CLAIMS

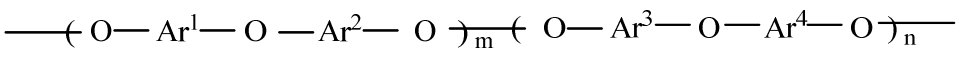
We claim:

1. A crosslinkable polymer additive manufacturing composition when used in an additive manufacturing method, comprising:

at least one aromatic polymer, and at least one crosslinking compound capable of crosslinking the at least one aromatic polymer, wherein the at least one crosslinking compound is present in the crosslinkable polymer composition in an amount of 1% by weight to 50% by weight of the weight of the at least one aromatic polymer and the composition is an additive manufacturing composition.

2. The crosslinkable polymer additive manufacturing composition when used according to claim 1, wherein the at least one aromatic polymer is selected from poly(arylene ether)s, polysulfones, polyethersulfones, polyimides, polyamides, polyetherketones, polyphenylene sulfides, polyureas, polyurethanes, polyphthalamide, polyamide-imides, polybenzimidazoles, polyaramids, and blends thereof.

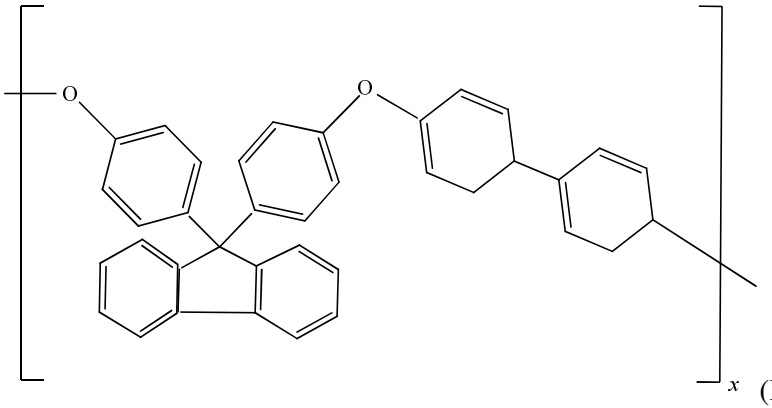
3. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 2, wherein the at least one aromatic polymer is a poly(arylene ether) including polymer repeating units along its backbone having the structure according to formula (I):



(I)

wherein Ar^1, Ar^2, Ar^3 and Ar^4 are identical or different aryl radicals, m = 0 to 1, and n = 1-m.

4. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 3, wherein the at least one aromatic polymer has repeating units along its backbone having the structure of formula (II):

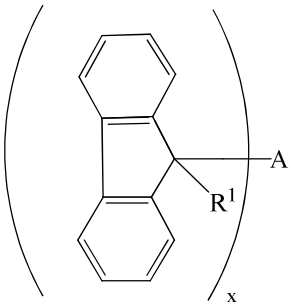


(II).

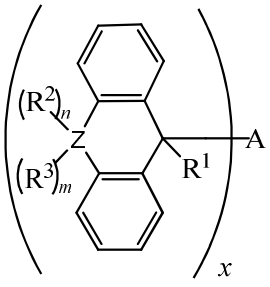
5. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 1, wherein the at least one aromatic polymer is a polyarylene ether or a polyaryletherketone.

6. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 5, wherein the polyaryletherketone is selected from the group of polyetherketone, polyetheretherketone, polyetherketoneketone, and polyetherketoneetherketoneketone.

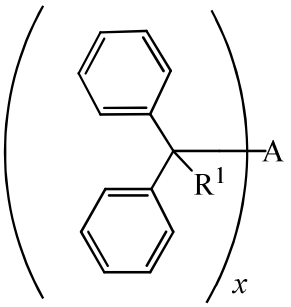
7. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 1, wherein the at least one crosslinking compound has a structure according to one of the following formulae:



(IV) ,



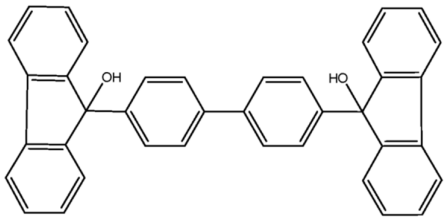
(V) , and

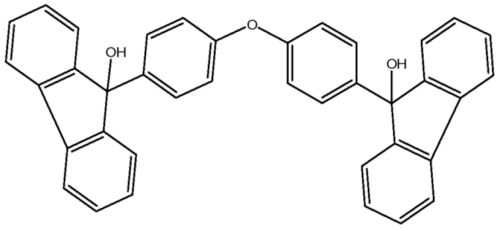


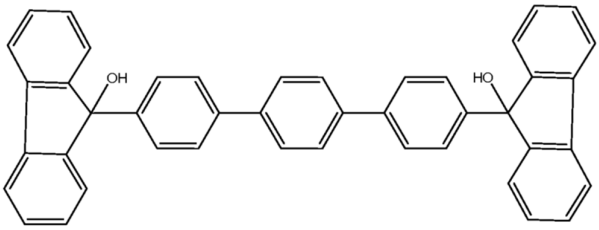
(VI) ,

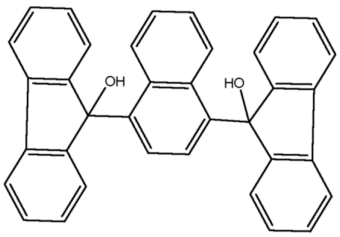
wherein A is a bond, an alkyl, an aryl, or an arene moiety having a molecular weight less than about 10,000 g/mol; wherein R^1, R^2, and R^3 are the same or different and are independently selected from the group consisting of hydrogen, hydroxyl (-OH), amine (NH_2), halide, ester, ether, amide, aryl, arene, or a branched or straight chain, saturated or unsaturated alkyl group of one to about six carbon atoms; wherein *m* is from 0 to 2, *n* is from 0 to 2, and *m* + *n* is greater than or equal to zero and less than or equal to two; wherein *Z* is selected from the group of oxygen, sulfur, nitrogen, and a branched or straight chain, saturated or unsaturated alkyl group of one to about six carbon atoms; and wherein *x* is about 1 to about 6.

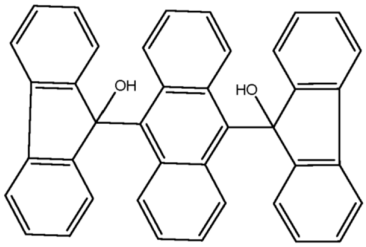
8. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 7, wherein the at least one crosslinking compound has a structure according to formula (IV) and is selected from the group consisting of:

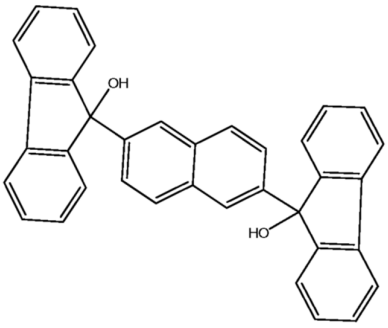


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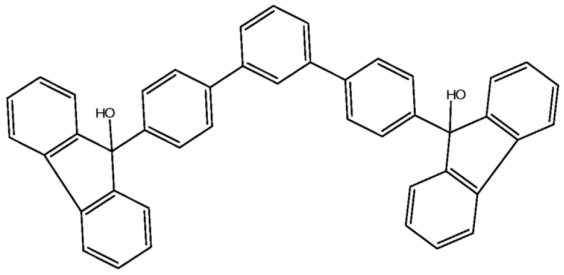
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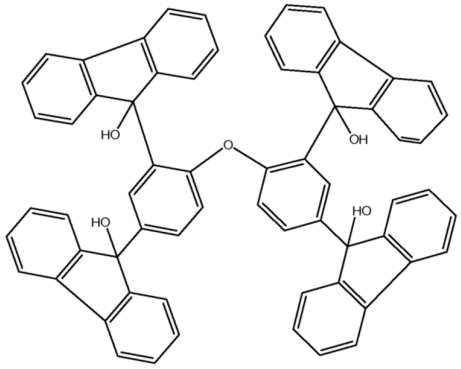
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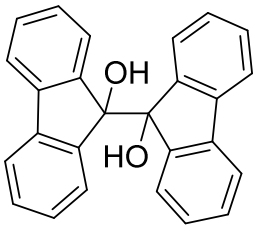
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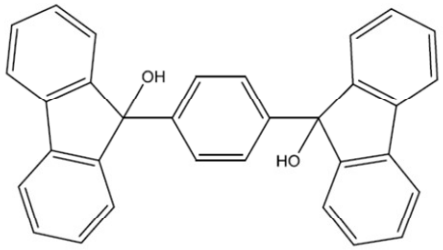
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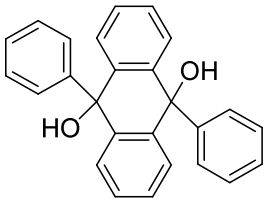
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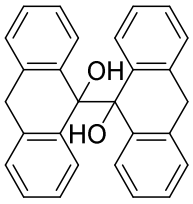


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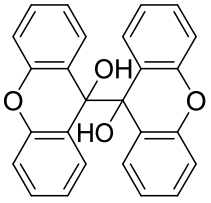
9. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 7, wherein the at least one crosslinking compound has a structure according to formula (V) and is selected from a group consisting of:



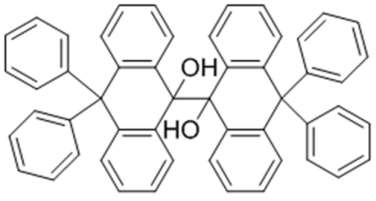
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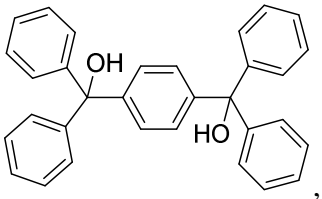


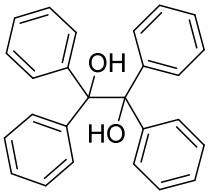
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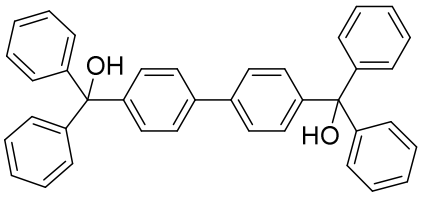


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10. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 7, wherein the at least one crosslinking compound has a structure according to formula (VI) and is selected from the group consisting of:



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, and


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11. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 7, wherein A has a molecular weight of 1,000 g/mol to 9,000 g/mol.

12. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 11, wherein A has a molecular weight of 2,000 g/mol to 7,000 g/mol.

13. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 1, wherein a weight ratio of the aromatic polymer to the crosslinking compound is 1:1 to 100:1.

14. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 13, wherein the weight ratio of the aromatic polymer to the crosslinking compound is 3:1 to 10:1.

15. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 1, further comprising a crosslinking reaction additive selected from a cure inhibitor and a cure accelerator.

16. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 15, comprising the crosslinking reaction additive in an amount of 0.01% to 5% by weight of the crosslinking compound.

17. The crosslinkable polymer composition when used in the additive manufacturing method according to claim 15, wherein the crosslinking reaction additive is a cure inhibitor and is lithium acetate.

18. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 15, wherein the crosslinking reaction additive is a cure accelerator and is magnesium chloride.

19. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 1, further comprising one or more

additives selected from continuous or discontinuous, long or short, reinforcing fibers selected from carbon fibers, glass fibers, woven glass fibers, woven carbon fibers, aramid fibers, boron fibers, polytetrafluoroethylene fibers, ceramic fibers, polyamide fibers; and/or one or more fillers selected from carbon black, silicate, fiberglass, calcium sulfate, boron, ceramic, polyamide, asbestos, fluorographite, aluminum hydroxide, barium sulfate, calcium carbonate, magnesium carbonate, silica, aluminum nitride, borax (sodium borax), activated carbon, pearlite, zinc terephthalate, graphite, graphene, talc, mica, silicon carbide whiskers or platelets, nanofillers, molybdenum disulfide, fluoropolymer fillers, carbon nanotubes and fullerene tubes.

20. The crosslinkable polymer additive manufacturing composition when used in the additive manufacturing method according to claim 19, wherein the polymer composition comprises 0.5% by weight to 65% by weight of the one or more additives and/or one or more fillers.

21. An article printed by an additive manufacturing process using the crosslinkable polymer additive manufacturing composition according to claim 1, wherein the article has at least one of the following properties:

(a) the article has improved interlayer adhesion relative to an article formed by the same additive manufacturing process using an aromatic polymer having the same backbone structure that is not crosslinked; and

(b) the article has improved isotropy in mechanical properties relative to an article formed by the same additive manufacturing process using an aromatic polymer having the same backbone structure that is not crosslinked.

22. The article of claim 21, wherein the additive manufacturing process used to form the article comprises selective laser sintering.

23. The article of claim 21, wherein the additive manufacturing process used to form the article comprises fused filament fabrication.

24. A crosslinked additive manufacturing composition formed from the composition when used in the additive manufacturing method according to claim 1, wherein the crosslinked composition has a lower viscosity and a reduced crystallization rate in comparison to a composition formed using the same additive manufacturing method and using the same aromatic polymer but that is not cross-linked.

25. The crosslinked additive manufacturing composition of claim 24, wherein a printed article formed and postcured from the crosslinked additive manufacturing composition has improved adhesive bonding between layers formed from printed filaments

or formed by injection molding in comparison to an uncrosslinked composition formed of the same aromatic polymer.

26. A method for preparing and using a crosslinkable polymer composition in an additive manufacturing method, comprising:

providing at least one aromatic polymer, and at least one crosslinking compound capable of crosslinking the at least one aromatic polymer;

combining the at least one aromatic polymer and the at least one crosslinking compound to form a crosslinkable polymer composition; and

using the crosslinkable polymer composition in an additive manufacturing process and crosslinking the at least one aromatic polymer in the crosslinkable polymer composition.

27. The method according to claim 26, further comprising combining the aromatic polymer and the crosslinking compound so the crosslinkable polymer composition is substantially homogeneous.

28. The method according to claim 26, further comprising combining the aromatic polymer and the crosslinking compound by mechanical blending.

29. The method according to claim 26, further comprising:

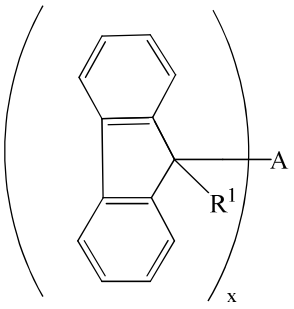
dissolving the aromatic polymer and the crosslinking compound in a common solvent; and

removing the common solvent by evaporation or by addition of a non-solvent so as to cause precipitation of the aromatic polymer and the crosslinking compound out of the common solvent.

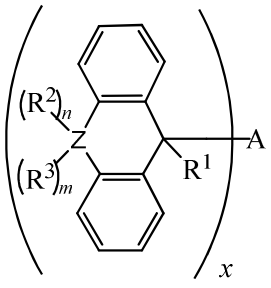
30. Use of crosslinked aromatic polymer in an additive manufacturing process to form articles, wherein the crosslinked aromatic polymer is a reaction product of at least one aromatic polymer and at least one crosslinking compound capable of crosslinking the aromatic polymer.

31. The use of the crosslinked aromatic polymer according to claim 30, wherein the aromatic polymer is selected from the group of poly(arylene ether)s, polysulfones, polyethersulfones, polyimides, polyamides, polyetherketones, polyphenylene sulfides, polyureas, polyurethanes, polyphthalamides, polyamide-imides, polybenzimidazoles, polyaramids, and blends thereof.

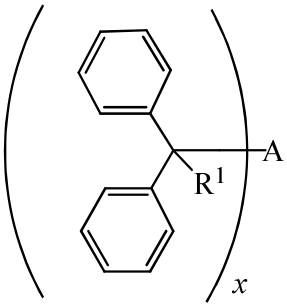
32. The use of the crosslinked polymer according to claim 30, wherein the crosslinking compound has a structure according to one of the following formulae:



(IV) ,



(V) , and



(VI) ,

wherein A is bond, an alkyl, an aryl, or an arene moiety having a molecular weight less than about 10,000 g/mol; wherein R^1, R^2, and R^3 are the same or different and are independently selected from the group consisting of hydrogen, hydroxyl (-OH), amine (NH_2), halide, ester, ether, amide, aryl, arene, or a branched or straight chain, saturated or unsaturated alkyl group of one to about six carbon atoms; wherein *m* is from 0 to 2, *n* is from 0 to 2, and *m* + *n* is greater than or equal to zero and less than or equal to two; wherein *Z* is selected from the group of oxygen, sulfur, nitrogen, and a branched or straight chain, saturated or unsaturated alkyl group of one to about six carbon atoms; and wherein *x* is about 1 to about 6.

33. A method of preparing an article by an additive manufacturing process, comprising:

providing the crosslinkable polymer additive manufacturing composition used in the method of additive manufacturing of claim 1; and

utilizing the crosslinkable polymer composition in the additive manufacturing process to prepare a printed article.

34. The method according to claim 33, wherein the additive manufacturing process is a powder bed fusion method.

35. The method according to claim 33, wherein the additive manufacturing process is a material extrusion method.

36. The method according to claim 33, wherein interlayer adhesion between layers of the printed article is improved relative to an article formed by the same additive

manufacturing process using an aromatic polymer having the same backbone structure that is not crosslinked.

37. The method according to claim 33, wherein isotropy in mechanical properties is improved in the printed article relative to an article formed by the same additive manufacturing process using an aromatic polymer having the same backbone structure that is not crosslinked.

38. The method according to claim 33, wherein processability is improved in the printed article relative to an article formed by the same additive manufacturing process using an aromatic polymer having the same backbone structure that is not crosslinked

39. The method according to claim 26, wherein

the at least one aromatic polymer in the crosslinkable polymer composition is crosslinked by at least one of thermally-induced crosslinking, grafted crosslinking, and chemical crosslinking.