

CLAIMS

1. A method of operating a mass spectrometer system comprising a pressurized cell, the method comprising:

5 a) emitting an ion stream from an ion source, the ion stream comprising a plurality of groups of ions of a plurality of different kinds, including a first group of ions of a first kind and a second group of ions of a second kind, wherein each respective group of ions comprises individual ions of i) a corresponding kind in the plurality of different kinds, and ii) energies that define a corresponding energy distribution for that respective group of ions, and wherein individual ions in the first
10 group of ions have on average a larger collisional cross-section than individual ions in the second group of ions;

b) transmitting to, and admitting the ion stream into, an entrance end of the pressurized cell, the pressurized cell being a quadrupole pressurized cell comprising a quadrupole rod set;

15 c) during b), for each respective group of ions in the ion stream, controlling a range of the corresponding energy distribution to lie within a selected maximum range;

d) supplying an RF voltage to the quadrupole rod set to form a quadrupolar field therewithin for radial confinement of ions being transmitted from the
20 entrance end to an exit end of the pressurized cell downstream of the entrance end;

e) focusing the ion stream at a location upstream of the quadrupole rod set to direct most of the ion stream within an acceptance ellipse of the quadrupole rod set;

25 f) providing an inert gas within the pressurized cell, the inert gas being substantially non-reactive with ions of the first and second kinds, to collide with a first proportion of the first group of ions and a second proportion of the second group of ions, the first proportion being substantially greater than the second proportion, to reduce the energies of the individual ions in the first group of ions to a greater extent than in the second group of ions; and,

g) providing an exit barrier at the exit end of the pressurized cell of a strength selected to prevent a larger proportion of the reduced energy ions in the first group of ions than in the second group of ions from penetrating the exit barrier.

2. The method as defined in claim 1, wherein the selected maximum range is 2eV measured at full width, half max (FWHM) of an ion group distribution.

3. The method as defined in claim 1, wherein the first and second group of ions are of kinds having equal or nearly equal mass to charge ratios.

4. The method as defined in claim 3, wherein the first group of ions is of a polyatomic kind and the second group of ions is of a monatomic kind.

5. The method as defined in claim 1, wherein the inert gas is selected from the group comprising: helium and neon.

6. The method as defined in claim 1, wherein the RF voltage supplied to the quadrupole rod set is selected to provide a quadrupolar field of sufficient strength to confine at least a substantial portion of the second group of ions within the quadrupole rod set when scattered due to collision with the inert gas.

7. The method as defined in claim 1, wherein the ion source is an inductively coupled plasma ion source.

8. The method as defined in claim 7, wherein each respective group of ions has a corresponding initial energy distribution at the ion source, and

b) comprises transmitting the ion stream from the inductively coupled plasma ion source to the pressurized cell while maintaining, for each respective group of ions in the ion stream, the range of the corresponding energy distribution to within five percent of an initial range of the corresponding initial energy distribution at the ion source.

9. The method as defined in claim 7, further comprising providing an axial field of a selected field strength within the pressurized cell to push the ions in the ion stream from the entrance end to the exit end of the pressurized cell.

10. The method as defined in claim 9, wherein the axial field of the selected field strength has an axial field gradient of between 0.1V/cm and 0.5 V/cm.

11. The method as defined in claim 10, wherein the axial field gradient is between 0.15V/cm and 0.25 V/cm.

5 12. The method as defined in claim 1, further comprising providing an exit potential to an exit member to attract the ions, the exit potential between -40V and -18V.

13. The method as defined in claim 12, wherein the exit potential provided to the exit member is between -35V and -25V.

10 14. The method as defined in claim 12, further comprising providing an entrance potential to an entrance member of the pressurized cell, the entrance potential being more positive than the exit potential.

15. The method as defined in claim 14, wherein the entrance potential is between -5V and +2V.

15 16. The method as defined in claim 15, wherein the entrance potential is between -3V and 0.

17. The method as defined in claim 1, wherein b) to g) occur in a kinetic energy discrimination (KED) mode of operation, and the method further comprises switching from the KED mode of operation to a dynamic reaction cell (DRC) mode of operation
20 by:

h) evacuating the inert gas from the pressurized cell and applying DRC mode cell voltages;

i) determining a spectral interferer ion kind in the ion stream, the spectral interferer ion kind having an equal or nearly equal mass to charge ratio as
25 an analyte ion kind,

j) selecting a gas that is reactive with one of the spectral interferer and ion analyte kinds, and inert toward the other of the spectral interferer and analyte ion kinds; and,

k) providing the selected reactive gas within the pressurized cell.

5 18. The method as defined in claim 17 wherein the method further comprises switching from the DRC mode of operation to the KED mode of operation by:

l) evacuating the selected reactive gas from the pressurized cell and applying KED mode cell voltages; and,

m) providing the inert gas within the pressurized cell.

10 19. The method as defined in claim 18, wherein the pressurized cell is supplied with a cell offset voltage, and the method further comprises for both the KED and DRC modes of operation, transmitting ions ejected from the pressurized cell to a downstream mass analyzer supplied with a downstream offset voltage, wherein the downstream offset voltage is more positive than the cell offset voltage when in the
15 KED mode of operation, and more negative than the cell offset voltage when in the DRC mode of operation.

20 20. The method as defined in claim 19, wherein the downstream offset voltage is between 2V to 5V more positive than the cell offset voltage when in the KED mode of operation, and between 4V to 6V more negative than the cell offset voltage when in the DRC mode of operation.

21. The method as defined in claim 19, wherein the exit barrier is formed in the KED mode of operation by a difference between the downstream offset and cell offset voltages, and the method further comprises controlling the difference between the downstream offset and cell offset voltages based on the first ion kind.

25 22. The system as defined in claim 21, wherein the difference between the downstream offset and cell offset voltages is further controlled based on the second ion kind.

23. The method as defined in claim 1, further comprising, upstream of the pressurized cell, deflecting the ion stream from a first trajectory to a second trajectory different from the first trajectory to remove at least one of photons, neutral particles and gas molecules from the ion stream.

5 24. The method as defined in claim 23, wherein the second trajectory is orthogonal to the first trajectory.

25. The method as defined in claim 23, wherein a) comprises emitting the ion stream from the ion source along the first trajectory, and b) comprises admitting the ion stream into the pressurized cell along the second trajectory.

10 26. A mass spectrometer system comprising:

an ion source operable to emit an ion stream comprising a plurality of groups of ions of a plurality of different kinds, including a first group of ions of a first kind and a second group of ions of a second kind, wherein each respective group of ions comprises individual ions of i) a corresponding kind in the plurality of different
15 kinds, and ii) energies that define a corresponding energy distribution for that respective group of ions, and wherein individual ions in the first group of ions have on average a larger collisional cross-section than individual ions in the second group of ions;

a pressurized cell comprising i) an ion inlet at an entrance end of the
20 pressurized cell for receiving the ion stream into the pressurized cell, and ii) a quadrupole rod set;

a voltage source linked to the quadrupole rod set, the voltage source operable to supply an RF voltage to the quadrupole rod set to form a quadrupolar field therewithin for radial confinement of ions being transmitted from the entrance
25 end to an exit end of the pressurized cell downstream of the entrance end, such that the pressurized cell is operable as a quadrupole pressurized cell;

ion optics included at a location upstream of the quadrupole rod set and configured to control, for each respective group of ions in the ion stream, a range of the corresponding energy distribution to lie within a selected maximum

range throughout transmission of the ion stream to the pressurized cell, and further to direct most of the ion stream within an acceptance ellipse of the quadrupole rod set;

an inert gas source fluidly coupled to the pressurized cell to provide a quantity of the inert gas therewithin, the inert gas being substantially non-reactive with ions of the first and second kinds, to collide with a first proportion of the first group of ions and a second proportion of the second group of ions, the first proportion being substantially greater than the second proportion, to reduce the energies of the individual ions in the first group of ions to a greater extent than in the second group of ions; and,

an exit barrier formed at the exit end of the pressurized cell, the exit barrier of a strength selected to prevent a larger proportion of the reduced energy ions in the first group of ions than in the second group of ions from penetrating the exit barrier.

27. The method as defined in claim 26, wherein the selected maximum range is about 2eV measured at full width, half max (FWHM) of an ion group distribution.

28. The system as defined in claim 26, wherein the first and second group of ions are of kinds having equal or nearly equal mass to charge ratios.

29. The system as defined in claim 28, wherein the first group of ions is of a polyatomic kind and the second group of ions is of a monatomic kind.

30. The system as defined in claim 26, wherein the quadrupolar field formed within the quadrupole rod set is of sufficient strength to confine at least a substantial portion of the second group of ions within the quadrupole rod set when scattered due to collision with the inert gas.

31. The system as defined in claim 26, wherein the ion source is an inductively coupled plasma ion source.

32. The system as defined in claim 26, further comprising

a reactive gas source fluidly coupled to the pressurized cell to provide a quantity of a reactive gas therewithin, the reactive gas source operable to provide a plurality of different reactive gas types; and,

a pump fluidly coupled to the pressurized cell to evacuate gas therefrom.

5 33. The system as defined in claim 32, further comprising a mode controller operable to switch from a kinetic energy discrimination (KED) mode of operation to a dynamic reaction cell (DRC) mode of operation by:

i) controlling the pump to evacuate the inert gas from the pressurized cell;

10 ii) determining a spectral interferer ion kind in the ion stream based on an analyte ion kind, the spectral interferer ion kind having an equal or nearly equal mass to charge ratio as the analyte ion kind;

15 iii) controlling the reactive gas source to provide within the pressurized cell a quantity of a reactive gas selected from the plurality of different reactive gas types in the reactive gas source, the selected reactive gas being of a type that is reactive with one of the spectral interferer and analyte ion kinds, but inert toward the other of the spectral interferer and analyte ion kinds; and

iv) applying the appropriate KED mode cell voltages.

20 34. The system as defined in claim 33, wherein the mode controller is configured to switch from the DRC mode of operation to the KED mode of operation by:

i) controlling a pump to evacuate the selected reactive gas from the pressurized cell; and then,

25 ii) controlling the inert gas source to provide a quantity of the inert gas within the pressurized cell.

35. The system as defined in claim 34, wherein the inert gas is selected from the group comprising: helium, neon.

36. The system as defined in claim 26, wherein the pressurized cell further comprises an auxiliary rod set linked to the voltage source to receive an auxiliary voltage, the auxiliary rod set configured to provide an axial field of a selected field strength within the pressurized cell to push the ions in the ion stream from the entrance end to the exit end of the pressurized cell.
37. The system as defined in claim 36, wherein the axial field of the selected field strength has an axial field gradient of between 0.1V/cm and 0.5 V/cm.
38. The system as defined in claim 37, wherein the axial field gradient is between 0.15V/cm and 0.25 V/cm.
39. The system as defined in claim 26, wherein the pressurized cell further comprises an exit member linked to the voltage source, the exit member supplied by the voltage source with an exit potential between -40V and -18V.
40. The system as defined in claim 39, wherein the exit potential supplied to the exit member by the voltage source is between -35V and -25V.
41. The system as defined in claim 39, wherein the pressurized cell further comprises an entrance member linked to the voltage source, the entrance member supplied by the voltage source with an entrance potential more positive than the exit potential.
42. The system as defined in claim 41, wherein the entrance potential is between -5V and +2V.
43. The system as defined in claim 42, wherein the entrance potential is between -3V and 0.
44. The system as defined in claim 33, further comprising a downstream mass analyzer operable to receive ions that penetrate the exit barrier, and wherein the voltage source supplies the pressurized cell with a cell offset voltage and the downstream mass analyzer with a downstream offset voltage.
45. The system as defined in claim 44, wherein

the mode controller is configured to control the downstream offset voltage to be i) more positive than the cell offset voltage when in the KED mode of operation, and ii) more negative than the cell offset voltage when in the DRC mode of operation.

5 46. The system as defined in claim 45, wherein the downstream offset voltage is controlled to be between 2V and 5V more positive than the cell offset voltage when in the KED mode of operation, and to be between 4V and 6V more negative than the cell offset voltage when in the DRC mode of operation.

10 47. The system as defined in claim 45, wherein the exit barrier is formed in the KED mode of operation by a difference between the downstream offset and cell offset voltages, and the mode controller is configured to control the difference between the downstream offset and cell offset voltages based on the first ion kind.

15 48. The system as defined in claim 47, wherein the mode controller is configured to control the difference between the downstream offset and cell offset voltages further based on the second ion kind.

20 49. The system as defined in claim 26, further comprising a ion deflector located upstream of the pressurized cell to deflect the ion stream from a first trajectory to a second trajectory different from the first trajectory, the ion deflector being operable to remove interfering particles from the ion stream including at least one of: photons, neutral particles, and gas molecules.

50. The system as defined in claim 49, wherein the ion deflector is a quadrupole ion deflector defining the second trajectory to be orthogonal to the first trajectory.

51. A system configured to permit switching of a cell between at least two modes comprising a collision mode and a reaction mode, the system comprising:

5 a cell configured to receive a collision gas in a collision mode to pressurize the cell and configured to receive a reactive gas in a reaction mode to pressurize the cell; and

10 a controller electrically coupled to the cell, the controller configured to provide a first effective voltage to the pressurized cell in the collision mode to select ions comprising an energy greater than a selected barrier energy, the controller further configured to provide a second effective voltage to the pressurized cell in the reaction mode to select ions using mass filtering.

52. The system of claim 51, in which the system is further configured to permit switching to a vented mode.

15 53. The system of claim 51, in which the system further comprises a gas manifold fluidically coupled to a gas inlet of the cell.

54. The system of claim 51, in which the cell comprises a quadrupole.

20 55. The system of claim 54, in which the cell comprises an exit member proximate to an exit aperture of the cell and electrically coupled to a voltage source, the exit member configured to direct analyte ions in the pressurized cell toward the exit aperture of the cell.

25 56. The system of claim 55, in which the exit member comprises a potential between -60 Volts and -18 Volts in the collision mode.

57. The system of claim 55, in which the exit member comprises a potential between -20 Volts and 0 Volts in the reaction mode.

30 58. The system of claim 55, in which the cell comprises an entrance member proximate to an entrance aperture of the cell and electrically coupled to the voltage

source, the entrance member configured to direct analyte ions into the pressurized cell and toward the exit aperture of the cell.

59. The system of claim 58, in which the entrance member comprises a potential
5 between -10 Volts and +2 Volts in the collision mode.

60. The system of claim 58, in which the entrance member comprises a potential substantially the same as a potential of the exit member in the reaction mode.

10 61. The system of claim 51, in which the cell is configured to switch from the collision mode to the reaction mode by exhausting the cell prior to introduction of a reactive gas into the cell.

15 62. The system of claim 51, in which the cell is configured to switch from the reaction mode to the collision mode by exhausting the cell prior to introduction of a collision gas into the cell.

20 63. The system of claim 51, further comprising an additional cell coupled to the cell, the additional cell configured to receive a collision gas in a collision mode to pressurize the additional cell and a reactive gas in a reaction mode to pressurize the additional cell.

25 64. The system of claim 63, in which the controller is configured to operate at least one of the cell and the additional cell in the reaction mode and to operate the other cell in a standard mode.

30 65. The system of claim 63, in which the controller is configured to operate at least one of the cell and the additional cell in the collision mode and to operate the other cell in a standard mode.

66. The system of claim 63, in which the controller is configured to operate at least one of the cell and the additional cell in the collision mode and to operate the other cell in the reaction mode.

67. The system of claim 63, in which the controller is configured to operate both the cell and the additional cell in the collision mode.

5 68. The system of claim 63, in which the controller is configured to operate both the cell and the additional cell in the reaction mode.

69. The system of claim 63, in which the controller is configured to operate both the cell and the additional cell in a standard mode.

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70. The system of claim 51, further comprising axial electrodes electrically coupled to a voltage source and configured to provide an axial field to direct ions toward an exit aperture of the cell.

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71. The system of claim 70, in which the axial field comprises a field gradient between 0.1 V/cm and 0.5 V/cm.

72. The system of claim 51, in which the controller is further configured to provide an offset voltage to the cell.

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73. The system of claim 72, further comprising a mass analyzer coupled to the cell comprising an offset voltage.

74. The system of claim 73, in which the offset voltage of the mass analyzer is more positive than the offset voltage of the cell when the cell is operated in the collision mode.

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75. The system of claim 73, in which the offset voltage of the mass analyzer is more negative than the offset voltage of the cell when the cell is operated in the reaction mode.

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76. The system of claim 51, further comprising an ionization source coupled to the pressurized cell.

77. The system of claim 76, in which the ionization source is an inductively coupled plasma.

78. The system of claim 77, further comprising a mass analyzer coupled to the cell.

79. The system of claim 77, in which the cell is positioned between the inductively coupled plasma and the mass analyzer.

80. The system of claim 77, in which the cell is positioned downstream from the mass analyzer.

81. A system comprising:

an ion source;

a cell coupled to the ion source and configured to operate in at least three different modes comprising a collision mode, a reaction mode and a standard mode. The three different modes each configured to select analyte ions from a plurality of ions introduced into the cell from the ion source, the cell configured to couple to the ion source at an entrance aperture to permit introduction of the plurality of ions from the ion source into the cell, the cell further comprising a gas inlet configured to receive a substantially inert gas to pressurize the cell in a collision mode and to receive a reactive gas to pressurize the cell in a reaction mode, the pressurized cell further comprising an exit aperture configured to provide the analyte ions from the cell;

a mass analyzer coupled to the cell; and

a controller electrically coupled to the cell and configured to provide the substantially inert gas to pressurize the cell in the collision mode, configured to provide the reactive gas to pressurize the cell in the reaction mode, and configured to maintain the cell under vacuum in the standard mode.

82. The system of claim 81, in which the controller provides a voltage to the pressurized cell to select the analyte ions from the plurality of analyte and non-analyte ions introduced into the pressurized cell.

5 83. The system of claim 82, in which the pressurized cell comprises a quadrupole.

84. The system of claim 83, in which the voltage is provided to the quadrupole to provide a quadrupolar field effective to confine a substantial amount of non-analyte ions in the plurality of introduced ions by colliding the non-analyte ions with the
10 substantially inert gas in the collision mode.

85. The system of claim 84, further comprising axial electrodes configured to provide an axial field to direct the analyte ions from the entrance aperture toward an exit aperture of the pressurized cell.

15 86. The system of claim 85, in which the axial field strength has an axial field gradient between 0.1 V/c, and 0.5 V/cm.

87. The system of claim 83, further comprising an exit member proximal to an exit
20 aperture of the pressurized cell, the exit member comprising an exit potential to attract analyte ions toward the exit aperture of the pressurized cell.

88. The system of claim 87, in which the exit potential is between about -60 Volts and -18 Volts in the collision mode.

25 89. The system of claim 87, in which the exit potential is between about -20 Volts and 0 Volts in the reaction mode.

90. The system of claim 87, further comprising an entrance member proximal to
30 the entrance aperture of the pressurized cell, the entrance member comprising an entrance potential more positive than the exit potential in the collision mode.

91. The system of claim 90, in which the entrance potential is between – 10 Volts and +2 Volts.

92. The system of claim 87, further comprising an entrance member proximal to the entrance aperture of the pressurized cell, the entrance member comprising an entrance potential substantially the same as the exit potential in the reaction mode.

93. The system of claim 92, in which the exit member comprises a potential between –60 Volts and –18 Volts in the collision mode.

94. The system of claim 92, in which the exit member comprises a potential between –20 Volts and 0 Volts in the reaction mode.

95. The system of claim 81, in which the mass analyzer is positioned between the ion source and the cell.

96. The system of claim 81, in which the mass analyzer is positioned downstream from the cell.

97. The system of claim 81, further comprising a detector coupled to the cell.

98. The system of claim 81, in which the ion source is configured as an inductively coupled plasma.

99. The system of claim 81, further comprising an additional cell coupled to the cell, the additional cell configured to operate in at least three different modes comprising a collision mode, a reaction mode and a standard mode.

100. The system of claim 99, in which the additional cell is configured to operate in a standard mode when the cell is being operated in the collision gas mode or the reaction mode.

101. The system of claim 81, in which the controller is further configured to provide an offset voltage to the mass analyzer.

5 102. The system of claim 101, in which the controller is configured to provide the offset voltage of the mass analyzer that is more positive than an offset voltage of the cell when the cell is operated in the collision mode and in which the controller is configured to provide the offset voltage of the mass analyzer that is more negative than the offset voltage of the cell when the cell is operated in the reaction mode.

10 103. A kit for facilitating operation of a mass spectrometer in at least two different modes comprising a collision mode and a reaction mode, the kit comprising a cell configured to receive a collision gas in the collision mode to pressurize the cell and configured to receive a reactive gas in the reaction mode to pressurize the cell, the
15 cell further configured to receive an effective voltage from a controller electrically coupled to the cell to permit selection of ions from the cell in the collision mode using an energy barrier and to permit selection of ions from the cell in the reaction mode using mass filtering.

20 104. The kit of claim 103, further comprising a gas manifold configured to fluidically couple to the cell.

105. The kit of claim 103, further comprising a storage medium comprising a method to control switching between the collision mode and the reaction mode.

25 106. The kit of claim 103, further comprising a controller.

30 107. The kit of claim 103, further comprising an additional cell configured to receive a collision gas in the collision mode to pressurize the additional cell and configured to receive a reactive gas in the reaction mode to pressurize the additional cell, the additional cell further configured to receive an effective voltage from a controller electrically coupled to the additional cell to permit selection of ions from the

additional cell in the collision mode using an energy barrier and to permit selection of ions from the additional cell in the reaction mode using mass filtering.

5 108. A method of facilitating operation of a mass spectrometer cell in at least two different modes comprising a collision mode and a reaction mode, the method comprising providing a controller configured to electrically couple to the cell, the controller configured to provide a first effective voltage to the cell in the collision mode to permit selection of ions comprising an energy greater than a selected barrier energy, the controller further configured to provide a second effective voltage
10 to the cell in the reaction mode to permit selection of ions using mass filtering.

109. A method of facilitating operation of a mass spectrometer in at least two different modes comprising a collision mode and a reaction mode, the method comprising providing a cell configured to receive a collision gas in the collision mode
15 to pressurize the cell and configured to receive a reactive gas in the reaction mode to pressurize the cell, the cell further configured to receive an effective voltage from a controller electrically coupled to the cell to permit selection of ions from the cell in the collision mode using an energy barrier and to permit selection of ions from the cell in the reaction mode using mass filtering.

CLAIMS

1. A system configured to permit switching of a cell between at least two modes comprising a collision mode and a reaction mode, the system comprising:

5 a cell configured to receive a collision gas in a collision mode to pressurize the cell and configured to receive a reaction gas in a reaction mode to pressurize the cell, the cell comprising a quadrupole rod set; and

 a controller electrically coupled to the quadrupole rod set of the cell and configured to provide a waveform from a voltage source to the quadrupole set
10 to provide a quadrupolar field within the cell, the controller configured to provide an effective voltage from the voltage source to the cell in the collision mode to select ions comprising an energy greater than a barrier energy and an effective voltage from the voltage source in the reaction mode to select ions using mass filtering.

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2. The system of claim 1, in which the effective voltage provided to the cell in the collision mode and the reaction mode is an offset voltage.

3. The system of claim 1, in which the system is further configured to permit
20 switching to a vented mode to permit transmission of ions by the cell.

4. The system of claim 1, further comprising a gas manifold coupled to the cell

and configured to provide the collision gas in the collision mode and the reaction gas in the reaction mode.

5 5. The system of claim 1, in which the cell comprises an exit aperture electrically coupled to the controller.

6. The system of claim 5, in which the cell comprises an entrance aperture electrically coupled to the controller.

10 7. The system of claim 1, in which the controller is configured to switch the cell between the collision mode and the reaction mode by exhausting the cell prior to introduction of a reaction gas into the cell.

15 8. The system of claim 1, in which the controller is configured to switch the cell between the reaction mode and the collision mode by exhausting the cell prior to introduction of a collision gas into the cell.

9. The system of claim 1, further comprising a mass analyzer coupled to the cell.

20 10. The system of claim 9, in which the mass analyzer comprises an offset voltage that is more positive than an offset voltage of the cell when the cell is operated in the collision mode.

11. The system of claim 10, in which the mass analyzer comprises an offset voltage that is more negative than an offset voltage of the cell when the cell is operated in the reaction mode.

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12. The system of claim 1, further comprising an ionization source coupled to the pressurized cell.

13. The system of claim 12, in which the ionization source is an inductively
10 coupled plasma.

14. The system of claim 1, further comprising an additional cell coupled to the cell, the additional cell configured to receive a collision gas in a collision mode to pressurize the additional cell and configured to receive a reaction gas in a
15 reaction mode to pressurize the additional cell, the additional cell comprising a quadrupole rod set.

15. The system of claim 14, in which the controller is configured to operate at least one of the cell and the additional cell in the reaction mode and to operate
20 the other cell in a vented mode.

16. The system of claim 14, in which the controller is configured to operate at

least one of the cell and the additional cell in the collision mode and to operate the other cell in a vented mode.

17. The system of claim 14, in which the controller is configured to operate at
5 least one of the cell and the additional cell in the collision mode and to operate the other cell in a reaction mode.

18. A method of switching a quadrupolar cell between a collision mode and a reaction mode, the method comprising:

10 introducing a first ion stream into the quadrupolar cell, the cell configured to receive a collision gas in a collision mode to pressurize the cell and configured to receive a reaction gas in a reaction mode to pressurize the cell, the cell comprising a quadrupole rod set operative to provide a quadrupolar field within the cell;

15 selecting ions comprising an energy greater than a barrier energy from the introduced first ion stream by introducing a collision gas into the cell in the collision mode, the cell comprising a voltage effective to permit selection of the ions comprising the energy greater than the barrier energy;

exhausting the introduced first ion stream and the introduced collision
20 gas from the cell;

introducing a second ion stream into the cell; and

selecting ions using mass filtering from the introduced second ion stream by introducing a reaction gas in the reaction mode, the cell comprising a voltage effective to permit selection of the ions using the mass filtering.

5 19. The method of claim 18, further comprising:

exhausting the introduced second ion stream and the introduced reaction gas from the cell;

introducing an additional ion stream into the cell; and

selecting ions comprising an energy greater than a barrier energy from
10 the introduced additional ion stream by introducing a collision gas into the cell in the collision mode, the cell comprising a voltage effective to permit selection of the ions comprising the energy greater than the barrier energy.

20. The method of claim 19, further comprising configuring the voltage effective
15 to permit selection of the ions comprising the energy greater than the barrier energy as an offset voltage.

21. The method of claim 20, further comprising providing ions from the cell comprising the offset voltage to a coupled mass analyzer comprising an offset
20 voltage.

22. The method of claim 21, further comprising configuring the offset voltage of

the mass analyzer to be more positive than the cell offset voltage when the cell is in the collision mode.

23. The method of claim 21, further comprising configuring the offset voltage of
5 the mass analyzer to be more negative than the cell offset voltage when the cell is in the reaction mode.

24. A method of switching a quadrupolar cell between a reaction mode and a collision mode, the method comprising:

10 introducing a first ion stream into the quadrupolar cell, the cell configured to receive a collision gas in a collision mode to pressurize the cell and configured to receive a reaction gas in a reaction mode to pressurize the cell, the cell comprising a quadrupole rod set operative to provide a quadrupolar field within the cell;

15 selecting ions using mass filtering from the introduced first ion stream by introducing a reaction gas in the reaction mode, the cell comprising a voltage effective to permit selection of the ions using the mass filtering;

exhausting the introduced first ion stream and the introduced reaction gas from the cell;

20 introducing a second ion stream into the cell; and

selecting ions comprising an energy greater than a barrier energy from the introduced second ion stream by introducing a collision gas into the cell in

the collision mode, the cell comprising a voltage effective to permit selection of the ions comprising the energy greater than the barrier energy.

25. The method of claim 24, further comprising:

5 exhausting the introduced second ion stream and the introduced collision gas from the cell;

 introducing an additional ion stream into the cell; and

 selecting ions using mass filtering from the introduced additional ion stream by introducing a reaction gas in the reaction mode, the cell comprising a
10 voltage effective to permit selection of the ions using the mass filtering.

26. The method of claim 24, further comprising providing ions from the cell to a coupled mass analyzer comprising an offset voltage.

15 27. The method of claim 26, further comprising configuring the offset voltage of the mass analyzer to be more positive than an offset voltage of the cell when the cell is in the collision mode.

28. The method of claim 26, further comprising configuring the offset voltage of
20 the mass analyzer to be more negative than an offset voltage of the cell when the cell is in the reaction mode.