CLAIMS

What is claimed is:

1. A lubricating composition comprising a base lubricant and graphene or its oxides, comprising:

   graphene, or its oxides; and

   a base lubricant,

   wherein the graphene or graphene oxide is formed prior to combination with the base lubricant by the method of:

   refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material;

   thereafter collecting vapors produced by the reflux of the reaction mixture; and

   directing the vapors to the base lubricant, thereby combining the graphene or graphene oxide with the base lubricant.

2. The method of claim 1, wherein the solvent comprises a product of heating of the carbonaceous material.

3. A lubricating composition comprising a base lubricant and one or more Bucky diamonds, wherein at least some of the Bucky diamonds comprise iron or an iron-containing molecule.

4. A method of composites fabrication comprising a composite resin and reinforcing fibers combined with graphene or its oxides, wherein the graphene or its oxide is formed and applied to the composite materials during fabrication by the method comprising:

   refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material;

   thereafter collecting vapors produced by the reflux of the reaction mixture; and

   directing the vapors to the composite materials.

5. The method of Claim 4, wherein the solvent comprises a product of heating of the carbonaceous material.

6. A method of lubricating a mechanical system comprising at least one internal friction surface having asperities, the method comprising:

operating a mechanical system comprising a lubricating composition, wherein the lubricating composition comprises a nano-polishing agent that removes asperities from at least one internal friction surface of the mechanical system;

wherein the lubricating composition comprises at least one carbon-containing additive that forms the nano-polishing agent *in situ* under locally pyrolytic conditions found within such mechanical system during its operation.

7. A tribological coating for a metallic substrate comprising graphene or its oxide, wherein the graphene or its oxide oxide is formed and applied to the metallic substrate by the method comprising:

refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material;

thereafter collecting vapors produced by the reflux of the reaction mixture; and

directing the vapors to the metallic substrate.

8. The method of Claim 8, wherein the solvent comprises a product of heating of the carbonaceous material.

9. A lubricating composition comprising a base lubricant and at least one carbon-containing additive that forms, *in situ*, under locally pyrolytic conditions, a tribologically-effective amount of graphene or its oxides.

10. A lubricating composition comprising a base lubricant and at least one carbon-containing additive that forms, *in situ*, under locally pyrolytic conditions, a tribologically-effective amount of reduced graphene oxide after combination with additives of the base lubricant.

11. A method of synthesizing a plurality of surface-graphitized abrasive nanoparticles comprising:

refluxing a reaction mixture comprising at least one solvent, at least one metal oxide, and at least one compound promoting polycyclic aromatic hydrocarbon formation to form at least one surface graphitized abrasive nanoparticle; and

thereafter collecting the surface-graphitized abrasive nanoparticles from the reaction mixture.

12. The method of Claim 11, wherein the solvent comprises a product of heating of one or more of the compounds.

13. A drug delivery formulation comprising surface-graphitized abrasive nanoparticles.

14. Medical diagnostic imaging contrast and labeling formulations comprising surface-graphitized abrasive nanoparticles.

15. Metal medical prosthetic device fabrication and polishing comprising surface-graphitized abrasive nanoparticles.

16. Anti-ballistic composites fabrication comprising surface-graphitized abrasive nanoparticles.

17. Ballistic projectile fabrication comprising surface-graphitized abrasive nanoparticles.

18. Metal fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

19. Machine fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

20. Bearing and race fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

21. Engine and turbine fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

22. Transmission and gear systems fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

23. Heat shielding fabrication agents comprising surface-graphitized abrasive nanoparticles.

24. Composites fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

25. Optic lens fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

26. Precious gem cutting and polishing agents comprising surface-graphitized abrasive nanoparticles.

27. Mould fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

28. Railroad track and wheel fabrication and polishing agents comprising surface-graphitized abrasive nanoparticles.

29. Cutting fluids comprising surface-graphitized abrasive nanoparticles.

30. Drilling fluids comprising surface-graphitized abrasive nanoparticles.

31. Ground and rock drilling and boring agents comprising surface-graphitized abrasive nanoparticles.

32. Method of oncological tumor thermal ablation comprising associating graphitized abrasive nanoparticles with an oncological tumor and thereafter exposing the surface-graphitized abrasive nanoparticles to an externally induced magnetic field.

33. A nanoparticle comprising:

a core comprising at least one metal atom; and

a surface-graphitized shell disposed on the exterior of the core.

34. The nanoparticle of claim 33, wherein the surface-graphitized shell comprises carbon, wherein the carbon comprises a fullerene.

35. A microparticle agglomerate comprising:

at least one nanoparticle, wherein the nanoparticle comprises:

a core, comprising at least one metal atom;

a surface-graphitized shell disposed on the exterior of the core: and

at least one graphitic carbon structure associated with the nanoparticle.

36. A lubricating composition comprising:

a base lubricant;

a tribologically-effective amount of a plurality of nanoparticles;

a core, wherein the core comprises at least one metal atom; and

a surface-graphitized shell disposed on the core.

37. The lubricating composition of claim 36, wherein the surface-graphitized shell comprises a substantially fullerene carbon shell.

38. An additive formulation for addition to a base lubricant, the additive formulation comprising a base solvent and an effective amount of at least one carbon-containing additive whereupon the carbon-containing additive forms, upon pyrolysis, a tribologically-effective amount of at least one graphitic carbon containing structure.

39. A coating applied to a surface of a material, the coating comprising at least one nanoparticle comprising a core comprising at least one metal atom, and a surface-graphitized shell disposed on the core.

40. The coating of claim 39, wherein the surface-graphitized shell comprises a substantially fullerene carbon shell.

41. A composite material comprising a matrix material and at least one nanoparticle dispersed in the matrix material, the nanoparticle comprising a core comprising at least one metal atom and a surface-graphitized shell disposed on the core.

42. The composite material of claim 41, wherein the surface-graphitized shell comprises a substantially fullerene carbon shell.

43. A composite material comprising a material coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

44. The composite material of Claim 44, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

45. A composite material comprising fibers coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

46. The composite material of Claim 45, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

47. A composite material comprising a fiber mesh coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

48. The composite material of Claim 47, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

49. A concrete mix comprising a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

50. The concrete mix of Claim 49, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

51. An asphalt mix comprising a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

52. The asphalt mix of Claim 51, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

53. Fiberglass coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

54. The fiberglass of Claim 53, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

55. Plastic coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

56. The plastic of Claim 44, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

57. A plastic precursor mix comprising one or more polymers and a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

58. The plastic precursor mix of Claim 57, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

59. Graphite coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

60. The graphite of Claim 59, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

61. Wire or cable coated with a solution comprising graphene and its derivatives, wherein the solution comprising graphene and its derivatives comprises a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation refluxed under conditions to prevent the complete combustion of carbon in the reaction mixture into carbon dioxide or carbon monoxide.

62. The wire or cable of Claim 61, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

63. A method of synthesizing nano-steel comprising refluxing a reaction mixture comprising at least one solvent, at least one metal oxide, and at least one compound promoting polycyclic aromatic hydrocarbon formation to form at least one surface-graphitized abrasive nanoparticle, thereafter collecting a vapor stream produced by the reflux of the reaction mixture and subjecting the collected vapor stream to an annealing treatment.

64. The method of Claim 63, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

65. A method of graphene collection comprising refluxing a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation and thereafter collecting a vapor stream produced by the reflux of the reaction mixture.

66. The method of Claim 65, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

67. A method of collection of derivatives of graphene comprising refluxing a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation and thereafter collecting a vapor stream produced by the reflux of the reaction mixture.

68. The method of Claim 67, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

69. A collection assembly configured to collect vapor produced by refluxing a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation.

70. A hydrophobic self-assembly assembly configured to self-assemble graphene and its derivatives from the vapor produced by refluxing a reaction mixture comprising at least one solvent and at least one compound promoting polycyclic aromatic hydrocarbon formation.

71. A method of hydrophobic self-assembly of graphene comprising refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material, thereafter collecting vapors produced by the reflux of the reaction mixture and thereafter directing the vapors to an aqueous substrate, whereupon graphene is deposited on the surface of the aqueous substrate; and recovering graphene from the surface of the aqueous substrate.

72. The method of Claim 71, wherein the solvent comprises a product of heating of at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation.

73. A method of production of graphene comprising refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material, thereafter collecting vapors produced by the reflux of the reaction mixture and directing the vapors to a substrate, whereupon graphene is deposited on the surface of the substrate, and recovering graphene from the surface of the substrate.

74. The method of Claim 73, wherein the solvent comprises a product of heating of at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation.

75. A method of lubrication of a mechanical system comprising operating a mechanical system containing a lubricating composition comprising an effective amount of at least one carbon-containing additive that chemically forms *in situ* a tribologically-effective amount of at least one tribologically useful graphitic carbon-containing structure during operation of the mechanical system.

76. A method of increasing the efficiency of an engine comprising operating an engine with a lubricating composition comprising an effective amount of at least one carbon-containing additive that that chemically forms *in situ* a tribologically-effective amount of at least one tribologically-useful graphitic carbon-containing structure during operation of the engine.

77. A method of decreasing the negative horsepower of an engine comprising operating an engine with a lubricating composition comprising an effective amount of at least one carbon-containing additive that that chemically forms *in situ* a tribologically-effective amount of at least one tribologically useful graphitic carbon-containing structure during operation of the engine.

78. A method of decreasing the torque of an engine comprising operating an engine with a lubricating composition comprising an effective amount of at least one carbon-containing additive that that chemically forms *in situ* a tribologically-effective amount of at least one tribologically-useful graphitic carbon-containing structure during operation of the engine.

79. A method of production of a tribological resin, film, coating or lacquer comprising refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material, thereafter mixing the reaction mixture with a resin, film, coating or lacquer prior to application of the resin, film, coating or lacquer.

80. The method of Claim 79, wherein the solvent comprises a product of heating of at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation.

81. A dynamic furnace configured for the production of surface-graphitized abrasive nanoparticles by a process comprising refluxing a reaction mixture comprising at least one solvent, at least one metal oxide, and at least one compound promoting polycyclic aromatic hydrocarbon formation to form at least one surface graphitized abrasive nanoparticle, thereafter collecting a vapor stream produced by the reflux of the reaction mixture containing the surface-graphitized abrasive nanoparticle and subjecting the collected vapor stream to a high shear environment comprising high speed rotation, high frequency oscillation or vibration, hydrodynamic squeezing, frictional impact with one or more moving parts, high speed stirring, or any combination thereof, and thereafter collecting the surface-graphitized abrasive nanoparticles.

82. The dynamic furnace of claim 81 further comprising a surface topography comprising fins, rods, bumps, depressions, holes, asperities, tunnels and any combination thereof.

83. A lubricating composition for a mechanical system comprising:

    a base lubricant; and

    at least one carbon-containing additive that forms a tribologically-effective amount of at least one graphitic carbon-containing structure when the lubricating composition is exposed to heat sufficient to create locally pyrolitic conditions within a mechanical system in which it is utilized,

    wherein the graphitic carbon-containing structure comprises one or more surface-graphitized abrasive nanoparticles comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon,

    wherein the graphitic carbon-containing structure comprises a nano-polishing agent configured to remove substantially all of the asperities from an internal friction surface of the mechanical system.

84. The lubricating composition of claim 83, wherein the carbon-containing additive comprises a cyclic molecule.
85. The lubricating composition of claim 84, wherein the carbon-containing additive comprises an aromatic molecule.

86. The lubricating composition of claim 84, wherein the carbon-containing additive comprises a hydrocarbon.

87. The lubricating composition of claim 84, wherein the carbon-containing additive consists essentially of carbon atoms, hydrogen atoms, and oxygen atoms.

88. The lubricating composition of claim 84, wherein the carbon-containing additive comprises pyranose, a furanose, a cyclic carbomer, a benzenoid, a sugar, a sugar alcohol, a sugar substitute, a sugar derivative, a cyclomethicone, a steroid, a cinnamate, a phenylphopanoid, a benzoate, a carboxylate, a benzopyran, a naturally-occurring or synthetic flavone or isoflavone, a salicylate, an antioxidant, a cyclic antioxidant, 4-vinylphenol, anthocyanidin, or chromenylium, a cyclic amino acid, a cyclohexane derivative, a benzene derivative 1,2-dihydroxybenzene (catechol), 1,3-dihydroxybenzene (resorcinol), 1,4-dihydroxybenzene (hydroquinone), a naphthoate, an acrylate, a phthalate, a succinate, a carpate, a fluorophore, a pharmaceutical, a phosphate, a commercial edible personal/sexual lubricating composition including a sugar or sugar-substitute amphiphile, a commercial ultraviolet ray sunscreen formulation, a commercial skin cream formulation, a commercial hand sanitizer formulation, a commercial human or animal hair care product, a commercial hair dye formulation, a commercial pesticide, a compound that degrades to one or more of the above-mentioned additives during refluxing of the reaction mixture, or combinations thereof.

89. A method of manufacturing a lubricating composition for a mechanical system comprising:

a) refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material;

b) thereafter collecting vapors produced by the reflux of the reaction mixture;

c) directing the vapors to a substrate, whereupon graphene and its derivatives are deposited on the surface of the substrate;

d) recovering graphene and its derivatives from the surface of the substrate; and

e) combining at least some of the recovered graphene and its derivatives with a base lubricant to form a lubricating composition for a mechanical system.

90. The method of claim 89, wherein the solvent comprises a product of heating of at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation.

91. The method of manufacturing the lubricating composition of claim 89, wherein the at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation comprises pyranose, a furanose, a cyclic carbomer, a benzenoid, a sugar, a sugar alcohol, a sugar substitute, a sugar derivative, a cyclomethicone, a steroid, a cinnamate, a phenylphopanoid, a benzoate, a carboxylate, a benzopyran, a naturally-occurring or synthetic flavone or isoflavone, a salicylate, an antioxidant, a cyclic antioxidant, 4-vinylphenol, anthocyanidin, or chromenylium, a cyclic amino acid, a cyclohexane derivative, a benzene derivative 1,2-dihydroxybenzene (catechol), 1,3-dihydroxybenzene (resorcinol), 1,4-dihydroxybenzene (hydroquinone), a naphthoate, an acrylate, a phthalate, a succinate, a carpate, a fluorophore, a pharmaceutical, a phosphate, a commercial edible personal/sexual lubricating composition,

including a sugar or sugar-substitute amphiphile, a commercial ultraviolet ray sunscreen formulation, a commercial skin cream formulation, a commercial hand sanitizer formulation, a commercial human or animal hair care product, a commercial hair dye formulation, a commercial pesticide, a compound that degrades to one or more of the above-mentioned additives during refluxing of the reaction mixture, or combinations thereof.

92. The method of manufacturing the lubricating composition of claim 89, wherein the at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation comprises a compound that promotes the formation of at least one C1 to C5 hydrocarbon radical.

93. The method of manufacturing the lubricating composition of claim 89, wherein the solvent comprises mineral oil, water, an alcohol, methanol, synthetic methanol, ethanol, isopropanol or combinations thereof.

94. The method of manufacturing the lubricating composition of claim 89, wherein the reaction mixture further comprises at least one supplemental carbon source.

95. The method of manufacturing the lubricating composition of claim 89, wherein the supplemental carbon source comprises natural graphite, synthetic graphite, one or more polycyclic aromatic hydrocarbons, graphene, activated carbon, nano-coal, "activated nano-coal", biochar, sugar char, coal phlegm, one or more benzenoids, naphthalene, an alcohol, methanol, synthetic methanol, ethanol, isopropanol, sugar, sucrose, a starch, cellulose, an olefin, an acetate, one or more non-graphitic hydrocarbons, an alkane, an alkene, an alkyne, a ketone, toluene, gasoline, diesel fuel, kerosene, coal tar, coke, or combinations thereof.

96. The method of manufacturing the lubricating composition of claim 89, wherein the substrate comprises a hydrophilic substrate.

97. The method of manufacturing the lubricating composition of claim 89, wherein the conditions comprise pyrolysis.

98. A method of manufacturing a lubricating composition for a mechanical system comprising:

a base lubricant; and

graphene oxide, wherein the graphene oxide is formed prior to combination with the base lubricant by the process of:

a) refluxing a reaction mixture comprising at least one solvent, at least one oxidizer and at least one compound promoting polycyclic aromatic hydrocarbon formation under conditions to prevent the complete combustion of the carbon source into carbon dioxide or carbon monoxide;

b) thereafter collecting a vapor stream produced by the reflux of the reaction mixture;

c) thereafter directing the vapor stream to a substrate, whereupon graphene oxide is deposited on the surface of the substrate;

d) recovering graphene oxide from the surface of the substrate; and

e) combining at least some of the recovered graphene oxide with the base lubricant to form a lubricating composition for a mechanical system.

99. The method of claim 98, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

100. A lubricating composition for a mechanical system comprising:

a base lubricant; and

one or more surface-graphitized abrasive nanoparticles comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon Bucky-diamonds, wherein at least one of the Bucky-diamonds comprises iron or an iron-containing molecule.

101. The lubricating composition of claim 100, wherein at least one Bucky-diamond surface-graphitized abrasive nanosized particle comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon is formed from at least one carbon-containing additive to the base lubricant when the lubricating composition is exposed to heat sufficient to create locally pyrolitic conditions.

102. The lubricating composition of claim 101, wherein the surface-graphitized abrasive nanosized particles comprise a nano-diamond core that comprises non-carbon hetero-atoms, and a fullerenic carbon shell formed around the core;

a base lubricant; and
one or more Bucky-diamonds.

103. The lubricating composition of claim 102, wherein the hetero-atom comprises iron or iron oxide at least one Bucky-diamond is formed from at least one carbon-containing additive to the base lubricant when the lubricating composition is exposed to heat sufficient to create locally pyrolitic conditions within a system to which the lubricating composition is added.

104. A method of lubricating a mechanical system comprising at least one internal friction surface having asperities, the method comprising:

operating the mechanical system with a lubricating composition comprising a nano-polishing agent and removing substantially all of the asperities from an internal friction surface of the mechanical system, wherein the lubricating composition comprises a base lubricant and at least one carbon-containing additive that forms at least one nano-polishing agent when the lubricating composition is exposed to locally pyrolitic conditions within the mechanical system in which it is utilized,

wherein the nano-polishing agent comprises one or more surface-graphitized abrasive nanoparticles comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon.

105. The method of claim 104, wherein the carbon-containing additive comprises a cyclic molecule.

106. The method of claim 104, wherein the carbon-containing additive comprises an aromatic molecule.

107. The method of claim 104, wherein the carbon-containing additive comprises a hydrocarbon.

108. The method of claim 104, wherein the carbon-containing additive consists essentially of carbon atoms, hydrogen atoms, and oxygen atoms.

109. The method of claim 104, further comprising operating the mechanical system containing the lubricating composition after the nano-polishing agent has removed substantially all of the asperities from the internal friction surface.

110. The method of claim 104, wherein the Ra of at least one internal friction surface following polishing by the nano-polishing agent is less than about 50 nm.

111. The method of claim 110, wherein the Ra of at least one internal friction surface following polishing by the nano-polishing agent is less than about 5 nm.

112. A method of synthesizing graphene comprising:

a) refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material;

b) thereafter collecting vapors produced by the reflux of the reaction mixture;

c) directing the vapors to a substrate, whereupon graphene is deposited on the surface of the substrate; and

d) recovering graphene from the surface of the substrate.

113. The method of claim 112, wherein the at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation comprises pyranose, a furanose, a cyclic carbomer, a benzenoid, a sugar, a sugar alcohol, a sugar substitute, a sugar derivative, a cyclomethicone, a steroid, a cinnamate, a phenylphopanoid, a benzoate, a carboxylate, a benzopyran, a naturally-occurring or synthetic flavone or isoflavone, a salicylate, an antioxidant, a cyclic antioxidant, 4-vinylphenol, anthocyanidin, or chromenylium, a cyclic amino acid, a cyclohexane derivative, a benzene derivative 1,2-dihydroxybenzene (catechol), 1,3-dihydroxybenzene (resorcinol), 1,4-dihydroxybenzene (hydroquinone), a naphthoate, an acrylate, a phthalate, a succinate, a carpate, a fluorophore, a pharmaceutical, a phosphate, a commercial edible personal/sexual lubricating composition including a sugar or sugar-substitute amphiphile, a commercial ultraviolet ray sunscreen formulation, a commercial skin cream formulation, a commercial hand sanitizer formulation, a commercial human or animal hair care product, a commercial hair dye formulation, a commercial pesticide, a compound that degrades to one or more of the above-mentioned additives during refluxing of the reaction mixture, or combinations thereof.

114. The method of claim 113, wherein the at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation comprises a compound that promotes the formation of at least one C1 to C5 hydrocarbon radical.

115. The method of claim 113, wherein the solvent comprises mineral oil, water, an alcohol, methanol, synthetic methanol, ethanol, isopropanol or combinations thereof.

116. The method of claim 113, wherein the reaction mixture further comprises at least one supplemental carbon source.

117. The method of claim 116, wherein the supplemental carbon source comprises natural graphite, synthetic graphite, one or more polycyclic aromatic hydrocarbons, graphene, activated carbon, nano-coal, "activated nano-coal", biochar, sugar char, coal phlegm, one or more benzenoids, naphthalene, an alcohol, methanol, synthetic methanol, ethanol, isopropanol, sugar, sucrose, a starch, cellulose, an olefin, an acetate, one or more

non-graphitic hydrocarbons, an alkane, an alkene, an alkyne, a ketone, toluene, gasoline, diesel fuel, kerosene, coal, coal tar, coke, or combinations thereof.

118. The method of claim 112, wherein the substrate comprises a hydrophilic substrate.

119. The method of claim 112, wherein the conditions comprise pyrolysis.

120. The method of claim 112, wherein the reaction mixture further comprises a metal-containing compound.

121. The method of claim 112, wherein the metal-containing compound comprises a metal oxide.

122. The method of claim 121, wherein the metal oxide comprises iron oxide, aluminum oxide, copper oxide, nickel oxide, titanium oxide, or lead oxide.

123. The method of claim 112, wherein the reaction mixture further comprises nanodiamonds.

124. The method of claim 112, wherein the substrate comprises an aqueous pool, wherein the graphene comprises aqueous gelled graphene.

125. The method of claim 112, wherein the solvent comprises a product of heating of at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation.

126. A method of graphene oxide production comprising:

a) refluxing a reaction mixture comprising at least one solvent, at least one oxidizer and at least one compound promoting polycyclic aromatic hydrocarbon formation under conditions to prevent the complete combustion of the carbon source into carbon dioxide or carbon monoxide;

b) thereafter collecting a vapor stream produced by the reflux of the reaction mixture:

c) thereafter directing the vapor stream to a substrate, whereupon graphene oxide is deposited on the surface of the substrate; and

d) recovering graphene oxide from the surface of the substrate.

127. The method of claim 126, wherein the conditions comprise pyrolysis.

128. The method of claim 126, wherein the reaction mixture further comprises a metal-containing compound.

129. The method of claim 128, wherein the metal-containing compound comprises a metal oxide.

130. The method of claim 129, wherein the metal oxide comprises iron oxide, aluminum oxide, copper oxide, nickel oxide, titanium oxide, or lead oxide.

131. The method of claim 126, wherein the reaction mixture further comprises nanodiamonds.

132. The method of claim 126, wherein the substrate comprises an aqueous pool, wherein the graphene oxide comprises aqueous gelled graphene oxide.

133. The method of claim 126, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

CLAIMS

1. A lubricating composition comprising a base lubricant and one or more Bucky diamonds, wherein at least some of the Bucky diamonds comprise iron or an iron-containing molecule.

2. A method of lubricating a mechanical system comprising at least one internal friction surface having asperities, the method comprising:

operating a mechanical system comprising a lubricating composition, wherein the lubricating composition comprises a nano-polishing agent that removes asperities from at least one internal friction surface of the mechanical system;

wherein the lubricating composition comprises at least one carbon-containing additive that forms the nano-polishing agent *in situ* under locally pyrolytic conditions found within such mechanical system during its operation.

3. A lubricating composition comprising a base lubricant and at least one carbon-containing additive that forms, *in situ*, under locally pyrolytic conditions, a tribologically-effective amount of graphene or its oxides.

4. A lubricating composition comprising a base lubricant and at least one carbon-containing additive that forms, *in situ*, under locally pyrolytic conditions, a tribologically-effective amount of reduced graphene oxide after combination with additives of the base lubricant.

5. A lubricating composition comprising:

a base lubricant;

a tribologically-effective amount of a plurality of nanoparticles;

a core, wherein the core comprises at least one metal atom; and

a surface-graphitized shell disposed on the core.

6. The lubricating composition of claim 5, wherein the surface-graphitized shell comprises a substantially fullerene carbon shell.

7. An additive formulation for addition to a base lubricant, the additive formulation comprising a base solvent and an effective amount of at least one carbon-containing additive whereupon the carbon-containing additive forms, upon pyrolysis, a tribologically-effective amount of at least one graphitic carbon containing structure.

8. A method of lubrication of a mechanical system comprising operating a mechanical system containing a lubricating composition comprising an effective amount of at least one carbon-containing additive that chemically forms *in situ* a tribologically-effective amount of at least one tribologically useful graphitic carbon-containing structure during operation of the mechanical system.

9. A method of increasing the efficiency of an engine comprising operating an engine with a lubricating composition comprising an effective amount of at least one carbon-containing additive that that chemically forms *in situ* a tribologically-effective amount of at least one tribologically-useful graphitic carbon-containing structure during operation of the engine.

10. A method of decreasing the negative horsepower of an engine comprising operating an engine with a lubricating composition comprising an effective amount of at least one carbon-containing additive that that chemically forms *in situ* a tribologically-effective amount of at least one tribologically useful graphitic carbon-containing structure during operation of the engine.

11. A method of decreasing the torque of an engine comprising operating an engine with a lubricating composition comprising an effective amount of at least one carbon-containing additive that that chemically forms *in situ* a tribologically-effective amount of at least one tribologically-useful graphitic carbon-containing structure during operation of the engine.

12. A lubricating composition for a mechanical system comprising:

a base lubricant; and

at least one carbon-containing additive that forms a tribologically-effective amount of at least one graphitic carbon-containing structure when the lubricating composition is

exposed to heat sufficient to create locally pyrolitic conditions within a mechanical system in which it is utilized,

wherein the graphitic carbon-containing structure comprises one or more surface-graphitized abrasive nanoparticles comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon,

wherein the graphitic carbon-containing structure comprises a nano-polishing agent configured to remove substantially all of the asperities from an internal friction surface of the mechanical system.

13. The lubricating composition of claim 12, wherein the carbon-containing additive comprises a cyclic molecule.

14. The lubricating composition of claim 13, wherein the carbon-containing additive comprises an aromatic molecule.

15. The lubricating composition of claim 13, wherein the carbon-containing additive comprises a hydrocarbon.

16. The lubricating composition of claim 13, wherein the carbon-containing additive consists essentially of carbon atoms, hydrogen atoms, and oxygen atoms.

17. The lubricating composition of claim 13, wherein the carbon-containing additive comprises pyranose, a furanose, a cyclic carbomer, a benzenoid, a sugar, a sugar alcohol, a sugar substitute, a sugar derivative, a cyclomethicone, a steroid, a cinnamate, a phenylphopanoid, a benzoate, a carboxylate, a benzopyran, a naturally-occurring or synthetic flavone or isoflavone, a salicylate, an antioxidant, a cyclic antioxidant, 4-vinylphenol, anthocyanidin, or chromenylium, a cyclic amino acid, a cyclohexane derivative, a benzene derivative 1,2-dihydroxybenzene (catechol), 1,3-dihydroxybenzene (resorcinol), 1,4-dihydroxybenzene (hydroquinone), a naphthoate, an acrylate, a phthalate, a succinate, a carpate, a fluorophore, a pharmaceutical, a phosphate, a commercial edible personal/sexual lubricating composition including a sugar or sugar-substitute amphiphile, a commercial ultraviolet ray sunscreen formulation, a commercial

skin cream formulation, a commercial hand sanitizer formulation, a commercial human or animal hair care product, a commercial hair dye formulation, a commercial pesticide, a compound that degrades to one or more of the above-mentioned additives during refluxing of the reaction mixture, or combinations thereof.

18. A method of manufacturing a lubricating composition for a mechanical system comprising:

a) refluxing a reaction mixture comprising at least one solvent and at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation under conditions that inhibit complete combustion of the carbonaceous material;
b) thereafter collecting vapors produced by the reflux of the reaction mixture;
c) directing the vapors to a substrate, whereupon graphene and its derivatives are deposited on the surface of the substrate;
d) recovering graphene and its derivatives from the surface of the substrate; and
e) combining at least some of the recovered graphene and its derivatives with a base lubricant to form a lubricating composition for a mechanical system.

19. The method of claim 18, wherein the solvent comprises a product of heating of at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation.

20. The method of manufacturing the lubricating composition of claim 18, wherein the at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation comprises pyranose, a furanose, a cyclic carbomer, a benzenoid, a sugar, a sugar alcohol, a sugar substitute, a sugar derivative, a cyclomethicone, a steroid, a cinnamate, a phenylphopanoid, a benzoate, a carboxylate, a benzopyran, a naturally-occurring or synthetic flavone or isoflavone, a salicylate, an antioxidant, a cyclic antioxidant, 4-vinylphenol, anthocyanidin, or chromenylium, a cyclic amino acid, a cyclohexane derivative, a benzene derivative 1,2-dihydroxybenzene (catechol), 1,3-dihydroxybenzene (resorcinol), 1,4-dihydroxybenzene (hydroquinone), a naphthoate, an acrylate, a phthalate, a succinate, a carpate, a fluorophore, a pharmaceutical, a phosphate, a commercial edible personal/sexual lubricating composition,

including a sugar or sugar-substitute amphiphile, a commercial ultraviolet ray sunscreen formulation, a commercial skin cream formulation, a commercial hand sanitizer formulation, a commercial human or animal hair care product, a commercial hair dye formulation, a commercial pesticide, a compound that degrades to one or more of the above-mentioned additives during refluxing of the reaction mixture, or combinations thereof.

21. The method of manufacturing the lubricating composition of claim 18, wherein the at least one carbonaceous material promoting polycyclic aromatic hydrocarbon formation comprises a compound that promotes the formation of at least one C1 to C5 hydrocarbon radical.

22. The method of manufacturing the lubricating composition of claim 18, wherein the solvent comprises mineral oil, water, an alcohol, methanol, synthetic methanol, ethanol, isopropanol or combinations thereof.

23. The method of manufacturing the lubricating composition of claim 18, wherein the reaction mixture further comprises at least one supplemental carbon source.

24. The method of manufacturing the lubricating composition of claim 18, wherein the supplemental carbon source comprises natural graphite, synthetic graphite, one or more polycyclic aromatic hydrocarbons, graphene, activated carbon, nano-coal, "activated nano-coal", biochar, sugar char, coal phlegm, one or more benzenoids, naphthalene, an alcohol, methanol, synthetic methanol, ethanol, isopropanol, sugar, sucrose, a starch, cellulose, an olefin, an acetate, one or more non-graphitic hydrocarbons, an alkane, an alkene, an alkyne, a ketone, toluene, gasoline, diesel fuel, kerosene, coal tar, coke, or combinations thereof.

25. The method of manufacturing the lubricating composition of claim 18, wherein the substrate comprises a hydrophilic substrate.

26. The method of manufacturing the lubricating composition of claim 18, wherein the conditions comprise pyrolysis.

27. A method of manufacturing a lubricating composition for a mechanical system comprising:

a base lubricant; and

graphene oxide, wherein the graphene oxide is formed prior to combination with the base lubricant by the process of:

a) refluxing a reaction mixture comprising at least one solvent, at least one oxidizer and at least one compound promoting polycyclic aromatic hydrocarbon formation under conditions to prevent the complete combustion of the carbon source into carbon dioxide or carbon monoxide;

b) thereafter collecting a vapor stream produced by the reflux of the reaction mixture;

c) thereafter directing the vapor stream to a substrate, whereupon graphene oxide is deposited on the surface of the substrate;

d) recovering graphene oxide from the surface of the substrate; and

e) combining at least some of the recovered graphene oxide with the base lubricant to form a lubricating composition for a mechanical system.

28. The method of claim 27, wherein the solvent comprises a product of heating of at least one compound promoting polycyclic aromatic hydrocarbon formation.

29. A lubricating composition for a mechanical system comprising:

a base lubricant; and

one or more surface-graphitized abrasive nanoparticles comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon Bucky-diamonds, wherein at least one of the Bucky-diamonds comprises iron or an iron-containing molecule.

30. The lubricating composition of claim 29, wherein at least one Bucky-diamond surface-graphitized abrasive nanosized particle comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon is formed from at least one carbon-

containing additive to the base lubricant when the lubricating composition is exposed to heat sufficient to create locally pyrolitic conditions.

31. The lubricating composition of claim 30, wherein the surface-graphitized abrasive nanosized particles comprise a nano-diamond core that comprises non-carbon hetero-atoms, and a fullerenic carbon shell formed around the core;

a base lubricant; and

one or more Bucky-diamonds.

32. The lubricating composition of claim 31, wherein the hetero-atom comprises iron or iron oxide at least one Bucky-diamond is formed from at least one carbon-containing additive to the base lubricant when the lubricating composition is exposed to heat sufficient to create locally pyrolitic conditions within a system to which the lubricating composition is added.

33. A method of lubricating a mechanical system comprising at least one internal friction surface having asperities, the method comprising:

operating the mechanical system with a lubricating composition comprising a nano-polishing agent and removing substantially all of the asperities from an internal friction surface of the mechanical system, wherein the lubricating composition comprises a base lubricant and at least one carbon-containing additive that forms at least one nano-polishing agent when the lubricating composition is exposed to locally pyrolitic conditions within the mechanical system in which it is utilized,

wherein the nano-polishing agent comprises one or more surface-graphitized abrasive nanoparticles comprising at least one non-carbon hetero-atom enveloped by an outer shell comprising substantially carbon.

34. The method of claim 33, wherein the carbon-containing additive comprises a cyclic molecule.

35. The method of claim 33, wherein the carbon-containing additive comprises an aromatic molecule.

36. The method of claim 33, wherein the carbon-containing additive comprises a hydrocarbon.

37. The method of claim 33, wherein the carbon-containing additive consists essentially of carbon atoms, hydrogen atoms, and oxygen atoms.

38. The method of claim 33, further comprising operating the mechanical system containing the lubricating composition after the nano-polishing agent has removed substantially all of the asperities from the internal friction surface.

39. The method of claim 33, wherein the Ra of at least one internal friction surface following polishing by the nano-polishing agent is less than about 50 nm.

40. The method of claim 39, wherein the Ra of at least one internal friction surface following polishing by the nano-polishing agent is less than about 5 nm.