CLAIMS

1. An atmospheric pressure ion source, comprising:

a spray probe for spraying a liquid into an ionization chamber, the ionization chamber having an exhaust port through which a residual fluid is extracted;

an exhaust system comprising a tubing which is connected to the exhaust port, the tubing having a transition from a first cross-section to a second cross section at a point downstream of the exhaust port, the second cross section being reduced in relation to the first cross section; and

a gas injector through which a gas can be injected into the tubing in a region of the transition.

2. The atmospheric pressure ion source of claim 1, wherein the tubing comprises a bend, and the transition is located downstream of, and proximate to, the bend.

3. The atmospheric pressure ion source of claim 2, wherein the tubing has rounded walls in the region of the bend.

4. The atmospheric pressure ion source of claim 2 or 3, wherein the tubing has a first segment upstream of the bend and a second segment downstream of the bend, and an angle between the first segment and the second segment ranges from 90° to 180°.

5. The atmospheric pressure ion source of any of claims 1-4, wherein the exhaust port is located and configured in order to receive a spray cone emanating from the spray probe.

6. The atmospheric pressure ion source of any of claims 1-5, wherein an axis of the exhaust port and an axis of the tubing coincide with an axis of the spray probe so

that a spray cone emanating from the spray probe is substantially centered on the joint axis.

7. The atmospheric pressure ion source of any of claims 1-6, wherein the gas injector is configured to supply an inert gas to the tubing at a flow rate of between 4 and 400 L/min.

8. The atmospheric pressure ion source of any of claims 1-7, wherein the exhaust system is configured to create a pressure differential between the ionization chamber and a point downstream of the exhaust port so that the residual fluid is aspirated through the exhaust port and into the tubing at flow rates of substantially 4 to 400 L/min.

9. The atmospheric pressure ion source of any of claims 1-8, wherein the gas injector has the shape of a nozzle.

10. The atmospheric pressure ion source of any of claims 1-9, wherein, at a point downstream of the cross section transition, the cross section of the tubing widens again as to obtain a diffusing effect for the fluids flowing there-through.

11. The atmospheric pressure ion source of any of claims 1-10, wherein, between the ionization chamber and the gas injector, the tubing has the shape of a truncated cylinder.

12. The atmospheric pressure ion source of any of claims 1-11, wherein ionization is performed by one of electrospray ionization, chemical ionization, and photo-ionization.

13. A method for operating an exhaust system for an atmospheric pressure ion source, comprising:

(a) providing an ionization chamber with an exhaust port and a tubing coupled to the exhaust port;

(b) providing a transition from a first cross section of the tubing to a second cross section of the tubing at a point downstream of the exhaust port, wherein the second cross section is reduced in relation to the first cross section; and

(c) injecting a gas into the tubing in a region of the transition to transfer momentum from the gas to surrounding fluid for extracting residual fluid from the ionization chamber through the exhaust port and into the tubing.

14. The method of claim 13, wherein in step (c), the gas is injected at flow rates of between 4 and 400 L/min.

15. The method of claim 13 or 14, wherein the exhaust system is operated such that residual fluid is aspirated through the exhaust port and into the tubing at flow rates of about 4 to 400 L/min.

16. The method of any of claims 13-15, wherein a flow rate of the injected gas and a flow rate of the general residual fluid extraction essentially equal each other.

17. The method of any of claims 13-16, wherein the injected gas is an inert gas.

18. The method of claim 17, wherein the inert gas is one of molecular nitrogen and air.

19. An atmospheric pressure ion source, comprising:

a spray probe for spraying a liquid into an ionization chamber, the ionization chamber having an exhaust port through which a residual fluid is extracted; and

an exhaust system comprising a tubing which is connected to the exhaust port and to a vacuum source, wherein the vacuum source is a gas jet pump.

Claims

1. An atmospheric pressure ion source, comprising:

a spray probe for spraying a liquid into an ionization chamber, the ionization chamber having an exhaust port through which a residual fluid is extracted;

an exhaust system comprising a tubing which is connected to the exhaust port, the tubing having a transition from a first cross-section to a second cross section at a point downstream of the exhaust port, the second cross section being reduced in relation to the first cross section; and

a gas injector a tip of which is located in the tubing and through which a gas can be injected into the tubing in a region of the transition.

2. The atmospheric pressure ion source of claim 1, wherein the tubing comprises a bend, and the transition is located downstream of, and proximate to, the bend.

3. The atmospheric pressure ion source of claim 2, wherein the tubing has rounded walls in the region of the bend.

4. The atmospheric pressure ion source of claim 2, wherein the tubing has a first segment upstream of the bend and a second segment downstream of the bend, and an angle between the first segment and the second segment ranges from 90° to 180°.

5. The atmospheric pressure ion source of claim 1, wherein the exhaust port is located and configured in order to receive a spray cone emanating from the spray probe.

6. The atmospheric pressure ion source of claim 1, wherein an axis of the exhaust port and an axis of the tubing coincide with an axis of the spray probe so that a spray cone emanating from the spray probe is substantially centered on the joint axis.

7. The atmospheric pressure ion source of claim 1, wherein the gas injector is configured to supply an inert gas to the tubing at a flow rate of between 4 and 400 L/min.

8. The atmospheric pressure ion source of claim 1, wherein the exhaust system is configured to create a pressure differential between the ionization chamber and a point downstream of the exhaust port so that the residual fluid is aspirated through the exhaust port and into the tubing at flow rates of substantially 4 to 400 L/min.

9. The atmospheric pressure ion source of claim 1, wherein the gas injector has the shape of a nozzle.

10. The atmospheric pressure ion source of claim 1, wherein, at a point downstream of the cross section transition, the cross section of the tubing widens again as to obtain a diffusing effect for the fluids flowing there-through.

11. The atmospheric pressure ion source of claim 1, wherein, between the ionization chamber and the gas injector, the tubing has the shape of a truncated cylinder.

12. The atmospheric pressure ion source of claim 1, wherein ionization is performed by one of electrospray ionization, chemical ionization, and photo-ionization.

13. A method for operating an exhaust system for an atmospheric pressure ion source, comprising:

(a) providing an ionization chamber with an exhaust port and a tubing coupled to the exhaust port;

(b) providing a transition from a first cross section of the tubing to a second cross section of the tubing at a point downstream of the exhaust port,

wherein the second cross section is reduced in relation to the first cross section; and

(c) injecting a gas into the tubing in a region of the transition, by operating a gas injector a tip of which is located in the tubing, to transfer momentum from the gas to surrounding fluid for extracting residual fluid from the ionization chamber through the exhaust port and into the tubing.

14. The method of claim 13, wherein in step (c), the gas is injected at flow rates of between 4 and 400 L/min.

15. The method of claim 13, wherein the exhaust system is operated such that residual fluid is aspirated through the exhaust port and into the tubing at flow rates of about 4 to 400 L/min.

16. The method of claim 13, wherein a flow rate of the injected gas and a flow rate of the general residual fluid extraction essentially equal each other.

17. The method of claim 13, wherein the injected gas is an inert gas.

18. The method of claim 17, wherein the inert gas is one of molecular nitrogen and air.

19. An atmospheric pressure ion source, comprising:

a spray probe for spraying a liquid into an ionization chamber, the ionization chamber having an exhaust port through which a residual fluid is extracted; and

an exhaust system comprising a tubing which is connected to the exhaust port and to a vacuum source, wherein the vacuum source is a gas jet pump an injector tip of which is located in the tubing.