WHAT IS CLAIMED IS:

1. A polymer foam article having a continuous thermoplastic polymer matrix defining a plurality of pneumatoceles throughout the entirety of the article, further wherein a surface region extending 500 microns from the surface of the article comprises compressed pneumatoceles throughout the entirety thereof.

2. The polymer foam article of claim 1 wherein the article further comprises compressed pneumatoceles more than 500 microns from the surface thereof.

3. The polymer foam article of claim 1 or claim 2 wherein the thermoplastic polymer is selected from polyolefins, polyamides, polyimides, polyesters, polycarbonates, poly (lactic acid)s , acrylonitrile-butadiene-styrene copolymers, polystyrenes, polyurethanes, polyvinyl chlorides, copolymers of tetrafluoroethylene, polyethersulfones, polyacetals, polyaramids, polyphenylene oxides, polybutylenes, polybutadienes, polyacrylates and methacryates, ionomeric polymers, poly ether-amide block copolymers, polyaryletherkeytones, polysulfones, polyphenylene sulfides, polyamide-imide copolymers, poly(butylene succinate)s, cellulosics, or polysaccharides, or any copolymer, alloy, admixture, or blend thereof.

4. The polymer foam article of claim 1 or claim 2 wherein the continuous polymer matrix comprises a polyolefin, a polyamide, an ionically functionalized olefin copolymer, or a polyether-amide block copolymer.

5. The polymer foam article of any one of claims 1-4 wherein the continuous polymer matrix comprises a mixed plastic waste stream.

6. The polymer foam article of any one of claims 1-5 wherein the continuous polymer matrix further comprises one or more additional materials selected from colorants, stabilizers, brighteners, nucleating agents, fibers, particulates, and fillers.

7. The polymer foam article of any one of claims 1-5 wherein the continuous polymer matrix further comprises a talc or a colorant or both talc and a colorant.

8. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 2 cm.

9. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 5 cm.

10. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 10 cm.

11. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a volume of more than 1000 cm^3.

12. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a volume of more than 5000 cm^3.

13. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 2 cm and a volume of more than 1000 cm^3.

14. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 5 cm and a volume of more than 1000 cm^3.

15. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 5 cm and a volume of more than 5000 cm^3.

16. The polymer foam article of any one of claims 1-7 wherein the polymer foam article comprises a thickness of more than 10 cm and a volume of more than 5000 cm^3.

17. The polymer foam article of any one of claims 1-16 comprising a density reduction of 30% to 85%.

18. The polymer foam article of any one of claims 1-17 comprising a void fraction of 5% to 70%.

19. The polymer foam article of any one of claims 1-18 wherein the article is spheroid.

20. The polymer foam article of any one of claims 1-18 wherein the article is cuboid.

21. The polymer foam article of any one of claims 1-18 wherein the article comprises a dumbbell shape, a tableware shape, an ornamental globe shape having raised geographical features, a human shape, an animal shape, a frame or encasement shape, or a shape suitable for disposing screws, bolts, and the like into the article.

22. A method of forming a polymer foam article, the method comprising:

heating and mixing a thermoplastic polymer with a pneumatogen source to form a molten pneumatic mixture, wherein the temperature of the molten pneumatic mixture exceeds the temperature at which the pneumatogen source produces a pneumatogen at atmospheric pressure, and wherein a pressure applied to the molten pneumatic mixture is sufficient to substantially prevent formation of pneumatoceles;

collecting a selected amount of the molten pneumatic mixture in a collection region;

defining an expansion volume in the collection region proximal to the molten pneumatic mixture to form a molten polymer foam from the molten pneumatic mixture;

dispensing the molten polymer foam from the collection region into a cavity defined by a mold, wherein the molten polymer foam contacts the surface of the mold defining the cavity; and

cooling the molten polymer foam in the mold cavity to form a solidified polymer foam article.

23. The method of claim 22 wherein the dispensing comprises partially filling the mold cavity.

24. The method of claim 22 wherein the dispensing comprises substantially filling the mold cavity.

25. The method of claim 22 wherein the dispensing comprises completely filling the mold cavity.

26. The method of any one of claims 22-25 wherein the heating, mixing, collecting, defining, and dispensing are carried out using an injection molding machine.

27. The method of any one of claims 22-26 wherein the pneumatogen source is an organic compound.

28. The method of any one of claims 22-26 wherein the pneumatogen source is a pneumatogen.

29. The method of any one of claims 22-28 wherein the pneumatogen is CO_2 or N_2.

30. A polymer foam spheroid having a diameter of 3 inches [7.62 cm] to 6 inches [15.24 cm] and comprising a continuous thermoplastic polymer matrix defining a plurality of pneumatoceles throughout the entirety of the spheroid, wherein the thermoplastic polymer matrix has a density that is 35% to 85% less than the density of the thermoplastic polymer in the absence of the pneumatoceles.

31. The polymer foam spheroid of claim 30 wherein the thermoplastic polymer matrix has a density that is 50% to 85% less than the density of the thermoplastic polymer in the absence of the pneumatoceles.

32. The polymer foam spheroid of claim 30 or claim 31 wherein the thermoplastic polymer matrix comprises a mixed plastic waste stream.

33. A polymer foam cuboid having a minimum dimension of about 1 inch [2.54 cm] and comprising a continuous thermoplastic polymer matrix defining a plurality of pneumatoceles throughout the entirety of the cuboid, further wherein the thermoplastic polymer matrix has a density that is 35% to 85% less than the density of the thermoplastic polymer in the absence of the pneumatoceles.

34. The polymer foam cuboid of claim 33 wherein the thermoplastic polymer matrix has a density that is 50% to 85% less than the density of the thermoplastic polymer in the absence of the pneumatoceles.

35. The polymer foam cuboid of claim 33 or claim 34 wherein the thermoplastic polymer matrix comprises a mixed plastic waste stream.

36. The polymer foam cuboid of any one of claims 33-35 having dimensions of about 1 inch [2.54 cm] by 1 inch [2.54 cm] by 2 inches [5.08 cm], or about 1 inch [2.54 cm] by 4 inches [10.16 cm] by 11 inches [27.94 cm], or about 1 inch [2.54 cm] by 4 inches[10.16 cm] by 17 inches [43.18 cm] or about 1 inch [2.54 cm] by 12 inches [30.48 cm] by 12 inches [30.48 cm] or about 2 inches [5.08 cm] by 2 inches [5.08 cm] by 2 inches [5.08 cm], or about 2 inches [5.08 cm] by 4 inches [10.16 cm] by 11 inches [27.94 cm] or about 2 inches [5.08 cm] by 4 inches [10.16 cm] by 4 inches [10.16 cm], or about 4 inches [10.16 cm] by 4 inches [10.16 cm] by 4 inches [10.16 cm] or about 12 inches [30.48 cm] by 12 inches [30.48 cm] by 12 inches [30.48 cm].

37. A polymer foam spheroid having a diameter of 3 inches [7.62 cm] to 6 inches [15.24 cm] and comprising a continuous thermoplastic polymer matrix defining a plurality of pneumatoceles throughout the entirety of the spheroid, further wherein the thermoplastic polymer matrix excludes glass or polymer bubbles.

38. The polymer foam spheroid of claim 37 wherein the thermoplastic polymer matrix has a density that is 30% to 85% less than the density of the thermoplastic polymer in the absence of the pneumatoceles.

39. The polymer foam spheroid of claim 37 or 38 wherein spheroid comprises a void fraction of 5% to 70%.

40. The polymer foam spheroid of any one of claims 37-39 wherein the thermoplastic polymer matrix comprises a mixed plastic waste stream.

41. A polymer foam cuboid having a minimum dimension of about 1 inch [2.54 cm] and comprising a continuous thermoplastic polymer matrix defining a plurality of pneumatoceles throughout the entirety of the cuboid, further wherein the thermoplastic polymer matrix excludes glass or polymer bubbles.

42. The polymer foam cuboid of claim 41 wherein the thermoplastic polymer matrix has a density that is 30% to 85% less than the density of the thermoplastic polymer in the absence of the pneumatoceles.

43. The polymer foam cuboid of claim 41 or claim 42 wherein cuboid comprises a void fraction of 5% to 70%.

44. The polymer foam cuboid of any one of claims 42-43 having dimensions of about 1 inch [2.54 cm] by 1 inch [2.54 cm] by 2 inches [5.08 cm], or about 1 inch [2.54 cm] by 4 inches [10.16 cm] by 11 inches [27.94 cm], or about 1 inch [2.54 cm] by 4 inches[10.16 cm] by 17 inches [43.18 cm] or about 1 inch [2.54 cm] by 12 inches [30.48 cm] by 12 inches [30.48 cm] or about 2 inches [5.08 cm] by 2 inches [5.08 cm] by 2 inches [5.08 cm], or about 2 inches [5.08 cm] by 4 inches [10.16 cm] by 11 inches [27.94 cm] or about 2 inches [5.08 cm] by 4 inches [10.16 cm] by 4 inches [10.16 cm], or about 4 inches [10.16 cm] by 4 inches [10.16 cm] by 4 inches [10.16 cm] or about 12 inches [30.48 cm] by 12 inches [30.48 cm] by 12 inches [30.48 cm].

45. The polymer foam cuboid of any one of claims 41-44 wherein the thermoplastic polymer matrix comprises a mixed plastic waste stream.

~~46. Use of an injection molding machine to define a molten polymer foam and dispense the molten polymer foam into a cavity defined by a mold, wherein the dispensing causes the molten polymer foam to contact a surface of the mold cavity.~~