Claims

What is claimed is:

1. An injection molded article comprising a thermoplastic polyurethane composition, wherein the thermoplastic polyurethane composition comprises the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl terminated intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component ~~comprises an aliphatic~~is hexamethylene diisocyanate, and ~~optionally,~~ a chain extender component, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC, wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises ~~at least 10 wt % hard segment~~13 wt % to 30 wt% hard segment, and wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570.

2. The injection molded article of claim 1 wherein the ~~thermoplastic polyurethane comprises about 10 wt % to about 50 wt % hard segment.~~

~~3. The injection molded article of any of claims 1 to 2 wherein the thermoplastic polyurethane has a water absorption range of at least 70% as measured by ASTM D570.~~

~~4. The injection molded article of any of claims 1 to 3 wherein the thermoplastic polyurethane has a water absorption range of at least 100% as measured by ASTM D570.~~

~~5. The injection molded article of any of claims 1 to 4 wherein the polyether polyol~~hydroxyl terminated intermediate ~~comprises~~ component consists of poly (ethylene glycol).

~~6. The injection molded article of any of claims 1 to 5 wherein the diisocyanate comprises one or more diisocyanates selected from the group consisting of isophorone diisocyanate (IPDI), 1,4-cyclohexyl diisocyanate (CHDI), decane-1,10-diisocyanate, lysine diisocyanate (LDI), 1,4-butane diisocyanate (BDI), 1,5-pentanediisocyanate (PDI), hydrogenated xylene diisocyanate (HXDI), isophorone diisocyanate, and hexamethylene diisocyanate (HDI).~~

~~7. The injection molded article of any of claims 1 to 6 wherein the diisocyanate consists essentially of~~

~~hexamethylene diisocyanate.~~

~~8. The injection molded article of any of claims 1 to 7 wherein the polyether polyol intermediate consists essentially of poly (ethylene glycol) and the diisoyanate consists essentially of hexamethylene diisocyanate.~~

~~9~~3. A method of making an injection molded article comprising:

preparing a thermoplastic polyurethane composition comprising a hydroxyl terminated intermediate component, wherein the hydroxyl terminated intermediate component comprises poly(ethylene glycol) an isocyanate component, wherein the isocyanate component ~~comprises an aliphatic~~is hexamethylene diisocyanate, and ~~optionally,~~ a chain extender component, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC, wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises ~~at least 10 wt % hard segment;~~13 wt % to 30 wt% hard segment, and wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570;

heating said thermoplastic polyurethane composition to a temperature of 120 °C to 190°C to melt said thermoplastic polyurethane composition;

injecting said melted thermoplastic polyurethane composition into a mold; and

cooling said thermoplastic polyurethane composition to form an article.

~~10~~4. The method of any of claim ~~9~~,3 wherein the hydroxyl terminated intermediate component ~~comprises~~consists of poly (ethylene glycol~~) and the isocyanate component comprises one or more diisocyanates selected from the group consisting of isophorone diisocyanate (IPDI), 1,4-cyclohexyl diisocyanate (CHDI), decane 1,10 diisocyanate, lysine diisocyanate (LDI), 1,4 butane diisocyanate (BDI), 1,~~).

~~pentanediisocyanate (PDI), hydrogenated xylene diisocyanate (HXDI), isophorone diisocyanate, and hexamethylene diisocyanate (HDI).~~

~~11. The method of any of claims 9 or 10 wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises at least 10 wt % to about 50 wt % hard segment.~~

~~12. The method of claim 11 wherein the thermoplastic polyurethane comprises about 10 wt % to about 30~~

~~wt % hard segment.~~

~~13. The method of any of claims 9 to 12 wherein the thermoplastic polyurethane has a water absorption range of at least 70% as measured by ASTM D570.~~

~~14. The method of any of claims 9 to 13 wherein the thermoplastic polyurethane has a water absorption range of at least 100% as measured by ASTM D570.~~

~~15. The method of any of claims 9 to 14 wherein the polyether polyol intermediate consists essentially of poly (ethylene glycol).~~

~~16. The method of any of claims 9 to 15 wherein the diisocyanate consists essentially of hexamethylene diisocyanate.~~

~~17. An injection molded article comprising a thermoplastic polyurethane composition, wherein the thermoplastic polyurethane composition comprises the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl functional intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component comprises hexamethylene diisocyanate, and a chain extender component, wherein the isocyanate component and the chain extender component make up a hard segment of the thermoplastic polyurethane, wherein the thermoplastic polyurethane composition comprises 10 wt % to about 30 wt % hard segment, wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570, and wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC.~~

5. ~~18~~. The use of a thermoplastic polyurethane composition comprising the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl ~~functional~~terminated intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component ~~comprises~~is hexamethylene diisocyanate, and ~~optionally,~~ a chain extender component in injection molding to form an article, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC, wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises 13 wt % to 30 wt% hard segment, and wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570.

~~19~~6. The use of a thermoplastic polyurethane composition as recited in claim ~~18,~~5 wherein the

~~thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC.~~

~~20. The use of a thermoplastic polyurethane composition as recited in claim 18 or 19 wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises at least 10 wt % hard segment.~~

~~21. The use of a thermoplastic polyurethane composition as recited in any of claims 18 to 20 wherein the thermoplastic polyurethane comprises about 10 wt % to about 50 wt % hard segment.~~

~~22. The use of a thermoplastic polyurethane composition as recited in any of claims 18 to 21 wherein the thermoplastic polyurethane has a water absorption range of at least 70% as measured by ASTM D570.~~

~~23. The use of a thermoplastic polyurethane composition as recited in any of claims 18 to 22 wherein the thermoplastic polyurethane has a water absorption range of at least 100% as measured by ASTM D570.~~

~~24. The use of a thermoplastic polyurethane composition as recited in any of claims 18 to 23 wherein the polyether polyol~~hydroxyl terminated intermediate component consists ~~essentially~~ of poly (ethylene glycol).

~~25. The use of a thermoplastic polyurethane composition as recited in any of claims 18 to 24 wherein the diisocyanate consists essentially of hexamethylene diisocyanate.~~

~~26~~7. A 3D printed article comprising a thermoplastic polyurethane composition, wherein the thermoplastic polyurethane composition comprises the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl terminated intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component ~~comprises an aliphatic~~is hexamethylene diisocyanate, and ~~optionally,~~ a chain extender component, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC, wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises 13 wt % to 30 wt% hard segment, and wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570.

~~27~~8. The 3D printed article of claim ~~26~~7 wherein the ~~isocyanate component and optional chain~~

~~extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises at least 10 wt % hard segment.~~

~~28. The 3D printed article of claim 26 wherein the thermoplastic polyurethane comprises about 10 wt % to about 50 wt % hard segment.~~

~~29. The 3D printed article of any of claims 26 to 28 wherein the thermoplastic polyurethane has a water absorption range of at least 70% as measured by ASTM D570.~~

~~30. The 3D printed article of any of claims 26 to 29 wherein the thermoplastic polyurethane has a water absorption range of at least 100% as measured by ASTM D570.~~

~~31. The 3D printed article of any of claims 26 to 30 wherein the polyether polyol~~hydroxyl terminated intermediate ~~comprises~~ component consists of poly (ethylene glycol).

~~32. The 3D printed article of any of claims 26 to 31 wherein the diisocyanate comprises one or more diisocyanates selected from the group consisting of isophorone diisocyanate (IPDI), 1,4 cyclohexyl diisocyanate (CHDI), decane 1,10 diisocyanate, lysine diisocyanate (LDI), 1,4 butane diisocyanate (BDI), 1,5 pentanediisocyanate (PDI), hydrogenated xylene diisocyanate (HXDI), isophorone diisocyanate, and hexamethylene diisocyanate (HDI).~~

~~33. The 3D printed article of any of claims 26 to 32 wherein the polyether polyol intermediate consists essentially of poly (ethylene glycol) and the diisoyanate consists essentially of hexamethylene diisocyanate.~~

~~34~~9. A method of making a 3D printed comprising:

preparing a thermoplastic polyurethane composition comprising a hydroxyl terminated intermediate component, wherein the hydroxyl terminated intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component ~~comprises an aliphatic~~is hexamethylene diisocyanate, and ~~optionally,~~ a chain extender component, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC, wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises 13 wt % to 30 wt% hard segment, and wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570;

operating a system for solid freeform fabrication of an object, wherein said system

comprises a solid freeform fabrication apparatus that deposits small beads of building material in a controlled manner,

wherein the building material comprises the thermoplastic polyurethane composition.

10. The method of claim 9 wherein the hydroxyl terminated intermediate component consists of poly (ethylene glycol).

11. The use of a thermoplastic polyurethane composition comprising the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl terminated intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component is hexamethylene diisocyanate (HDI), and a chain extender component in a solid freeform fabrication apparatus to form an article, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC, wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises ~~at least 10 wt % hard segment;~~ 13 wt % to 30 wt% hard segment, and wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570.

~~operating a system for solid freeform fabrication~~

12. The use of ~~an object, wherein said system comprises a solid freeform fabrication apparatus that deposits small beads of building material in a controlled manner,~~

~~wherein the building material comprises the~~a thermoplastic polyurethane composition~~.~~

~~35. The method of~~ as recited in claim ~~34,~~11 wherein the hydroxyl terminated intermediate component ~~comprises~~consists of poly (ethylene glycol~~) and the isocyanate component comprises one or more diisocyanates selected from the group consisting of isophorone diisocyanate (IPDI), 1,4 cyclohexyl diisocyanate (CHDI), decane 1,10 diisocyanate, lysine diisocyanate (LDI), 1,4 butane diisocyanate (BDI), 1,5-pentanediisocyanate (PDI), hydrogenated xylene diisocyanate (HXDI), isophorone diisocyanate, and hexamethylene diisocyanate (HDI).~~

~~36. The method of any of claims 34 or 35 wherein the isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises at least 10 wt % to about 50 wt% hard segment.~~

~~37. The method of claim 36 wherein the thermoplastic polyurethane comprises about 10 wt % to about 30~~

wt % hard segment.

38. The method of any of claims 34 to 37 wherein the thermoplastic polyurethane has a water absorption range of at least 70% as measured by ASTM D570.

39. The method of any of claims 34 to 38 wherein the thermoplastic polyurethane has a water absorption range of at least 100% as measured by ASTM D570.

40. The method of any of claims 34 to 36 wherein the polyether polyol intermediate consists essentially of poly (ethylene glycol).

41. The method of any of claims 34 to 40 wherein the diisocyanate consists essentially of hexamethylene diisocyanate.

42. A three dimensional printed article comprising a thermoplastic polyurethane composition, wherein the thermoplastic polyurethane composition comprises the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl functional intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component comprises hexamethylene diisocyanate, and a chain extender component, wherein the isocyanate component and the chain extender component make up a hard segment of the thermoplastic polyurethane, wherein the thermoplastic polyurethane composition comprises 10 wt % to about 30 wt % hard segment, wherein the thermoplastic polyurethane composition has a water absorption range of at least 100% as measured by ASTM D570, and wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC.

43. The use of a thermoplastic polyurethane composition comprising the reaction product of a hydroxyl terminated intermediate component, wherein the hydroxyl functional intermediate component comprises poly(ethylene glycol), an isocyanate component, wherein the isocyanate component comprises one or more diisocyanates selected from the group consisting of isophorone diisocyanate (IPDI), 1,4 cyclohexyl diisocyanate (CHDI), decane 1,10 diisocyanate, lysine diisocyanate (LDI), 1,4 butane diisocyanate (BDI), 1,5-pentanediisocyanate (PDI), hydrogenated xylene diisocyanate (HXDI), isophorone diisocyanate, and hexamethylene diisocyanate (HDI), and optionally, a chain extender component in a solid freeform fabrication apparatus to form an article.

44. The use of a thermoplastic polyurethane composition as recited in claim 43, wherein the thermoplastic polyurethane composition has a crystallization temperature of at least 75°C measured by DSC.

45. The use of a thermoplastic polyurethane composition as recited in claim 43 or 44 wherein the

~~isocyanate component and optional chain extender component make up a hard segment of the thermoplastic polyurethane and wherein the thermoplastic polyurethane comprises at least 10 wt % hard segment.~~

~~46. The use of a thermoplastic polyurethane composition as recited in any of claims 43 to 45 wherein the thermoplastic polyurethane comprises about 10 wt % to about 50 wt % hard segment.~~

~~47. The use of a thermoplastic polyurethane composition as recited in any of claims 43 to 46 wherein the thermoplastic polyurethane has a water absorption range of at least 70% as measured by ASTM D570.~~

~~48. The use of a thermoplastic polyurethane composition as recited in any of claims 43-46 wherein the thermoplastic polyurethane has a water absorption range of at least 100% as measured by ASTM D570.~~

~~49. The use of a thermoplastic polyurethane composition as recited in any of claims 43-48 wherein the polyether polyol intermediate consists essentially of poly (ethylene glycol).~~

~~50. The use of a thermoplastic polyurethane composition as recited in any of claims 43 to 49 wherein the diisocyanate consists essentially of hexamethylene diisocyanate.~~

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