CLAIM(S):

1. A method for making a solid carbon material comprising:

delivering a liquid comprising at least one liquid organic compound into a reaction region of a reactor;

delivering a gas comprising at least one gaseous organic compound into the reaction region of the reactor; and

inducing a chemical reaction between the at least one liquid organic compound and the at least one gaseous organic compound, wherein:

the chemical reaction occurs in the reaction region of the reactor;

the solid carbon material is made via the reaction;

the solid carbon material is made during the reaction in the form of a dispersion comprising the solid carbon material dispersed in the liquid; and

the chemical reaction is a homogeneous reaction comprising homogeneous nucleation of the solid carbon material in the reaction region of the reactor.

2. The method of claim 1, wherein the chemical reaction comprises gas-liquid mass transfer.

3. The method of claim 1 or 2. wherein a composition of the gas is different from a composition of the liquid.

4. The method of ~~claim 1~~any one of claims 1-3, wherein a composition of the at least one gaseous compound is different from a composition of the at least one liquid organic compound.

~~5. The method of claim 1, wherein the chemical reaction does not occur on or at a catalyst.~~

~~6. The method of claim 1, wherein the method does not include a heterogeneous nucleation of the solid carbon material on a solid substrate.~~

~~7.~~5. The method of ~~claim 1~~any one of claims 1-4, wherein the step of delivering the liquid is performed via a first input stream into the reaction region and the step of delivering the gas is performed via a second input stream into the reaction region; wherein the first stream path and the second input stream are different and physically separate.

~~8.~~6. The method of ~~claim 1~~any one of claims 1-5, wherein the step of delivering the liquid and the step of delivering the gas are performed concurrently or the step of delivering the gas is performed after the liquid is delivered to the reaction region.

~~9. The method of claim 1, wherein the solid carbon material remains dispersed in the liquid while present in the reaction region.~~

~~10. The method of claim 1, wherein the liquid is substantially free of a solid carbon material during the step of delivering the liquid and prior to the steps of delivering the gas and inducing the chemical reaction.~~

~~11. The method of claim 1, wherein the liquid is substantially free of solid particles and is substantially not a colloid, suspension, or sol material during the step of delivering the liquid and prior to the steps of delivering the gas and inducing the chemical reaction.~~

~~12. The method of claim 1, wherein the solid carbon material is formed only in the reaction region of the reactor.~~

~~13. The method of claim 1, wherein the solid carbon material is not made when the method is performed without the step of delivering the gas with otherwise equivalent steps and conditions.~~

~~14.~~7. The method of ~~claim 1~~any one of claims 1-6, wherein delivering the gas comprises entraining the gas in the liquid, injecting the gas into the liquid, bubbling the gas into the liquid, or a combination of these.

~~15.~~8. The method of ~~claim 1~~any one of claims 1-7, wherein the gas is delivered directly into the reaction region during the step of delivering the gas.

~~16.~~9. The method of ~~claim 1~~any one of claims 1-8, wherein the step of inducing the chemical reaction comprises inducing a shear force in the liquid.

~~17. The method of claim 1, wherein the step of inducing the chemical reaction comprises agitating or stirring the liquid and the gas in the reaction region, optionally under pressure.~~

~~18.~~10. The method of ~~claim 1~~any one of claims 1-9, wherein:

the reactor is a cavitation reactor;

the reaction zone is a cavitation zone of the cavitation reactor; and

the method comprises forming cavitation bubbles in the liquid within the cavitation region of the cavitation reactor.

~~19.~~11. The method of claim ~~18~~10, wherein during the step of delivering the gas, the gas is delivered directly into or within 1 mm of a cavitation bubble-nucleation region, the cavitation bubble-nucleation region corresponding to nucleation of the cavitation bubbles in the hydrodynamic cavitation reaction during the step of forming.

~~20.~~12. The method of claim ~~18~~10, the forming step comprising forming a cavitation cloud comprising the cavitation bubbles in the cavitation region of the reactor, wherein the gas is delivered directly inside or within 1 mm of the cavitation cloud.

~~21.~~13. The method of claim ~~18~~10, the forming step comprising forming a cavitation cloud comprising the cavitation bubbles; wherein the carbon material is formed within the cavitation cloud.

~~22. The method of claim 18, wherein the liquid is substantially free of the carbon material during the step of delivering the liquid and prior to formation of cavitation bubbles therein.~~

~~23. The method of claim 18, wherein the cavitation reactor comprises a hydrodynamic cavitation reactor having a pre-cavitation region and an orifice region, wherein the orifice region is between the pre-cavitation region and the cavitation region; the orifice region comprising at least one orifice, such that the liquid flows from the pre-cavitation region to the cavitation region through the at least one orifice; wherein each of the at least one orifice is characterized by an orifice diameter that is less than a diameter of the pre-cavitation region.~~

~~24. The method of claim 23, wherein the gas is delivered directly to a cavitation end of the at least one orifice or within 1 mm of an end of the at least one orifice; the cavitation end of the at least one orifice being an end of the at least one orifice nearest to the cavitation region of the cavitation reactor.~~

~~25.~~14. The method of ~~claim 1~~any one of claims 1-13, wherein the gaseous organic compound is selected from the group consisting of alkane, alkene, alkyne, cycloalkane, heterocycyloalkane, arene, heteroarene, and a combination thereof, wherein the alkane, alkene, alkyne, cycloalkane, heterocycloalkane, arene, or heteroarene can be optionally substituted with one or more substituents.

~~26.~~15. The method of ~~claim 1~~any one of claims 1-14, wherein the at least one gaseous organic compound is selected from the group consisting of methane, acetylene, ethylene, propane, 1,3-butadiene, butane, and any combination thereof.

~~27. The method of claim 1, the at least one liquid organic compound being selected from the group consisting of a monomer, an oligomer, a prepolymer, a polymer, an organic solvent, and any combination thereof.~~

~~28.~~16. The method of ~~claim 1~~any one of claims 1-15, the at least one liquid organic compound being selected from the group consisting of methanol, ethanol, isopropyl alcohol, methylpyrrolidone, d-cyclopentadiene, hexane, benzene, toluene, heptane, xylene, dimethyl sulfoxide, mineral oil, motor oil, ~~MOBILE 1™ motor oil, Syn 530 motor oil, AMSOIL™, NonSyn, QUAKER STATE™ 530,~~ base oil, hydrogenated castor oil, transmission oil, gear oil, vegetable oil, hydrocarbon base oil, additized oil, non-additized oil, kerosene, diesel fuel, ethylene glycol, propylene glycol, diethylene glycol, triethylamine, trimethylamine, pentane, cyclopentane, cyclohexane, 1,4-dioxane, chloroform, diethyl ether, dichloromethane, tetrahydrofuran, ethyl acetate, acetone, dimethylformamide, acetonitrile, nitromethane, propylene carbonate, formic acid, butanol, propanol, acetic acid, octadecene, oleic acid, oleylamine, octane, diethylene glycol ether, 1,2-dicholorobenze, methyl acetate, tetrachloroethylene, diphenylthiourea, hexafluro-2-propanol, cinnamic acid, trimethylamine, benzenthiol, ethanethiol, ethanedithiol, 4-aminobenzenethiol, acrylic acid, carbon disulfide, 1,2-dichlorobenzene, N-methyl-2-pyrrolidone, and any combination thereof.

~~29.~~17. The method of ~~claim 1~~any one of claims 1-16, wherein the liquid comprises water.

~~30.~~18. The method of ~~claim 1~~any one of claims 1-17, wherein the solid carbon material comprises graphite**,** expanded graphite, a graphite-like material, graphene, a

graphene-like material, carbon platelets, carbon nanotubes, carbon onions, other carbon allotrope, a composite comprising graphene, cationic graphene, or any combination thereof.

~~31.~~19. The method of ~~claim 1~~any one of claims 1-18, the carbon material comprising graphene or a graphene-like material.

~~32. The method of claim 1, the carbon material comprising a graphene-polymer nanocomposite.~~

~~33. The method of claim 1, wherein the carbon material is characterized by an oxygen content of 7 at.% or less.~~

~~34. The method of claim 1, wherein the dispersion is characterized by a coefficient of friction that is reduced by at least 5% with respect to the same liquid without the solid carbon material.~~

~~35. The method of claim 1, wherein the solid carbon material or the dispersion is part of a battery anode, a battery cathode, an electrically-conductive material, a thermally-conductive material, a lubricating fluid, or a heat transfer fluid.~~

~~36.~~20. The method of ~~claim 1~~any one of claims 1-19, further comprising functionalizing the solid carbon material to provide a functionalized solid carbon material.

~~37.~~21. The method of ~~claim 1~~any one of claims 1-19, wherein the dispersion is a first dispersion, the chemical reaction is a first chemical reaction, the solid carbon material is a precursor material, the gas is a first gas, and the reactor is a first reactor; the method further comprising:

delivering the first dispersion into a second reactor;

delivering a second gas comprising at least one gaseous organic compound directly into a reaction region of the second reactor; and

inducing a second chemical reaction in the reaction region of the second reactor; wherein:

the second chemical reaction converts the precursor material into a second solid carbon material;

the second carbon material is dispersed in the liquid; and

the precursor material and the second carbon material are different.

~~38.~~22. The method of claim ~~37~~21, wherein the second reactor is a cavitation reactor and the step of inducing comprises forming cavitation bubbles in the first dispersion within the reaction region of the second reactor.

~~39.~~23. The method of claim ~~37~~21, wherein the first reactor and the second reactor are the same.

~~40. A method for functionalizing a first solid carbon material dispersed in a liquid, the first solid carbon precursor material dispersed in the liquid being a first dispersion, wherein the method comprises steps of:~~

~~delivering the first dispersion into a reaction region of a reactor; wherein the liquid comprises at least one liquid organic compound;~~

~~delivering a gas into the reaction region of the reactor; and~~

~~inducing a functionalization chemical reaction, wherein:~~

~~the functionalization chemical reaction forms a second carbon material from the first carbon material;~~

~~the functionalization chemical reaction occurs in the reaction region of the reactor; and~~

~~the second solid carbon material is made during the reaction in the form of a second dispersion, the second dispersion comprising the second solid carbon material dispersed in the liquid.~~

~~41. The method of claim 40, wherein the first solid carbon material comprises graphene oxide, graphite, expanded graphite, a graphite-like material, graphene, a graphene-like material, carbon platelets, carbon nanotubes, carbon onions, other carbon allotrope, a composite comprising graphene, cationic graphene, or any combination thereof.~~

~~42. The method of claim 40, wherein the second solid carbon material comprises, reduced graphene oxide, graphene oxide, edge-oxidized graphene, graphite, expanded graphite, a graphite-like material, graphene, a graphene-like material, carbon platelets, carbon nanotubes, carbon onions, other carbon allotrope, a composite comprising graphene, cationic graphene, or any combination thereof.~~

~~43. The method of claim 40, wherein the functionalization chemical reaction comprises oxidizing the first solid carbon material such that the second solid carbon material is soluble in water.~~

~~44. The method of claim 40, wherein the functionalization chemical reaction comprises adding oxygen atoms to the first solid carbon material, removing oxygen atoms from the first solid carbon material, adding carbon atoms to the first solid carbon material, adding nitrogen atoms to the first solid carbon material, adding sulfur atoms to the first solid carbon material, or a combination thereof.~~

~~45. The method of claim 40, wherein the gas comprises oxygen, water vapor, hydrogen, nitrogen, sulfur dioxide, CO_2, ozone, or any combination thereof.~~

~~46. The method of claim 40, wherein: the reactor is a cavitation reactor and the reaction region is a cavitation region; the method comprises forming cavitation bubbles in the liquid within the cavitation region of the cavitation reactor; and the gas is injected directly into the cavitation region.~~

~~47. A functionalized material prepared by the method of claim 40.~~