CLAIMS

1. A material comprising a synthetic anthracite.
2. The material of claim 1, wherein the synthetic anthracite comprises a templated morphology.
3. The material of any of claims 1 or 2, wherein the synthetic anthracite comprises a perimorphic framework.
4. The material of any of claims 1 to 3, wherein the synthetic anthracite comprises at least one of: a mesoporous and macroporous structure.
5. The material of any of claims 1 to 4, wherein the synthetic anthracite comprises at least one of: a microscopic and macroscopic structure.
6. The material of any of claims 1 to 5, wherein the synthetic anthracite comprises a layered graphenic network crosslinked via structural dislocations.
7. The material of any of claims 1 to 6, wherein the synthetic anthracite comprises an ambient superconductor.
8. The material of claim 7, wherein the ambient superconductor is macroscopic.
9. A material comprising a synthetic anthracitic network.
10. The material of claim 9, wherein the synthetic anthracitic network comprises a layered graphenic network crosslinked via structural dislocations.
11. The material of any of claims 9 to 10, wherein the synthetic anthracitic network comprises an sp^x network.

12. The material of any of claims 9 to 10, wherein the synthetic anthracitic network comprises a helicoidal network.

13. The material of any of claims 9 to 12, wherein the synthetic anthracitic network comprises an *x*-Carbon.

14. The material of any of claims 9 to 12, wherein the synthetic anthracitic network comprises a *z*-Carbon.

15. The material of any of claims 9 to 14, wherein the structural dislocations comprise Y-dislocations.
16. The material of any of claims 9 to 14, wherein the structural dislocations comprise mixed

dislocations.

17. The material of claim 16, wherein the mixed dislocations comprise chiral columns.

18. The material of any of claims 9 to 14, wherein the structural dislocations comprise screw dislocations.

19. The material of claim 17, wherein the structural dislocations comprise double screw dislocations.

20. The material of any of claims 9 to 19, wherein the synthetic anthracitic network comprises sp^2-hybridized regions and diamondlike regions.

21. The material of claim 20, wherein the diamondlike regions comprise at least one of: cubic diamond, hexagonal diamond, and amorphous diamond.

22. The material of claim 20, wherein the diamondlike regions comprise at least one of: chair conformations, boat conformations, and half-chair conformations.

23. The material of claim 20, wherein the diamondlike regions comprise sp^x-rings possessing both sp^2-hybridized and sp^3-hybridized atoms.

24. The material of any of claims 9 to 23, wherein the synthetic anthracitic network comprises a ring-connected singleton.

25. The material of any of claims 9 to 24, wherein the synthetic anthracitic network comprises a multilayer network.

26. The material of any of claims 9 to 25, wherein the multilayer anthracitic network comprises a minimum average BET surface area of less than 2,300 m^2/g as measured via N_2-adsorption.

27. The material of claim 26, wherein the multilayer anthracitic network comprises a minimum average BET surface area between 1,000 m^2/g and 2,300 m^2/g as measured via N_2-adsorption.

28. The material of claim 26, wherein the multilayer anthracitic network comprises a minimum average BET surface area between 10 m^2/g and 1,000 m^2/g as measured via N_2 adsorption.

29. The material of any of claims 9 to 28, wherein the multilayer anthracitic network comprises an average BJH specific porosity of less than 10.0 cm^3/g, as measured via N_2 adsorption.

30. The material of claim 29, wherein the multilayer anthracitic network comprises an average BJH specific porosity between 7.5 cm^3/g and 10.0 cm^3/g, as measured via N_2 adsorption.

31. The material of claim 29, wherein the multilayer anthracitic network comprises an average BJH specific porosity between 2.5 cm^3/g and 7.5 cm^3/g, as measured via N_2 adsorption.

32. The material of claim 29, wherein the multilayer anthracitic network comprises an average BJH specific porosity between 2.5 cm^3/g and 7.5 cm^3/g, as measured via N_2 adsorption.

33. The material of any of claims 9 to 32, wherein the average Raman spectrum obtained using 532 nm excitation comprises an unfitted D band having a peak intensity between 1342 cm^{-1} and 1375 cm^{-1}.

34. The material of any of claims 9 to 32, wherein the average Raman spectrum obtained using 532 nm excitation comprises an unfitted D band having a peak intensity between 1332 cm^{-1} and 1342 cm^{-1}.

35. The material of any of claims 9 to 32, wherein the average Raman spectrum obtained at 532 nm excitation comprises an unfitted D band having a peak intensity between 1318 cm^{-1} and 1332 cm^{-1}.

36. The material of any of claims 9 to 32, wherein the average Raman spectrum obtained at 532 nm excitation comprises an unfitted D band having a peak intensity between 1300 cm^{-1} and 1318 cm^{-1}.

37. The material of any of claims 9 to 36, wherein the average Raman spectrum obtained at 532 nm excitation comprises an unfitted G band having a peak intensity between 1580 cm^{-1} and 1595 cm^{-1}.

38. The material of any of claims 9 to 36, wherein the average Raman spectrum obtained at 532 nm excitation comprises an unfitted G band having a peak intensity between 1595 cm^{-1} and 1610 cm^{-1}.

39. The material of any of claims 9 to 36, wherein the average Raman spectrum obtained at 532 nm excitation comprises an unfitted G band having a peak intensity above 1610 cm^{-1}.

40. The material of any of claims 9 to 39, wherein the average Raman spectrum obtained at 532 nm excitation comprises an unfitted peak between 600 $^{-1}$ and 750 cm^{-1}.

41. The material of any of claims 9 to 40, wherein the average Raman spectrum obtained at 532 nm excitation comprises a trough located between the unfitted G peak and the unfitted D peak, wherein the ratio of the trough's height to the height of the unfitted G peak is between 0.60 and 0.80.

42. The material of any of claims 9 to 40, wherein the average Raman spectrum obtained at 532 nm excitation comprises a trough located between the unfitted G peak and the unfitted D peak, wherein the ratio of the trough's height to the height of the unfitted G peak is between 0.40 and 0.60.

43. The material of any of claims 9 to 40, wherein the average Raman spectrum obtained at 532 nm excitation comprises a trough located between the unfitted G peak and the unfitted D peak, wherein the ratio of the trough's height to the height of the unfitted G peak is between 0.20 and 0.40.

44. The material of any of claims 9 to 40, wherein the average Raman spectrum obtained at 532 nm excitation comprises a trough located between the unfitted G peak and the unfitted D peak, wherein the ratio of the trough's height to the height of the unfitted G peak is between 0.05 and 0.20.

45. The material of any of claims 9 to 44, wherein the average Raman spectrum obtained at 532 nm excitation comprises an I_D/I_G peak intensity ratio between its unfitted D peak and unfitted G peak of less than 3.0.

46. The material of claim 45, wherein the average Raman spectrum obtained at 532 nm excitation comprises an I_D/I_G peak intensity ratio between its unfitted D peak and unfitted G peak between 2.0 and 3.0.

47. The material of claim 45, wherein the average Raman spectrum obtained at 532 nm excitation comprises an I_D/I_G peak intensity ratio between its unfitted D peak and unfitted G peak between 1.0 and 2.0.

48. The material of claim 45, wherein the average Raman spectrum obtained at 532 nm excitation comprises an I_D/I_G peak intensity ratio between its unfitted D peak and unfitted G peak between 0.1 and 1.0.

49. The material of any of claims 9 to 48, wherein the average Raman spectrum at 532 nm excitation comprises an I_{2D}/I_G peak intensity ratio between its unfitted 2D peak and unfitted G peak of less than 0.50.

50. The material of any of claims 9 to 48, wherein the average Raman spectrum at 532 nm excitation comprises an I_{2D}/I_G peak intensity ratio between its unfitted 2D peak and unfitted G peak between 0.25 and 0.50.

51. The material of any of claims 9 to 48, wherein the average Raman spectrum at 532 nm excitation comprises an I_{2D}/I_G peak intensity ratio between its unfitted 2D peak and unfitted G peak between 0.05 and 0.25.

52. The material of any of claims 9 to 51, wherein the XRD profile comprises a <002> peak position corresponding to an average interlayer d-spacing of 3.35 Å to 3.45 Å.

53. The material of any of claims 9 to 51, wherein the XRD profile comprises a <002> peak position corresponding to an average interlayer d-spacing of greater than 3.45 Å.

54. The material of any of claims 9 to 51, wherein the XRD profile comprises a <002> peak position corresponding to an average interlayer d-spacing between 3.45 Å and 3.55 Å.

55. The material of any of claims 9 to 51, wherein the XRD profile comprises a <002> peak position corresponding to an average interlayer d-spacing between 3.55 Å and 3.65 Å.

56. The material of any of claims 9 to 51, wherein the XRD profile comprises a <002> peak position corresponding to an average interlayer d-spacing between 3.65 Å and 4.00 Å.

57. The material of any of claims 9 to 56, wherein the XRD profile comprises an expanded mode of the <002> peak with a peak position corresponding to an expanded interlayer d-spacing of greater than 3.75 Å.

58. The material of claim 57, wherein the XRD profile comprises an expanded mode of the <002> peak with a peak position corresponding to an expanded interlayer d-spacing between 3.75 and 4.50 Å.

59. The material of claim 57, wherein the XRD profile comprises an expanded mode of the <002> peak with a peak position corresponding to an expanded interlayer d-spacing between 4.50 and 5.25 Å.

60. The material of claim 57, wherein the XRD profile comprises an expanded mode of the <002> peak with a peak position corresponding to an expanded interlayer d-spacing between 5.25 and 6.00 Å.

61. The material of any of claims 9 to 60, wherein the XRD profile comprises a <100> peak with a peak position corresponding to an average intralayer d-spacing of less than 2.13 Å.

62. The material of claim 61, wherein the XRD profile comprises a <100> peak with a peak position corresponding to an average intralayer d-spacing between 2.11 and 2.13 Å.

63. The material of claim 61, wherein the XRD profile comprises a <100> peak with a peak position corresponding to an average intralayer d-spacing between 2.09 and 2.11 Å.

64. The material of claim 61, wherein the XRD profile comprises a <100> peak with a peak position corresponding to an average intralayer d-spacing between 2.00 and 2.09 Å.

65. The material of any of claims 9 to 64, wherein the synthetic anthracitic network comprises a perimorphic framework.

66. The material of claim 65, wherein the perimorphic framework comprises a microscopic particle comprising at least one of: a spheroidal particle, a hollow spheroidal particle, a fibrous particle, a rosette particle, a cuboidal particle, a prismatic particle.

67. The material of any of claims 9 to 67, wherein the synthetic anthracitic network is a macroform comprising at least one of a grain, a pellet, a textile, a paper, a filament, and a molded article.

68. The material of any of claims 9 to 68, wherein the synthetic anthracitic network comprises carbon structures grafted to one another via pyrolytic growth, the carbon structures comprising at least one of: carbon black, glassy carbon, activated carbon, carbon nanoparticles.

69. The material of any of claims 9 to 68, wherein the synthetic anthracitic network comprises an ambient superconductor.

70. The material of claim 69, wherein the ambient superconductor comprises ambient superconducting grains and the synthetic anthracitic network comprises granular ambient superconductivity.

71. The material of any of claims 9 to 70, wherein the ambient superconductor comprises a porous material evacuated to an internal pressure of less than 760 Torr.

72. The material of claim 71, wherein the ambient superconductor is evacuated to an internal pressure between 1 Torr and 10 Torr.

73. The material of claim 71, wherein the ambient superconductor is evacuated to an internal pressure between 100 mTorr and 1 Torr.

74. The material of claim 71, wherein the ambient superconductor is evacuated to an internal pressure of 10 mTorr and 100 mTorr.

75. The material of claim 71, wherein the ambient superconductor is evacuated to an internal pressure below 10 mTorr.

76. The material of any of claims 9 to 75, wherein the ambient superconductor comprises a gas-impermeable barrier phase to prevent the intrusion of external gas molecules.

77. The material of any of claims 9 to 75, wherein the ambient superconductor comprises a gas-impermeable barrier phase to prevent the intrusion of external gas molecules.

78. The material of claim 76, wherein the gas-impermeable barrier phase comprises a metal.

79. The material of any of claims 9 to 77, wherein the ambient superconductor is superconducting at 20°C temperature and 1 atmosphere of external pressure.

80. The material of any of claims 9 to 77, wherein the ambient superconductor comprises a macroscopic article comprising a continuous filament, sheet, or molded component.

CLAIMS

1. A process for forming perimorphic frameworks, the process comprising:

I. Forming a perimorphic wall around each template particle in a population of template particles, the forming of the perimorphic wall comprising:

over a templating surface of a template particle, in the presence of a vapor comprising radicals, at a first temperature of at least 400° C.:

growing graphenic structures via radical addition at edges of the graphenic structures; and

at interfaces between the edges of graphenic structures, grafting the edges covalently by forming sp^2-sp^2 and sp^3-sp^3 bonds between them, the grafting of the graphenic structures coalescing them into a larger, coalesced graphenic layer generally encapsulating the templating surface and comprising both sp^2- and sp^3-hybridized states; and

nucleating higher-layer graphenic regions above the coalesced graphenic layer, the higher-layer graphenic regions nematically aligned with the coalesced graphenic layer and growing via radical addition at their edges, the coalesced graphenic layer and higher-layer graphenic regions covalently connected and together comprising the perimorphic wall, the perimorphic wall rendering the template particle endomorphic and together with it comprising a perimorphic composite particle; and

II. Heating the perimorphic composite particles to a second temperature, the second temperature higher than the first temperature and at least 800° C., to induce sp^3-to-sp^2 rehybridization in the perimorphic wall; and

III. Exposing the perimorphic composite particles to a liquid to remove the endomorphic template particles from the perimorphic walls, the removing of the template particles forming perimorphic frameworks having a BET specific surface of at most 2,300 m^2g^{-1} and an X-ray diffraction pattern with an unfitted peak in the 2θ range of 20° to 28°, each of the perimorphic frameworks having a templated pore-and-wall architecture.

2. The process of claim 1, wherein:

the graphenic structures, coalesced graphenic layer, higher-layer graphenic regions, and perimorphic wall formed over the templating surface of each template particle comprise carbon; and

a powder of the perimorphic composite particles before being heated to the second temperature comprises a first 532-nm Raman spectrum having:

an unfitted D peak between 1300 cm^{-1} and 1332 cm^{-1}; and

an unfitted G peak between 1580 cm^{-1} and 1612 cm^{-1}; and

an interpeak interval between the unfitted D and G peaks of at least 260 cm^{-1}; and

a peak intensity ratio ID/IG of at most 1.5; and

a peak intensity ratio I2D/IG is at most 0.2; and

a powder of the perimorphic composite particles after being heated to the second temperature comprises a second 532-nm Raman spectrum having:

an unfitted D peak between 1340 cm^{-1} and 1375 cm^{-1} and at least 8 cm^{-1} higher than the unfitted D peak of the first 532-nm Raman spectrum; and

an unfitted G peak between 1580 cm^{-1} and 1612 cm^{-1}; and

an interpeak interval between the unfitted D and G peaks of at most 250 cm^{-1}; and

a peak intensity ratio ID/IG of at most 1.5; and

a peak intensity ratio I2D/IG is at most 0.2; and

the first and second 532-nm Raman spectra are each an average spectrum, where each average spectrum is produced by averaging 16 point spectra generated by raster scanning under 532 nm excitation.

3. The process of claim 1, wherein the graphenic structures, coalesced graphenic layer, higher-layer graphenic regions, and perimorphic wall formed over the templating surface of each template particle comprise at least one of boron nitride and boron carbonitride.

4. The process of claim 1, wherein:

the forming of the perimorphic wall around each template particle comprises chemical vapor deposition; and

the pore-and-wall architecture of the perimorphic frameworks comprises an endocellular pore structure generally enclosed by the perimorphic wall; and

the perimorphic wall and endocellular pore structure comprise conjoined cellular subunits, the cellular subunits having an internal diameter of at most 1,000 nm.

5. The process of claim 1, wherein the first temperature is at most 700° C. and the second temperature is at least 1,000° C.

6. The process of claim 1, wherein the first temperature is at most 600° C. and the second temperature is at least 900° C.

7. The process of claim 1, wherein the process further comprises:

drying the perimorphic frameworks, the drying comprising at least one of:

a collapsing of cellular subunits of the perimorphic frameworks; and

an elastic deformation of the perimorphic frameworks; and

a reversible shrinking of the perimorphic frameworks.

8. The process of claim 1, wherein the coalesced graphenic layer and higher-layer graphenic regions comprise a synthetic anthracitic network covalently connected by structural dislocations comprising at least one Y-dislocations, screw dislocations, and mixed dislocations.

9. The process of claim 1, wherein each of the perimorphic walls, after being heated to the second temperature, comprises a helicoidal network.

10. The process of claim 1, wherein the process further comprises:

decomposing a powder of template precursor particles to form a powder of template particles, each template particle comprising:

an inorganic compound comprising metal cations and at least one of oxygen anions and oxyanions; and

a porous substructure comprising conjoined subunits and pores, the pores comprising at least one of mesopores and macropores.

11. A process for forming perimorphic frameworks, the process comprising:

I. Forming a perimorphic wall around each template particle in a population of template particles, the forming of the perimorphic wall comprising:

over a templating surface of a template particle, in the presence of a vapor comprising radicals, at a first temperature of at least 400° C.:

growing graphenic structures via radical addition at edges of the graphenic structures; and

at interfaces between the edges of graphenic structures, grafting the edges covalently by forming sp^2-sp^2 and sp^3-sp^3 bonds between them, the grafting of the graphenic structures coalescing them into a larger, coalesced graphenic layer generally encapsulating the templating surface and comprising both sp^{-2}- and sp^3-hybridized states; and

nucleating higher-layer graphenic regions above the coalesced graphenic layer, the higher-layer graphenic regions nematically aligned with the coalesced graphenic layer and growing via radical addition at their edges, the coalesced graphenic layer and higher-layer graphenic regions covalently connected and together comprising the perimorphic wall, the perimorphic wall rendering the template particle endomorphic and together with it comprising a perimorphic composite particle; and

II. Exposing the perimorphic composite particles to a liquid to remove the endomorphic template particles from the perimorphic walls, the removing of the template particles forming perimorphic frameworks having a BET specific surface of at most 2,300 m^2g^{-1} and an X-ray diffraction pattern with an unfitted peak in the 2θ range of 20° to 28°, each of the perimorphic frameworks a particle having a templated pore-and-wall architecture; and

III. Heating the perimorphic frameworks to a second temperature, the second temperature higher than the first temperature and at least 800° C., to induce sp^3-to-sp^2 rehybridization in the perimorphic wall.

12. The process of claim 11, wherein:

the graphenic structures, coalesced graphenic layer, higher-layer graphenic regions, and perimorphic wall formed over the templating surface of each template particle comprise carbon; and

a powder of the perimorphic composite particles comprises a first 532-nm Raman spectrum having:

an unfitted D peak between 1300 cm^{-1} and 1332 cm^{-1}; and

an unfitted G peak between 1580 cm^{-1} and 1612 cm^{-1}; and

an interpeak interval between the unfitted D and G peaks of at least 260 cm^{-1}; and

a peak intensity ratio ID/IG of at most 1.5; and

a peak intensity ratio I2D/IG is at most 0.2; and

the perimorphic frameworks after being heated to the second temperature comprise a second 532-nm Raman spectrum having:

an unfitted D peak between 1340 cm^{-1} and 1375 cm^{-1} and at least 8 cm^{-1} higher than the unfitted D peak of the first 532-nm Raman spectrum; and

an unfitted G peak between 1580 cm^{-1} and 1612 cm^{-1}; and

an interpeak interval between the unfitted D and G peaks of at most 250 cm^{-1}; and

a peak intensity ratio ID/IG of at most 1.5; and

a peak intensity ratio I2D/IG is at most 0.2; and

the first and second 532-nm Raman spectra are each an average spectrum, where each average spectrum is produced by averaging 16 point spectra generated by raster scanning under 532 nm excitation.

13. The process of claim 11, wherein the graphenic structures, coalesced graphenic layer, higher-layer graphenic regions, and perimorphic wall formed over the templating surface of each template particle comprise at least one of boron nitride and boron carbonitride.

14. The process of claim 11, wherein:

the forming of the perimorphic wall around each template particle comprises chemical vapor deposition; and

the pore-and-wall architecture of the perimorphic frameworks comprises an endocellular pore structure generally enclosed by the perimorphic wall; and

the perimorphic wall and endocellular pore structure comprise conjoined cellular subunits, the cellular subunits having an internal diameter of at most 1,000 nm.

15. The process of claim 11, wherein the first temperature is at most 700° C. and the second temperature is at least 1,000° C.

16. The process of claim 11, wherein the first temperature is at most 600° C. and the second temperature is at least 900° C.

17. The process of claim 11, wherein the process further comprises:

drying the perimorphic frameworks, the drying comprising at least one of:

a collapsing of cellular subunits of the perimorphic frameworks; and

an elastic deformation of the perimorphic frameworks; and

a reversible shrinking of the perimorphic frameworks.

18. The process of claim 11, wherein the coalesced graphenic layer and higher-layer graphenic regions comprise a synthetic anthracitic network covalently connected by structural dislocations comprising at least one Y-dislocations, screw dislocations, and mixed dislocations.

19. The process of claim 11, wherein each of the perimorphic walls, after being heated to the second temperature, comprises a helicoidal network.

20. The process of claim 11, wherein the process further comprises:

decomposing a powder of template precursor particles to form a powder of template particles, each template particle comprising:

an inorganic compound comprising metal cations and at least one of oxygen anions and oxyanions; and

a porous substructure comprising conjoined subunits and pores, the pores comprising at least one of mesopores and macropores.