Claims

1. An article of manufacture comprising:

a polyvinyl alcohol (PVOH);

an inorganic filler comprising particles having an average diameter of less than 20 micrometers, wherein the inorganic filler is present in a range between 25 wt. % and 50 wt. % based on the total article weight, and

cellulose particles present in a range between 1 wt. % and 50 wt. % based on the total article weight;

wherein the PVOH has a degree of hydrolysis of greater than 95% and is present in a range between 20 wt. % and 99 wt. % based on the total article weight.

2. The article of Claim 1, wherein the article is a fiber or a film.

3. The article of Claim 2, wherein the inorganic filler particles have an average diameter of less than 3 micrometers.

4. The article of Claim 2, wherein the inorganic filler is precipitated calcium carbonate, ground calcium carbonate, gypsum, titanium dioxide, clay, silica, or any combination thereof.

5. The article of Claim 2, wherein the PVOH is present in a range between 40 wt. % and 60 wt. % based on the total weight of the fiber or the film.

6. The article of Claim 2, wherein the PVOH has a degree of polymerization in a range between 500 and 3,000.

7. The article of Claim 6, wherein the degree of polymerization is in a range between 1,000 and 1,600.

8. The article of Claim 2, wherein the degree of hydrolysis is greater than 98 %.

9. The article of Claim 1, wherein the cellulose particles are cellulose nanofibrils or cellulose fines.

10. The article of Claim 9, wherein the cellulose particles are hardwood kraft pulp particles, softwood kraft pulp particles, hardwood sulfite pulp particles, softwood sulfite pulp particles, grass pulp particles, or any combination thereof.

11. The article of Claim 1, further comprising a processing aid.

12. The article of Claim 11, wherein the processing aid is present in a range between 0.5 wt. % and 10 wt. % based on the total fiber weight.

13. The article of Claim 11, wherein the processing aid is carboxymethylcellulose, starch, glyoxal, glutaraldehyde, dialdehydes boric acid carbonate, zirconium ammonium carbonate, glyoxalated polyacrylamide, polyamide-epichlorohydrin, polyamine-epichlorohydrin, urea-formaldehyde, melamine-formaldehyde, polyethyleneimine, propylene glycol, diethylene glycol, triethylene glycol, dipropylene glycol, glycerol, or any combination thereof.

14. The article of Claim 1, wherein the PVOH is partially soluble in water at a temperature of less than 98ºC.

15. The article of Claim 14, wherein the PVOH is partially soluble in water at a temperature in a range between 75ºC and 95ºC.

16. The article of Claim 1, further comprising a $CO_2$-generating acid.

17. The article of Claim 1, further comprising $CO_2$-generating sodium bicarbonate.

18. An article of manufacture comprising:

a polyvinyl alcohol (PVOH), the PVOH having a degree of hydrolysis of greater than 95%, being partially soluble in water at a temperature of less than 95°C, and being present in a range between 20 wt. % and 99 wt. % based on total article weight; and

an inorganic filler comprising particles having an average diameter of 1.5 to 20 micrometers.

19. The article of Claim 18, wherein article is a fiber or a film.

20. The article of Claim 18, wherein the inorganic filler particles have an average diameter of less than 3 micrometers.

21. The article of Claim 18, wherein the inorganic filler is present in a range between 1 wt. % and 50 wt. % based on the total article weight.

22. The article of Claim 18, wherein the filler is precipitated calcium carbonate, ground calcium carbonate, gypsum, titanium dioxide, clay, silica, or any combination thereof.

23. The article of Claim 18, wherein the PVOH is present in a range between 40 wt. % and 60 wt. % based on the total weight of the fiber.

24. The article of Claim 18, wherein the PVOH has a degree of polymerization in a range between 500 and 3,000.

25. The article of Claim 24, wherein the degree of polymerization is in a range between 1,000 and 1,600.

26. The article of Claim 18, wherein the degree of hydrolysis is greater than 98%.

27. The article of Claim 18, further comprising cellulose particles in a range between 1 wt. % and 50 wt. % based on the total weight of the article.

28. The article of Claim 27, wherein the cellulose particles are cellulose nanofibrils or cellulose fines.

29. The article of Claim 27, wherein the cellulose particles are hardwood kraft pulp particles, softwood kraft pulp particles, hardwood sulfite pulp particles, softwood sulfite pulp particles, grass pulp particles, or any combination thereof.

30. The article of Claim 18, further comprising a processing aid.

31. The article of Claim 30, wherein the processing aid is present in a range between 0.5 wt. % and 10 wt. % based on the total article weight.

32. The article of Claim 30, wherein the processing aid is carboxymethylcellulose, starch, glyoxal, glutaraldehyde, dialdehydes boric acid carbonate, zirconium ammonium carbonate, glyoxalated polyacrylamide, polyamide-epichlorohydrin, polyamine-epichlorohydrin, urea-formaldehyde, melamine-formaldehyde, polyethyleneimine, propylene glycol, diethylene glycol, triethylene glycol, dipropylene glycol, glycerol, or any combination thereof.

33. The article of Claim 18, wherein the PVOH is partially soluble in water at a temperature in a range between 75ºC and 95ºC.

34. The article of Claim 18, further comprising a $CO_2$-generating acid.

35. The article of Claim 18, further comprising $CO_2$-generating sodium bicarbonate.

36. A method of making an article of manufacture, the method comprising:

mixing a polyvinyl alcohol (PVOH) with an inorganic filler comprising particles having an average diameter of less than about 20 micrometers, the PVOH having a degree of hydrolysis of greater than 95%, being partially soluble in water at a temperature of less than 95°C, and being present in a range between 20 wt. % and 99 wt. % based on the total article weight;

further comprising mixing the PVOH, the filler, or both with cellulose particles; and

preparing an extrudable spin mass.

37. The method of Claim 36, wherein the article is a fiber or a film.

38. The method of Claim 36, further comprising wet spinning, dry spinning, shear spinning, or slit extruding the extrudable spin mass to form the fiber or the film.

39. The method of Claim 36, wherein the cellulose particles are cellulose nanofibrils or cellulose fines.

40. The method of Claim 39, wherein the cellulose particles are derived from hardwood kraft pulp, softwood kraft pulp, hardwood sulfite pulp, softwood sulfite pulp, grass pulp, or any combination thereof.

41. The method of Claim 36, further comprising extracting the cellulose particles from waste paper, seed pods, algae, bacteria, tunicates, or any combination thereof.

42. The method of Claim 36, wherein the PVOH has a degree of polymerization in a range between 500 and 3,000.

43. The method of Claim 42, wherein the degree of polymerization is in a range between 1,000 and 1,600.

44. The method of Claim 36, wherein the degree of hydrolysis is greater than 98 %.

45. The method of Claim 36, wherein the PVOH is substantially soluble in water at a temperature of less than 98ºC.

46. The method of Claim 36, wherein the PVOH is substantially soluble in water at a temperature in a range between 75ºC and 95ºC.

47. The method of Claim 36, further comprising mixing the PVOH and the inorganic filler with sodium bicarbonate to generate $CO_2$ and increase bulk.