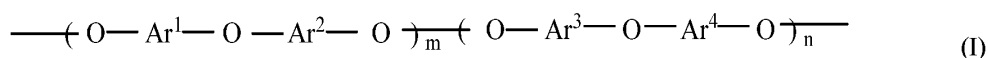


CLAIMS

We claim:

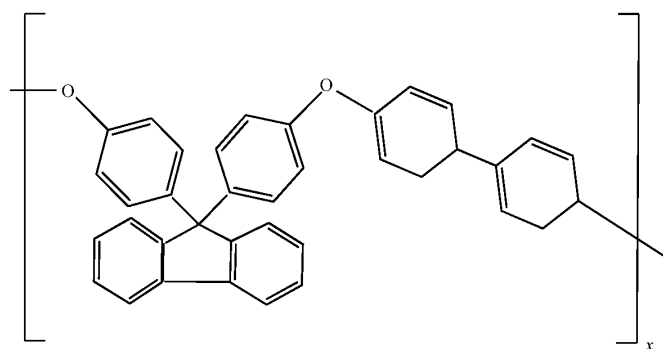
1. A method of coating an insulation component with a crosslinked aromatic polymer
5 for use in a high temperature, high voltage and/or corrosive environments, comprising:
 providing a composition comprising at least one crosslinkable aromatic
polymer;
 heat processing the composition;
 applying a coating of the composition to an exterior surface of an insulation
10 component; and
 crosslinking the aromatic polymer in the composition to provide a coated
insulation component.
2. The method according to claim 1, wherein crosslinking is initiated by application of heat.
- 15 3. The method according to claim 1, wherein the at least one crosslinkable aromatic polymer comprises a self-crosslinking aromatic polymer.
4. The method according to claim 1, wherein crosslinking is initiated after coating the insulation component.
5. The method according to claim 1, wherein the crosslinkable aromatic polymer is at
20 least partially crosslinked during the coating of the insulation component.
6. The method according to claim 1, wherein the crosslinking occurs generally simultaneously with the coating of the insulation component.
7. The method according to claim 1, wherein the at least one crosslinkable aromatic polymer is selected from polyarylenes, polysulfones, polyethersulfones, polyphenylene
25 sulfides, polyphenylene oxides, polyimides, polyetherimides, thermoplastic polyimides, polybenzamide, polyamide-imide, polyurea, polyurethane, polyphthalamide, polybenzimidazole, polyaramid, and blends, co-polymers, and alloys thereof.
8. The method according to claim 7, wherein the aromatic polymer comprises one or more functionalized groups for crosslinking.
- 30 9. The method according to claim 7, wherein the aromatic polymer is a polyarylene selected from polyetherketone, polyetheretherketone, polyetherdiphenylether ketone, polyetherketone ketone, and blends, co-polymers and alloys thereof.
10. The method according to claim 7, wherein the at least one crosslinkable polymer is a polyarylene ether having repeating units along its backbone according to the structure of
35 formula (I):



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

5 m .

11. The method according to claim 12, wherein the at least one crosslinkable aromatic polymer has repeating units along its backbone having the structure of formula (II):



10

(II)

12. The method according to claim 7, wherein the at least one crosslinkable aromatic polymer comprises a blend of at least two different polymers, each having at least one reaction kinetics property that is different from the other, wherein the at least one reaction kinetics property comprises one or more selected from a crosslinking reaction, a crosslinking reaction rate, and a thermal property.

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13. The method according to claim 12, wherein the at least one reaction kinetics property is the crosslinking reaction rate.

14. The method according to claim 12, wherein the blend is selected from the group of polyphenylene sulfide and polyetherether ketone; polyphenylene oxide and polyphenylene sulfide; and polyetherimide and polyphenylene sulfide.

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15. The method according to claim 12, wherein the blend comprises at least one first crosslinkable aromatic polymer that has a crosslinking reaction rate that is slower than at least one second crosslinkable aromatic polymer.

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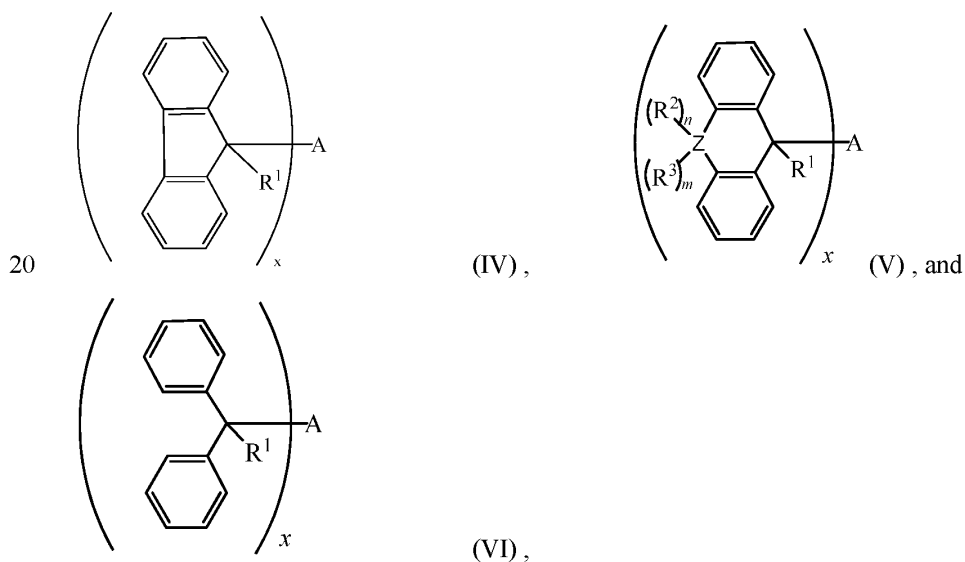
16. The method according to claim 15, further comprising slowing the crosslinking reaction rate of the second crosslinkable aromatic polymer by incorporating the first crosslinkable aromatic polymer into the second crosslinkable aromatic polymer in an amount that is about 1 to about 50 percent by weight based on the total weight of the first

and the second crosslinkable aromatic polymers to provide a degree of crosslinking for the blend that facilitates melt processing and post-curing of the blend.

17. The method according to claim 15, further comprising accelerating the crosslinking reaction rate of the first crosslinkable aromatic polymer by incorporating the second crosslinkable aromatic polymer into the first crosslinkable aromatic polymer in an amount that is about 1 to about 50 percent by weight based on the total weight of the first and the second crosslinkable aromatic polymers to provide a degree of crosslinking for the blend that facilitates melt processing and post-curing of the blend

18. The method according to claim 15, wherein the at least one first crosslinkable polymer is polyphenylene sulfide and wherein the at least one second crosslinkable polymer is selected from the group consisting of (i) one or more polyarylene selected from polyetherketone, polyetheretherketone, polyetherdiephenylether ketone, polyetherketone ketone, and blends, co-polymers and alloys thereof; (ii) one or more of polysulfone, polyphenylsulfone, polyethersulfone, co-polymers and alloys thereof; and (iii) one or more of polyimide, thermoplastic polyimide, polyetherimide, and blends, co-polymers and alloys thereof.

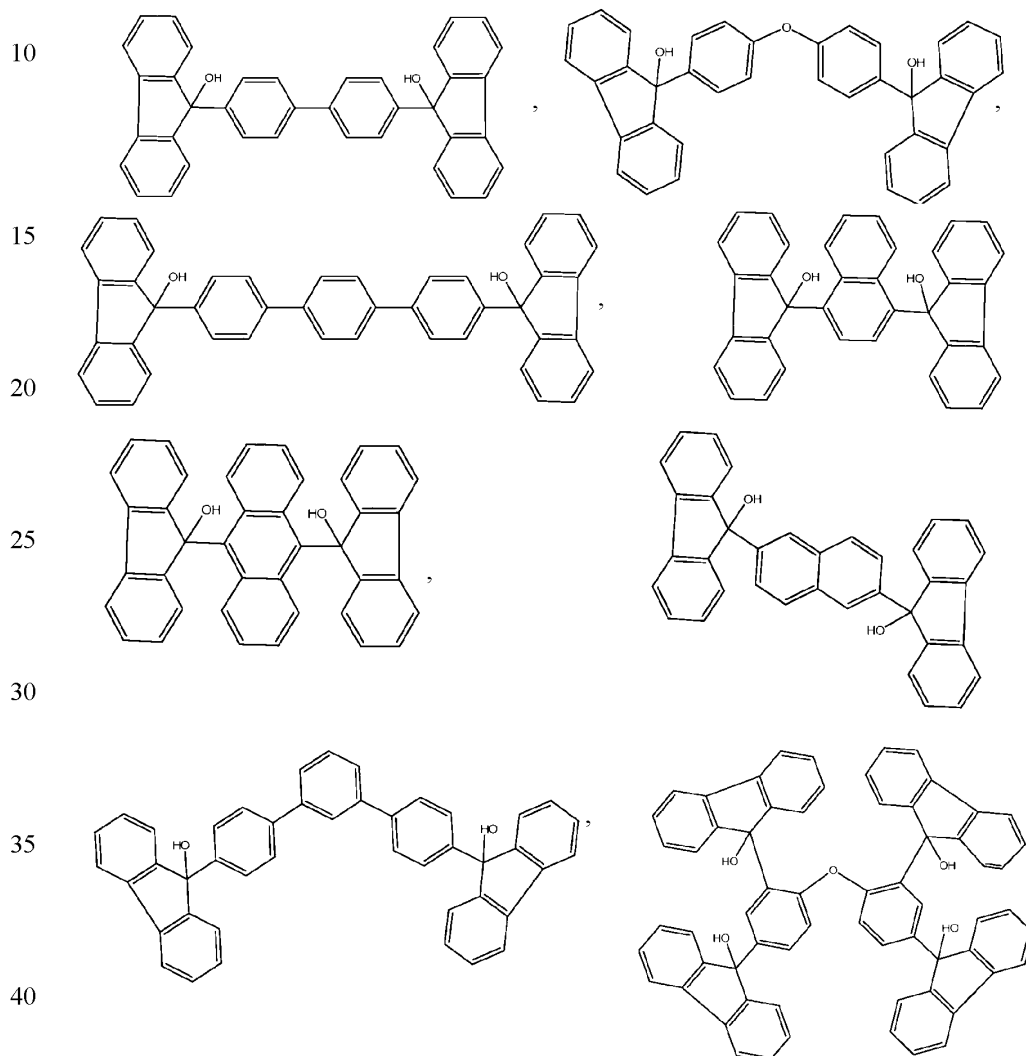
19. The method according to claim 1, wherein the composition further comprises at least one crosslinking compound that has a structure according to one of the following formulae:

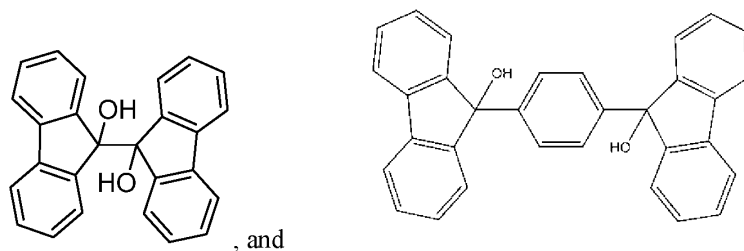


wherein A is a bond, an alkyl, an aryl, or an arene moiety having a molecular weight less than about 10,000 g/mol; wherein R¹, R², and R³ are the same or different and are independently selected from the group consisting of hydrogen, hydroxyl (-OH), amine

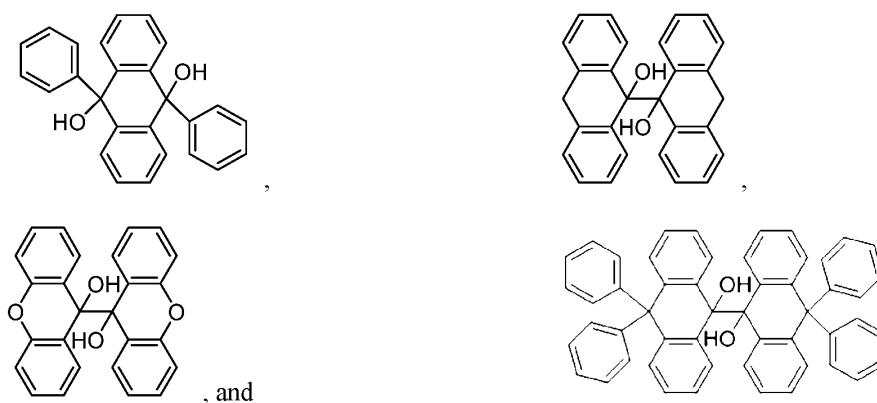
(NH₂), halide, ester, ether, amide, aryl, arene, or a branched or straight chain, saturated or unsaturated alkyl group of one to about six carbon atoms; wherein m is from 0 to 2, n is from 0 to 2, and $m + n$ is greater than or equal to zero and less than or equal to two; wherein Z is selected from the 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.

20. The method according to claim 19, wherein the at least one crosslinking compound has a structure according to formula (IV) and is selected from the group consisting of

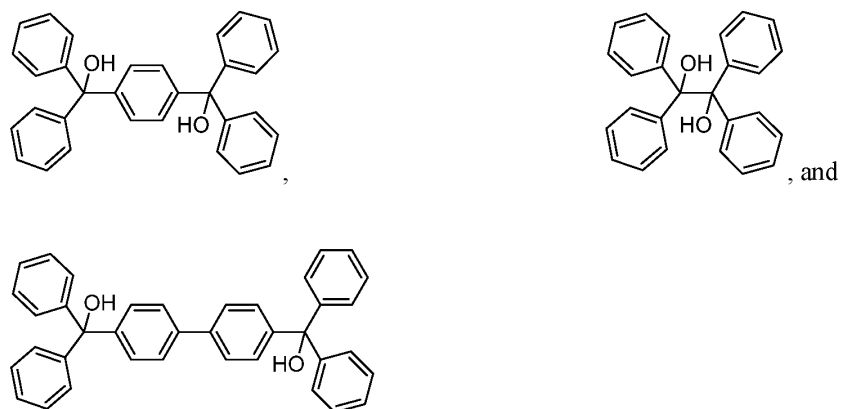




21. The method according to claim 19, wherein the at least one crosslinking compound
 5 has a structure according to formula (V) and is selected from a group consisting of:



22. The method according to claim 19, wherein the at least one crosslinking compound
 10 has a structure according to formula (VI) and is selected from the group consisting of:



23. The method according to claim 19, wherein A has a molecular weight of about 1,000
 15 g/mol to about 9,000 g/mol.

24. The method according to claim 23, wherein A has a molecular weight of about 2,000
 g/mol to about 7,000 g/mol.

25. The method according to claim 19, wherein the at least one crosslinking compound is present in the composition in an amount of about 1% by weight to about 50% by weight of an unfilled weight of the composition.

26. The method according to claim 19, wherein a weight ratio of the aromatic polymer
5 to the crosslinking compound in the composition is about 1:1 to about 100:1.

27. The method according to claim 19, wherein the composition further comprises a crosslinking reaction control additive selected from a cure inhibitor or a cure accelerator.

28. The method according to claim 27, wherein the crosslinking reaction control
10 additive is present in the composition in an amount of about 0.01% to about 15% by weight of the crosslinking compound.

29. The method according to claim 27, wherein the crosslinking reaction control additive is a cure inhibitor comprising lithium acetate.

30. The method according to claim 27, wherein the crosslinking reaction control additive is a cure accelerator comprising magnesium chloride.

15 31. The method according to claim 1, wherein the composition comprises 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, glass beads, glass
20 spheres, milled glass, calcium sulfate, boron, ceramic, polyamide, asbestos, fluorographite, aluminum hydroxide, barium sulfate, calcium carbonate, magnesium carbonate, silica, aluminum nitride, aluminum oxide, 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
25 tubes.

32. The method according to claim 31, wherein the composition comprises about 0.5% by weight to about 65% by weight of the one or more additives and/or one or more fillers.

33. The method according to claim 1, wherein the composition further comprises a crosslinking compound.

30 34. The method according to claim 1, wherein the heat processing of the composition further comprises extruding the composition for coating the insulation component.

35. The method according to claim 34, wherein the composition is extruded through a cross-head die.

36. The method according to claim 34, wherein the extruder comprises is a twin-screw
35 extruder.

37. The method according to claim 34, wherein curing occurs at least partially in an oven.

38. The method according to claim 37, wherein the oven is an infrared or convection oven.

5 39. The method according to claim 37, further comprising curing and/or post-curing the crosslinkable aromatic polymer after coating in the oven.

40. The method according to claim 37, wherein the residence time in the oven and/or the cross-linking rate are controlled.

10 41. The method according to claim 1, further comprising preparing the exterior surface of the insulation component to enhance bonding.

42. The method according to claim 41, wherein the exterior surface is prepared by at least one of cleaning, roughening and/or chemically modifying the surface.

43. The method according to claim 41, wherein the exterior surface is prepared by chemically modifying the exterior surface using a primer and/or a coupling agent.

15 44. The method according to claim 1, wherein applying a coating to the exterior surface of the insulation component comprises applying the composition directly to the exterior surface of the insulation component.

20 45. The method according to claim 44, wherein the exterior surface is prepared by at least one of cleaning the surface, roughening the surface and/or chemically modifying the surface.

46. The method according to claim 1, further comprising applying at least one intermediate layer to the exterior surface of the insulation product prior to applying the coating of the composition.

25 47. The method according to claim 46, wherein the at least one intermediate layer comprises the ability to enhance bonding with the exterior surface of the insulation component.

48. The method according to claim 46, wherein the coating of the composition encapsulates the insulation component.

30 49. The method according to claim 1, further comprising applying a release agent to the coating prior to the coating contacting another surface.

50. The method according to claim 1, wherein the insulation component is selected from wire, metallic and/or fiber optic cable, hybrid cables, telemetry cables, sensors, RFID chips, piezoelectric sensors, cables or wires for logging while drilling, motor windings, motor rotors, motor stators, chemical pumps, electronic actuators for aircraft, and 5G transmission
35 cables.

51. A coated insulation component formed from the method of claim 1.

52. The coated insulation component of claim 51, wherein the coating formed from the composition having the crosslinked polymer on the coated insulation component provides improved wear resistance relative to a coated insulation component coated with a composition having an uncrosslinked aromatic polymer of the same polymer backbone structure.

53. The coated insulation component of claim 51, wherein the coated insulation component has improved insulation resistance at a high service temperature over a range of voltages relative to a coated insulation component coated with a composition having an uncrosslinked aromatic polymer of the same polymer backbone structure.

54. The coated insulation component of claim 51, wherein the coated insulation component has improved dielectric breakdown resistance at a high service temperature relative to a coated insulation component coated with a composition having an uncrosslinked aromatic polymer of the same polymer backbone structure.

55. A composition for coating an insulation component, comprising:
a first crosslinkable aromatic polymer and a second crosslinkable aromatic polymer, wherein the first crosslinkable aromatic polymer has at least one reaction kinetics property that is different from the same reaction kinetics property in the second crosslinkable aromatic polymer, wherein the at least one reaction kinetics property comprises one or more selected from a crosslinking reaction, a crosslinking reaction rate, and a thermal property.

56. The composition according to claim 55, wherein the first crosslinkable polymer and the second crosslinkable polymer are selected from polyarylenes, polysulfones, polyethersulfones, polyphenylene sulfides, polyphenylene oxides, polyimides, polyetherimides, thermoplastic polyimides, polybenzamide, polyamide-imide, polyurea, polyurethane, polyphthalamide, polybenzimidazole, polyaramid, and blends, co-polymers, and alloys thereof.

57. The composition according to claim 55, wherein the aromatic polymer comprises one or more functionalized groups for crosslinking.

58. The composition according to claim 55, wherein the second crosslinkable aromatic polymer is at least one polyarylene selected from polyetherketone, polyetheretherketone, polyetherdiephenylether ketone, polyetherketone ketone, and blends, co-polymers and alloys thereof.

59. The composition according to claim 55, wherein the at least one reaction kinetics property is the crosslinking reaction rate.

60. The composition according to claim 59, wherein the first crosslinkable aromatic polymer has a crosslinking reaction rate that is slower than the second crosslinkable aromatic polymer.

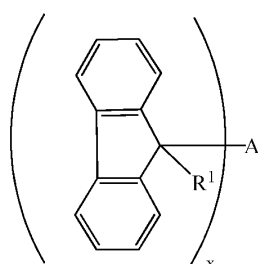
61. The composition according to claim 59, wherein the blend comprises from about 1 percent to about 50 percent by weight of the first crosslinkable aromatic polymer and about 50 percent by weight to about 1 percent by weight of the second crosslinkable polymer and a range of the weight percentage ratio of the first crosslinkable aromatic polymer to the second crosslinkable aromatic polymer is about 1:50 to about 50:1 to provide a degree of crosslinking for the blend to facilitate melt processing and post-curing of the blend.

62. The composition according to claim 60, wherein the at least one first crosslinkable polymer is polyphenylene sulfide and wherein the at least one second crosslinkable polymer is selected from the group consisting of (i) one or more polyarylene selected from polyetherketone, polyetheretherketone, polyetherdiephenylether ketone, polyetherketone ketone, and blends, co-polymers and alloys thereof; (ii) one or more of polysulfone, polyphenylsulfone, polyethersulfone, co-polymers and alloys thereof; and (iii) one or more of polyimide, thermoplastic polyimide, polyetherimide, and blends, co-polymers and alloys thereof.

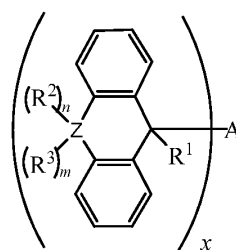
63. The composition according to claim 62, wherein the second crosslinkable aromatic polymer is selected from the group of polyetherether ketone; polyphenylene oxide, and polyetherimide

64. The composition according to claim 55, wherein the composition further comprises one or more additional aromatic crosslinkable polymers, different from the first and the second aromatic crosslinkable polymers.

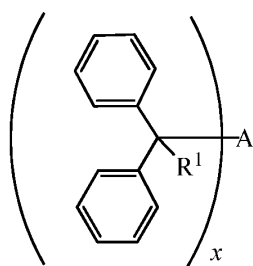
65. The composition according to claim 55, further comprising at least one crosslinking compound that has a structure according to one of the following formulae:



(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 (NH₂), 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.

66. The composition according to claim 65, wherein the at least one crosslinking compound is present in the composition in an amount of about 1% by weight to about 50% by weight of an unfilled weight of the composition.

67. The composition according to claim 65, wherein a weight ratio of the total weight of the crosslinkable aromatic polymers to the crosslinking compound in the composition is about 1:1 to about 100:1.

68. The composition according to claim 65, wherein the composition further comprises a crosslinking reaction control additive selected from a cure inhibitor or a cure accelerator.

69. The composition according to claims 55, wherein the first crosslinkable aromatic polymer, the second crosslinkable aromatic polymer or both of the first and the second crosslinkable polymers are self-crosslinkable, thermally crosslinkable, chemically crosslinkable or thermally and chemically crosslinkable.