of claim 3, wherein the conversion circuit is further configured to provide: (i) an anode potential of about 100 V to about 5 kV for the anode; and (ii) a cathode potential about 70 V below the anode potential for the cathode, wherein the electrode potential is between about 0 V and about 140 V below the anode potential.

5. The mass spectrometer of claim 1, wherein the conversion circuit is configured to convert the input voltage, having a first value of about 1 V to about 36 V, to the electrode potential, having a second value of about 100 V to about 5 kV.

6. The mass spectrometer of claim 1, wherein the feedthrough is the only electrical connection between the inside and the outside of the vacuum cavity.

7. A mass spectrometry method comprising:

(A) heating at least one component in a vacuum cavity in response to a signal from control electronics so as to drive gas off the at least one component

(B) providing the vacuum cavity evacuated to a pressure of about 10^{-5} mm Hg or less;

(C) receiving an input voltage from a power source outside the vacuum cavity;

(D) converting the input voltage to an electrode potential with a conversion circuit disposed within the vacuum cavity;

(E) charging an electrode within the vacuum cavity to the electrode potential; and

(F) accelerating a charged particle within the vacuum cavity with the electrode charged in (E).

8. The method of claim 7, wherein the input voltage is about 3 V to about 36 V and the electrode potential is about 100 V to about 5 kV.

9. The method of claim 7, wherein the charged particle is an electron, and wherein (F) further comprises: (F1) varying the electrode potential to control acceleration of the electron.

10. The method of claim 9, wherein (F1) comprises: controlling the electrode potential with an electronic component disposed within the vacuum cavity.

11. The method of claim 7, wherein the charged particle is an ionized analyte particle, and further comprising: (G) determining a mass of the ionized analyte particle based on acceleration of the charged particle.

12. A mass spectrometer comprising:

(A) a vacuum housing defining a vacuum cavity;

(B) a magnet, in a magnetic yoke that defines at least one gap, to generate a magnetic field having a first strength in a first region within the at least one gap and a second strength in a second region within the at least one gap;

(C) an ion pump, positioned so as to be in the first region within the at least one gap, to maintain a vacuum pressure of the vacuum cavity;

(D) a mass analyzer, positioned so as to be in the second region within the at least one gap, to determine a mass of an ionized analyte particle propagating through the vacuum cavity;

(E) a control electrode, disposed within the vacuum cavity, to control acceleration of an electron that ionizes the analyte particle;

(F) a conversion circuit, disposed within the vacuum cavity, to provide a converted voltage to the ion pump, the control electrode, and/or the mass analyzer;

(G) control electronics disposed within the vacuum cavity and operably coupled to the conversion circuit to vary a potential of the control electrode; and

(H) a heater, operably coupled to the control electronics and in thermal communication with at least one component within the vacuum cavity, to heat the at least one component in response to a signal from the control electronics so as to drive gas off the at least one component.

13. The mass spectrometer of claim 12, wherein the magnet in the magnetic yoke is configured such that the first strength is about 0.1 Tesla and the second strength is about 0.7 Tesla when the magnetic field is generated.

14. The mass spectrometer of claim 12, wherein the mass analyzer is a magnetic sector analyzer.

15. The mass spectrometer of claim 12, further comprising: signal processing electronics, disposed within the vacuum cavity and configured to be powered by the conversion circuit, to process signals provided by the mass analyzer.

16. The mass spectrometer of claim 12, further comprising: an electron source, disposed within the vacuum cavity, to provide the electron; a cathode to repel the electron; and an anode, disposed on

opposite the control electrode from the electron source, to accelerate the electron toward the analyte particle.

17. The mass spectrometer of claim 16, wherein the conversion circuit is further configured to provide: (i) an anode potential of about 100 V to about 5 kV for the anode;

(ii) a cathode potential about 70 V below the anode potential for the cathode; and

(iii) a control potential about 0 V and about 140 V below the anode potential for the control electrode.

18. The mass spectrometer of claim 16, wherein the conversion circuit is configured to provide the converted voltage, having a first value of about 100 V to about 5 kV, from an input voltage, having a second value of about 1 V to about 36 V.

19. The mass spectrometer of claim 1, wherein the control electronics comprise at least one digital-to-analog converter to set the electrode potential for the electrode.

20. The mass spectrometer of claim 1, wherein the heater comprises a network of resistive heating elements disposed on a substrate.

21. The mass spectrometer of claim 1, further comprising:

(I) an ion pump, disposed within the vacuum cavity, to pump the gas out of the vacuum cavity so as to maintain the vacuum of about 10^{-5} mm Hg or less.

22. The mass spectrometer of claim 1, further comprising:

(J) a wireless communications interface, operably coupled to the control electronics, to relay data and instructions between the inside of the vacuum cavity and the outside of the vacuum cavity.

23. The mass spectrometer of claim 12, wherein the control electronics comprise at least one digital-to-analog converter to set the electrode potential for the electrode.

24. The mass spectrometer of claim 12, wherein the heater comprises a network of resistive heating elements disposed on a substrate.

25. The mass spectrometer of claim 12, further comprising: a wireless communications interface, operably coupled to the control electronics, to relay data and instructions between the inside of the vacuum cavity and the outside of the vacuum cavity.