CLAIMS

1. A method for processing fumed silica into silica agglomerations comprising:

providing fumed silica particles, wherein the fumed silica particles have a first Brunauer Emmett Teller (BET) surface area of greater than about 50 meters squared per gram (m^2/g), and are characterized by a dominant branched morphology comprising from 5 nanometer (nm) to 50 nm primary particles, with an average bulk density of less than 64 kilograms per cubic meter (kg/m^3);

combining the fumed silica particles with a liquid carrier to form a solution of suspended fumed silica particles, wherein the solution of suspended fumed silica particles comprises from about 2 weight percent (wt %) to about 8 wt % of the fumed silica particles;

atomizing the solution of suspended fumed silica particles to produce silica-containing droplets, wherein at least a majority of the silica-containing droplets are characterized by a droplet diameter of about 250 nm to about 100 micrometers (μm) and a fumed silica particle weight percentage of from about 2 wt % to about 8 wt %; and

subjecting the silica-containing droplets to a temperature of from about 50°C to about 1500°C for a period of time of at least about 0.5 seconds to substantially remove the liquid carrier from the silica-containing droplets to produce the silica agglomerations, wherein substantially all of the produced silica agglomerations exhibit a second BET surface area that is at least about 75% of the first BET surface area, and a dominant globular morphology characterized by an average bulk density of greater than 64 kg/m^3.

2. The method of claim 1, wherein the method further comprises collecting at least a majority of the produced silica agglomerations by filtration or condensation.

3. The method of claim 1, wherein the atomizing step comprises aerosolizing, spray drying, using an ultrasonic transducer, or any combination thereof, to produce the silica-containing droplets.

4. The method of claim 1, wherein the atomizing step comprises injecting a carrier gas into the solution of suspended fumed silica particles.

5. The method of claim 4, wherein the carrier gas is selected from the group consisting of nitrogen, air, or combinations thereof.

6. The method of claim 1, wherein the liquid carrier is selected such that the produced silica agglomerations have substantially the same chemical composition as the provided fumed silica particles, wherein the produced silica agglomerations are comprised of less than about 2 wt % of impurities.

7. The method of claim 1, wherein the liquid carrier is comprised of H_2O.

8. The method of claim 1, wherein the method comprises doping the solution of suspended fumed silica particles such that the produced silica agglomerations do not have substantially the same chemical composition as the provided fumed silica particles.

9. The method of claim 8, wherein the doping step comprises selecting the liquid carrier such that the produced silica agglomerations do not have substantially the same chemical composition as the provided fumed silica particles.

10. The method of claim 8, wherein the doping step comprises introducing a carrier gas to the solution of suspended fumed silica particles such that the produced silica agglomerations do not have substantially the same chemical composition as the provided fumed silica particles.

11. The method of claim 1, wherein the fumed silica particles have a first BET surface area from about 200 m^2/g to about 600 m^2/g.

12. The method of claim 1, wherein substantially all of the produced silica agglomerations exhibit a second BET surface area that is at least about 90% of the first BET surface area.

13. The method of claim 1, wherein the silica-containing droplets comprise from about 3 wt % to about 6 wt % of fumed silica particles.

14. The method of claim 1, wherein the solution of suspended fumed silica particles comprises from about 3 wt % to about 6 wt % of fumed silica particles.

15. The method of claim 1, wherein the silica-containing droplets comprise about 6 wt % of fumed silica particles.

16. The method of claim 1, wherein the solution of suspended fumed silica particles comprises about 6 wt % of fumed silica particles.

17. The method of claim 1, wherein the silica-containing droplets are subjected to a temperature of from about 400°C to about 1500°C.

18. The method of claim 1, wherein the subjecting step comprises passing the silica-containing droplets through a tube furnace.

19. The method of claim 18, wherein the subjecting step comprises passing the silica-containing droplets through a tube furnace at a flow rate of from about 3 liters per minute (L/min) to about 50 L/min.

20. The method of claim 1, wherein the method is substantially reversible, such that the silica agglomerations may be reverted into a solution of suspended fumed silica particles.

21. The method of claim 1, further comprising,

redispersing the silica agglomerations into the liquid carrier to form a solution of suspended fumed silica particles, wherein the solution of suspended fumed silica particles comprises from about 2 wt % to about 8 wt % of fumed silica particles.

22. A method for processing fumed metallic oxides comprising:

providing fumed metallic oxide particles, wherein the fumed metallic oxide is selected from the group consisting of SiO_2, Al_2O_3, TiO_2, CeO_2, B_2O_3, ZrO_2, GeO_2, WO_3, Nb_2O_5, and combinations thereof, wherein the fumed metallic oxide particles have a first Brunauer Emmett Teller (BET) surface area of greater than about 50 m^2/g, and a dominant branched morphology comprising from 5 nm to 50 nm primary particles;

combining the fumed metallic oxide particles with a liquid carrier to form a solution of suspended fumed metallic oxide particles, wherein the solution of suspended fumed metallic oxide particles comprises from about 2 wt % to about 8 wt % of the fumed metallic oxide particles;

atomizing the solution of suspended fumed metallic oxide particles to produce metallic oxide-containing droplets, wherein at least a majority of the metallic oxide-containing droplets are characterized by a droplet diameter of about 250 nm to about 100 μm and a fumed metallic oxide particle weight percentage of from about 2 wt % to about 8 wt %; and

subjecting the metallic oxide-containing droplets to a temperature of from about 50°C to about 1500°C for a period of time of at least about 0.5 seconds to substantially remove the liquid carrier from the metallic oxide-containing droplets to produce metallic oxide agglomerations, wherein substantially all of the produced metallic oxide agglomerations exhibit a dominant globular morphology and a second BET surface area that is at least about 75% of the first BET surface area.

23. The method of claim 22, wherein the fumed metallic oxide particles are fumed alumina (Al_2O_3) particles and the produced metallic oxide agglomerations are alumina agglomerations.

24. The method of claim 23, wherein the fumed alumina particles have a first BET surface area from about 80 m^2/g to about 150 m^2/g.

25. The method of claim 23, wherein the fumed alumina particles have an average bulk density of less than 60 kg/m^3 and the produced alumina agglomerations have an average bulk density of greater than 40 kg/m^3.

26. The method of claim 22, wherein the fumed metallic oxide is silica (SiO_2).

27. The method of claim 22, wherein the fumed metallic oxide is a mixed oxide comprising at least two metallic oxides selected from the group consisting of SiO_2, Al_2O_3, TiO_2, CeO_2, B_2O_3, ZrO_2, GeO_2, WO_3, and Nb_2O_5.

28. A method for processing fumed silica into silica agglomerations comprising:

providing fumed silica particles, wherein the fumed silica particles have a first Brunauer Emmett Teller (BET) surface area of from about 200 m^2/g to about 600 m^2/g, and are characterized by a dominant branched morphology comprising from 5 nm to 50 nm primary particles, with an average bulk density of less than 64 kilograms per cubic meter (kg/m^3);

combining the fumed silica particles with a liquid carrier to form a solution of suspended fumed silica particles, wherein the solution of suspended fumed silica particles comprises from about 2 weight percent (wt %) to about 8 wt % of the fumed silica particles;

atomizing the solution of suspended fumed silica particles to produce silica-containing droplets, wherein at least a majority of the silica-containing droplets are characterized by a droplet diameter of about 250 nm to about 100 micrometers (μm) and a fumed silica particle weight percentage of from about 2 wt % to about 8 wt %; and

subjecting the silica-containing droplets to a temperature of from about 850°C to about 1500°C for a period of time of at least about 0.5 seconds to substantially remove the liquid carrier from the silica-containing droplets to produce the silica agglomerations, wherein substantially all of the produced silica agglomerations exhibit a second BET surface area that is at least about 85% of the first BET surface area, and a

dominant globular morphology characterized by an average bulk density of greater than 64 kg/m^3.