CLAIMS

1. A method of preparing a porous carbon material comprising turbostratic carbon, the method comprising
   a) freezing a liquid mixture comprising a polymer suspended or dissolved in a solvent to form a frozen mixture, wherein the freezing comprises (i) gradually submersing a container containing the liquid mixture at a rate of about 1 mm/min to about 100 mm/min in liquid nitrogen to directional freeze the liquid mixture along the direction of movement of the container, or (ii) atomizing the liquid mixture to reduce or to separate all of the liquid mixture into tiny droplets or into a fine spray in the liquid nitrogen;
   b) removing the solvent from the frozen mixture to form a porous frozen mixture; and
   c) pyrolyzing the porous frozen mixture to obtain the porous carbon material comprising turbostratic carbon.

2. The method according to claim 1, wherein the solvent is an organic solvent.

3. The method according to claim 1, wherein the solvent is selected from the group consisting of dimethyl sulfoxide, dimethylformamide, dioxane, halogenated alkanes, maleic anhydride, propylene carbonate, dimethylacetamide, tetramethylene sulfone, gamma-butyrolactone, and combinations thereof.

4. The method according to claim 1, wherein the polymer is selected from the group consisting of polyacrylonitrile, polymethylacrylonitrile, polypyrrole, polystyrene, polyaromatic hydrocarbons, copolymers thereof, and combinations thereof.

5. The method according to claim 1, wherein the liquid mixture comprises polyacrylonitrile dissolved in dimethyl sulfoxide.

6. The method according to claim 1, wherein the solvent is an aqueous solution.

7. The method according to claim 6, wherein the polymer is selected from the group consisting of poly(sodium 4-styrenesulfonate), chitosan, alginate, lignin, polysaccharides, copolymers thereof, and combinations thereof.

8. The method according to claim 6, wherein the liquid mixture comprises poly(sodium 4-styrenesulfonate) dissolved in water.

9. The method according to claim 6, further comprising adding an acid or a base into the liquid mixture.

10. The method according to claim 1, wherein concentration of the polymer in the liquid mixture is in the range of about 0.5 wt% to about 50 wt%.

11. The method according to claim 1, wherein molecular weight of the polymer is in the range of about 50,000 g/mol to about 300,000 g/mol.

12. The method according to claim 1, wherein the frozen mixture comprises microparticles.

13. The method according to claim 1, wherein removing the solvent from the frozen mixture comprises at least one of (i) freeze drying the frozen mixture, or (ii) solvent exchange and vacuum drying the frozen mixture.

14. The method according to claim 1, wherein pyrolyzing the porous frozen mixture comprises heating the porous frozen mixture in an inert environment at a temperature in the range of about 600 °C to about 3000 °C.

15. The method according to claim 1, further comprising thermally annealing the porous frozen mixture at a temperature not exceeding 280 °C prior to pyrolyzing.

16. The method according to claim 1, wherein the liquid mixture further comprises an additive selected from the group consisting of silicon nanoparticles, metal nanoparticles, metal oxide nanoparticles, metal salts, nitrogen-rich organic compounds, carbon nanomaterials, and combinations thereof.

17. The method according to claim 16, wherein the additive is melamine or graphene.

18. An electrode comprising the porous carbon material comprising turbostratic carbon prepared by a method comprising

a) freezing a liquid mixture comprising a polymer suspended or dissolved in a solvent to form a frozen mixture, wherein the freezing comprises (i) gradually submersing a container containing the liquid mixture at a rate of about 1 mm/min to about 100 mm/min in liquid nitrogen to directional freeze the liquid mixture along the direction of movement of the container, or (ii) atomizing the liquid mixture to reduce or to separate all of the liquid mixture into tiny droplets or into a fine spray in the liquid nitrogen;

b) removing the solvent from the frozen mixture to form a porous frozen mixture; and

c) pyrolyzing the porous frozen mixture to obtain the porous carbon material comprising turbostratic carbon.

19. The electrode according to claim 18, wherein the electrode is an anode of a lithium ion battery.

20. A method of preparing a porous carbon material, the method comprising

a) freezing a liquid mixture comprising a polymer with molecular weight in the range of about 50,000 g/mol to about 300,000 g/mol suspended or dissolved in a solvent to form a frozen mixture, wherein the freezing comprises (i) gradually submersing a container containing the liquid mixture at a rate of about 1 mm/min to about 100 mm/min in liquid nitrogen to directional freeze the liquid mixture along the direction of movement of the container, or (ii) atomizing the liquid mixture to reduce or to separate all of the liquid mixture into tiny droplets or into a fine spray in the liquid nitrogen;

b) removing the solvent from the frozen mixture to form a porous frozen mixture; and

c) pyrolyzing the porous frozen mixture to obtain the porous carbon material.