Collection Device and Methods for Use

Cross Reference

This application claims priority to U.S. Provisional Patent Application 62/171,008, U.S. Provisional Patent Application 62/171,001, and U.S. Provisional Patent Application 62/171,060, each filed June 4, 2015, each of which are incorporated by reference herein in their entirety.

Background

A need exists for apparatuses and methods capable of producing sub-micron and nano-sized particles. The need is particularly pronounced in the field of pharmaceutics. Conventional techniques for particle-size reduction currently practiced suffer from many disadvantages. As such, a need remains for improved equipment and processes for the preparation, harvesting and collection of small particles.

Summary of the Invention

In a first aspect, the invention includes a particle collection device, comprising: a vessel defining a chamber, wherein the vessel includes a distal end and a proximal end; an inlet port extending from the proximal end of the vessel, wherein the inlet port is in fluid communication with the chamber; an outlet port extending from the proximal end of the vessel, wherein the outlet port is in fluid communication with the chamber, and wherein the outlet port includes a porous material positioned between the chamber and the outlet port; a sampling tube having a distal end and a proximal end, wherein the proximal end of the sampling tube extends from the proximal end of the vessel, and wherein the distal end of the sampling tube extends into the chamber; a collection insert positioned substantially within the chamber; and a support frame positioned between an interior wall of the chamber and the collection insert.

In a second aspect, the invention includes a particle collection system, comprising: one or more particle formation systems; one or more particle filtration systems in communication with one or more particle formation systems; and one or more particle collection devices according to the first aspect in communication with the one or more particle filtration systems.

In a third aspect, the invention includes a method for isolating particles, the method comprising: providing a collection device according to the first aspect; receiving a plurality of particles through the inlet port of the particle collection device; collecting the plurality of particles in the chamber of the vessel; receiving a fluid through the inlet port; and venting the fluid through the porous material and out of the outlet port.

In a fourth aspect, the invention includes a non-transitory computer readable medium having stored thereon instructions, that when executed by one or more processors, causes the collection device according to the first aspect to: receive a plurality of particles through the inlet port of the particle collection device; collect the plurality of particles in the chamber of the vessel; receive a gas through the inlet port; and vent the gas through the porous material and out of the outlet port.

Claims

We claim:

1. A particle collection device, comprising:

a vessel defining a chamber, wherein the vessel includes a distal end and a proximal end;

an inlet port extending from the proximal end of the vessel, wherein the inlet port is in fluid communication with the chamber;

an outlet port extending from the proximal end of the vessel, wherein the outlet port is in fluid communication with the chamber, and wherein the outlet port includes a porous material positioned between the chamber and the outlet port;

a sampling tube having a distal end and a proximal end, wherein the proximal end of the sampling tube extends from the proximal end of the vessel, and wherein the distal end of the sampling tube extends into the chamber;

a collection insert positioned substantially within the chamber; and

a support frame positioned between an interior wall of the chamber and the collection insert.

2. The particle collection device of claim 1, wherein the collection insert comprises a plastic bag.

3. The particle collection device of any one of claims 1 or 2, wherein the support frame comprises:

a distal ring;

a proximal ring;

one or more support legs connecting the distal ring to the proximal ring; and

a gasket positioned adjacent to the proximal ring.

4. The particle collection device of claim 3, wherein the gasket comprises a neoprene gasket.

5. The particle collection device of any one of claims 1-4, wherein the porous material is selected from the group consisting of a frit, a mesh, and a cloth.

6. The particle collection device of any one of claims 1-5, wherein the porous material comprises a sintered filter having a distal end and a proximal end, wherein the proximal end of the sintered filter extends from the proximal end of the vessel and is coupled to the outlet port, and wherein the distal end of the sintered filter extends into the chamber.

7. The particle collection device of any one of claims 1-6, wherein an outer diameter of the inlet port has a range from about 12.7 mm to about 101.6 mm, wherein an outer diameter of the outlet port has a range from about 12.7 mm to about 20.8 mm, wherein an outer diameter of the sampling tube has a range from about 6.35 mm to about 25.4 mm, and/or wherein an outer diameter of the vessel has a range from about 152.4 mm to about 914.4 mm.

8. The particle collection device of any one of claims 1-7, wherein the inlet port includes a coupling mechanism to connect an outlet of a particle filtration system to the inlet port.

9. The particle collection device of claim 8, wherein the coupling mechanism comprises one or more sanitary fittings.

10. The particle collection device of claim 8, wherein the coupling mechanism comprises one or more compression fittings.

11. A particle collection system, comprising:

one or more particle formation systems;

one or more particle filtration systems in communication with one or more particle formation systems; and

one or more particle collection devices of any one of claims 1-10 in communication with the one or more particle filtration systems.

12. The system of claim 11, wherein the one or more particle formation systems comprise one or more high pressure supercritical fluid (SCF) particle formation systems, and wherein the one or more high pressure SCF particle formation systems include:

a pressurizable precipitation chamber including a SCF inlet, a process fluid inlet, and a fluid outlet; and

a process fluid disperser to disperse process fluid into the precipitation chamber.

13. The particle collection system of any one of claims 11-12, wherein the one or more particle filtration systems comprise a tandem particle filtration system including at least one high pressure harvesting filter system and at least one low pressure collection device in tandem and downstream of the harvesting filter.

14. The particle collection system of claim 13, further comprising at least one of:

a) two particle harvesting filters, two particle collection filters and two collection devices; b) two particle harvesting filters, one particle collection filter and one or more collection devices; c) two particle harvesting filters, two particle collection filters and one or more collection devices; d) two particle harvesting filters, one particle collection filter and one or more collection devices; e) two tandem filter particle harvesting and collection devices arranged in parallel; f) two or more particle harvesting filters arranged in parallel, one particle collection filter and two or more collection devices arranged in parallel; g) two or more precipitation chambers; h) at least two tandem filter particle filtration systems; i) at least two collection devices; or j) a combination thereof.

14. A method for isolating particles, the method comprising:

providing a collection device of any one of claims 1-10;

receiving a plurality of particles through the inlet port of the particle collection device;
collecting the plurality of particles in the chamber of the vessel;
receiving a fluid through the inlet port; and
venting the fluid through the porous material and out of the outlet port.

15. The method of claim 14, further comprising:
removing the plurality of particles from the chamber of the vessel.

16. A non-transitory computer readable medium having stored thereon instructions, that when executed by one or more processors, causes the collection device of any one of claims 1-10 to:
receive a plurality of particles through the inlet port of the particle collection device;
collect the plurality of particles in the chamber of the vessel;
receive a gas through the inlet port; and
vent the gas through the porous material and out of the outlet port.