~~WHAT IS CLAIMED IS:~~CLAIMS

1. A reactor for coating particles, comprising:

(a) a stationary vacuum chamber to hold a bed of particles to be coated, the chamber including:

(i) a lower portion in fluid connection with a first channel portion,

(1) wherein the first channel portion extends at a shallow angle toward a curved inner surface of ~~having a lower portion that forms~~ a half-cylinder formed by the lower portion of the chamber; and

(2) wherein the first channel portion opens to the chamber at a plurality of apertures; and

(ii) an upper portion;

(b) a vacuum port in the upper portion of the chamber;

(c) a motor to rotate a rotatable drive shaft;

(d) a paddle assembly including:

(i) ~~a~~ the rotatable drive shaft, the rotatable drive shaft extending through the chamber along ~~the~~ an axial axis of the half cylinder; and~~,~~

(ii) a plurality of paddles extending radially from the drive shaft such that rotation of the drive shaft by the motor orbits the plurality of paddles about the drive shaft; and

~~a motor to rotate the drive shaft; and~~

~~a chemical delivery system to deliver a first fluid;~~

(e) a first gas injection assembly configured to:

(i) receive ~~the~~ a first fluid from ~~the~~ a chemical delivery system; ~~and having apertures configured to~~ and

(ii) inject a first reactant or precursor gas into the lower portion of the chamber through the apertures ~~and such that the first reactant or precursor gas flows is injected to the chamber~~ substantially tangent to ~~a~~ the curved inner surface of the half-cylinder.

2. The reactor of claim 1, wherein the first gas injection assembly is configured to inject the reactant or precursor gas in a direction perpendicular to the axial axis.

3. The reactor of claim 1, wherein the first gas injection assembly comprises a first plurality of apertures extending in a first row parallel to the axial axis, and wherein the first

gas injection assembly is configured to inject the reactant or precursor gas through the first plurality of apertures.

4. The reactor of claim 3, wherein the first plurality of apertures are positioned in a lower quarter of the lower portion of the chamber.

5. The reactor of claim 3, wherein the chemical delivery system is configured to deliver a second fluid, and further comprising a second gas injection assembly to receive the second fluid from the chemical delivery system and having apertures configured to inject a second reactant or precursor gas into the lower portion of the chamber and such that the second reactant or precursor gas flows substantially tangent to a curved inner surface of the half-cylinder.

6. The reactor of claim 5, wherein the second gas injection assembly comprises second plurality of apertures extending in a second row parallel to the axial axis, and wherein the second gas injection assembly is configured to inject ~~the inject~~ the second reactant or precursor gas through the second plurality of apertures.

7. The reactor of claim 3, wherein the first gas injection assembly include a manifold and a plurality of channels extending from the manifold to ~~the~~ a first plurality of nozzles, and comprising a restriction between the manifold and the plurality of channels.

8. A reactor for coating particles, comprising:

a stationary vacuum chamber to hold a bed of particles to be coated, the chamber having a lower portion that forms a half-cylinder and an upper portion;

a vacuum port in the upper portion of the chamber;

a motor to rotate a rotatable drive shaft;

a paddle assembly including:

~~a~~ the rotatable drive shaft, the rotatable drive shaft extending through the chamber along ~~the~~ an axial axis of the half cylinder,

a plurality of paddles extending radially from the drive shaft such that rotation of the drive shaft by the motor orbits the plurality of paddles about the drive shaft; and

~~a motor to rotate the drive shaft; and~~

a chemical delivery system to deliver a plurality of fluids including at least a first liquid; and

a first gas injection assembly to receive the first liquid from the chemical delivery system, the first gas injection assembly including a vaporizer to convert the first liquid to a first reactant or precursor gas, a manifold to receive the first reactant or precursor gas from the vaporizer, and a plurality of channels leading from the manifold to a plurality of apertures located in the lower portion of the chamber.

9. The reactor of claim 8, wherein the vaporizer, the manifold, and a plurality of passages are formed in a unitary body.

10. The reactor of claim 8, comprising a passage connecting the chemical delivery system to deliver an inert gas from the chemical delivery system to the manifold.

11. The reactor of claim 8, wherein the vaporizer includes a cavity, a heater to heat walls of the cavity, and a nozzle to aerosolize the first liquid as the first liquid passes into cavity.

12. A method of coating particles, comprising:

dispensing particles into a vacuum chamber to fill at least a lower portion of the chamber that forms a half-cylinder;

evacuating the chamber through a vacuum port in an upper portion of the chamber;

rotating a paddle assembly such that a plurality of paddles orbit a drive shaft; and

injecting a reactant or precursor gas into the lower portion of the chamber as the paddle assembly rotates such that ~~the~~ a first reactant or precursor gas flows substantially tangent to a curved inner surface of the half-cylinder.

13. A method of coating particles, comprising:

dispensing particles into a vacuum chamber to fill at least a lower portion of the chamber that forms a half-cylinder;

evacuating the chamber through a vacuum port in an upper portion of the chamber;

rotating a paddle assembly such that a plurality of paddles orbit a drive shaft;

flowing a reactant or precursor from a chemical delivery system to a vaporizer;

converting ~~the~~ a first liquid to a first reactant or precursor gas in the vaporizer; and

passing the gas from the vaporizer through a manifold and a plurality of channels to a plurality of apertures located in the lower portion of the chamber.

~~14. A method of coating particles, comprising:~~

~~dispensing particles into a vacuum chamber to form a particle bed in at least a lower portion of the chamber that forms a half-cylinder;~~

~~evacuating the chamber through a vacuum port in an upper portion of the chamber;~~

~~rotating a paddle assembly such that a plurality of paddles orbit a drive shaft to stir the particles in the particle bed;~~

~~injecting a reactant or precursor gas through a plurality of channels into the lower portion of the chamber as the paddle assembly rotates to coat the particles; and~~

~~injecting the reactant or precursor gas or a purge gas through the plurality of channels at a sufficiently high velocity such that the reactant or precursor a purge gas de-agglomerates particles in the particle bed.~~

~~15. The method of claim 14, comprising injecting the reactant or precursor gas at a sufficiently high velocity such that the reactant or precursor gas de-agglomerates particles.~~

~~16. The method of claim 14, comprising injecting the purge gas at a sufficiently high velocity such that the purge gas de-agglomerates particles.~~

~~17. The method of claim 14, comprising injecting the purge gas at a greater velocity than the reactant or precursor gas is injected.~~

~~18. A reactor for coating particles, comprising:~~

~~a stationary vacuum chamber to hold a bed of particles to be coated;~~

~~a paddle assembly including a rotatable drive shaft and one or more paddles in the vacuum chamber, the paddles connected to the drive shaft such that rotation of the drive shaft by a motor stirs the particles in the particle bed;~~

~~a chemical delivery system including a gas injection assembly to a deliver a precursor or reactant gas and a purge gas into the lower portion of the chamber;~~

~~at least one flow regulator to control a flow rate of the precursor or reactant gas and the purge gas;~~

~~a controller configured to~~

~~cause the chemical delivery system to inject the reactant or precursor gas into the lower portion of the chamber as the paddle assembly rotates to coat the particles; and~~

~~cause the chemical delivery system and the at least one flow regulator to inject the reactant or precursor gas or the purge gas into the chamber at a sufficiently high velocity such that the reactant or precursor or purge gas de-agglomerates particles in the particle bed.~~

~~19. The reactor of claim 18, wherein the controller is configured to cause the at least one regulator to flow the reactant or precursor gas into the chamber at a sufficiently high velocity such that the reactant or precursor gas de-agglomerates particles.~~

~~20. The reactor of claim 18, wherein the controller is configured to cause the at least one regulator to flow the purge gas into the chamber at a sufficiently high velocity such that the purge gas de-agglomerates particles.~~