

We claim:

1. A copolymer comprising a reaction product of:

(a) a di- or polyfunctional nucleophilic initiator selected from the group consisting of alcohols, phenols, amines, thiols, thiophenols, sulfinic acids, and deprotonated species thereof;

(b) from 1 to 30 recurring units per active hydrogen equivalent of the initiator of a phenyl glycidyl ether; and

(c) from 1 to 100 recurring units per active hydrogen equivalent of the initiator of one or more alkylene oxides (AO) selected from the group consisting of ethylene oxide, propylene oxide, butylene oxides, and combinations thereof;

wherein the copolymer comprises 20 to 60 wt.% of the phenyl glycidyl ether recurring units based on the combined amounts of the phenyl glycidyl ether and AO recurring units; and

wherein the copolymer has a number-average molecular weight within the range of 1,900 to 56,000 g/mol.

2. The copolymer of claim **1** further comprising a capping group selected from the group consisting of ethers, esters, carbonates, carbamates, carbamimidic esters, borates, sulfates, phosphates, phosphatidylcholines, ether acids, ester alcohols, ester acids, ether diacids, ether amines, ether ammoniums, ether amides, ether sulfonates, ether betaines, ether sulfobetaines, ether phosphonates, phospholanes, and phospholane oxides.

3. The copolymer of claim **1** wherein the nucleophilic initiator has an average functionality within the range of 2 to 6.

4. The copolymer of claim **1** comprising 2 to 20 recurring units of the phenyl glycidyl ether per active hydrogen equivalent of the initiator.

5. The copolymer of claim **1** comprising 5 to 80 recurring units of ethylene oxide, propylene oxide, or combinations thereof per active hydrogen equivalent of the initiator.

6. The copolymer of claim **1** wherein the di- or polyfunctional nucleophilic initiator is an alcohol or a phenol.

7. The copolymer of claim **1** wherein the di- or polyfunctional nucleophilic initiator is an amine and one or more nitrogen atoms of the copolymer are optionally oxidized to introduce an amine oxide functionality.

8. The copolymer of claim **1** wherein the di- or polyfunctional nucleophilic initiator is a thiol or a thiophenol, and one or more sulfur atoms of the copolymer are optionally oxidized to introduce sulfoxide and/or sulfone functionality.

9. The copolymer of claim **1** wherein the di- or polyfunctional nucleophilic initiator is a mixed nucleophile.

10. The copolymer of claim **1** wherein the di- or polyfunctional nucleophilic initiator is a complex initiator comprising:

(a) a hydroxy-functional reaction product of an epoxide or a glycidyl ether with a di- or polyfunctional nucleophile selected from the group consisting of alcohols, phenols, amines, thiols, thiophenols, sulfinic acids, and deprotonated species thereof; or

(b) a hydroxy-functional reaction product of a di- or polyfunctional epoxide or glycidyl ether with a monofunctional nucleophile selected from the group consisting of alcohols, phenols, amines, thiols, thiophenols, sulfinic acids, and deprotonated species thereof.

11. The copolymer of claim **1** further comprising recurring units of another monomer selected from the group consisting of thiiranes, glycidyl ethers, and other epoxides.

12. The copolymer of claim **1** further comprising recurring units of a functionalized glycidyl ether.

13. The copolymer of claim **1** comprising 25 to 45 wt.% of phenyl glycidyl ether recurring units based on the combined amounts of phenyl glycidyl ether and AO recurring units

14. The copolymer of claim **1** having a number-average molecular weight within the range of 2,700 to 32,000 g/mol.

15. The copolymer of claim **1** wherein one or more aromatic rings of the copolymer are sulfonated.

16. A dispersant composition comprising a carrier and the copolymer of claim **1**.

17. The dispersant composition of claim **16** wherein the carrier is water.

18. The dispersant composition of claim **17** further comprising a pH adjusting agent.

19. The dispersant composition of claim **16** comprising 5 to 90 wt.% of the copolymer.

20. A dispersion comprising a solid, water, a pH adjusting agent, and the copolymer of claim **1**.

21. The dispersion of claim **20** wherein the solid is a pigment.

22. The dispersion of claim **21** wherein the pigment is an organic pigment selected from the group consisting of monoazos, diazos, anthraquinones, anthrapyrimidines, quinacridones, quinophthalones, dioxazines, flavanthrones, indanthrones, isoindolines, isoindolinones, metal complexes, perinones, perylenes, phthalocyanines, pyranthrones, thioindigos, triphenylmethanes, anilines, benzimidazolones, diarylides, diketopyrrolopyrroles, naphthols, and aldazines.

23. The dispersion of claim **21** wherein the pigment is an inorganic pigment selected from the group consisting of white pigments, black pigments, chromatic pigments, and luster pigments.

24. The dispersion of claim **21** having a pH within the range of 8 to 10 and a viscosity at 10 s⁻¹ and 25°C less than 3000 cP.

25. The dispersion of claim **21** having an average particle size within the range of 100 to 1000 nm.

26. The dispersion of claim **21** wherein the pigment is a monoazo yellow, a quinacridone violet, a phthalocyanine blue, or a carbon black.

27. A wettable polymer composition comprising at least one agricultural active, an anionic surfactant, and the copolymer of claim **1**.

28. The composition of claim **27** comprising 80 to 95 wt.% of the agricultural active, 0.1 to 5 wt.% of the anionic surfactant, and 1 to 20 wt.% of the copolymer.

29. A suspension concentrate comprising at least one agricultural active, a carrier, and the copolymer of claim **1**.

30. The suspension concentrate of claim **29** wherein the carrier is water and the concentrate comprises 20 to 60 wt.% of the agricultural active, 25 to 75 wt.% of water, and 0.5 to 3.5 wt.% of the copolymer.

31. A water-dispersible granule or a seed coating comprising an agricultural active and the copolymer of claim **1**.

32. A copolymer comprising a reaction product of:

(a) a monofunctional nucleophilic initiator selected from the group consisting of thiols, thiophenols, aralkylated phenols, sulfinic acids, secondary amines, C₁₀-C₂₀ terpene alcohols, and deprotonated species thereof;

(b) from 1 to 30 recurring units per active hydrogen equivalent of the initiator of a phenyl glycidyl ether; and

(c) from 1 to 100 recurring units per active hydrogen equivalent of the initiator of one or more alkylene oxides (AO) selected from the group consisting of ethylene oxide, propylene oxide, butylene oxides, and combinations thereof;

wherein the copolymer comprises 20 to 60 wt.% of phenyl glycidyl ether recurring units based on the combined amounts of phenyl glycidyl ether and AO recurring units; and

wherein the copolymer has a number-average molecular weight within the range of 900 to 12,000 g/mol.

33. The copolymer of claim **32** further comprising a capping group selected from the group consisting of ethers, esters, carbonates, carbamates, carbamimidic esters, borates, sulfates, phosphates, phosphatidylcholines, ether acids, ester alcohols, ester acids, ether diacids, ether amines, ether ammoniums, ether amides, ether sulfonates, ether betaines, ether sulfobetaines, ether phosphonates, phospholanes, and phospholane oxides.

34. The copolymer of claim **32** comprising 2 to 20 recurring units of the phenyl glycidyl ether per active hydrogen equivalent of the initiator.

35. The copolymer of claim **32** comprising 5 to 80 recurring units of ethylene oxide, propylene oxide, or combinations thereof per active hydrogen equivalent of the initiator.

36. The copolymer of claim **32** wherein the nucleophilic initiator is thiophenol.

37. The copolymer of claim **32** wherein the nucleophilic initiator is a secondary amine selected from the group consisting of morpholine, dipropylamine, and N-methylaniline.

38. The copolymer of claim **32** wherein the nucleophilic initiator is a terpene alcohol selected from the group consisting of farnesol, linalool, geraniol, nerolidol, geranylgeraniol, and terpineol.

39. The copolymer of claim **32** wherein the monofunctional nucleophilic initiator is a complex initiator comprising a hydroxy-functional reaction product of an epoxide or a glycidyl ether with a monofunctional nucleophile selected from the group consisting of alcohols, phenols, amines, thiols, thiophenols, sulfinic acids, and deprotonated species thereof.

40. The copolymer of claim **32** further comprising recurring units of another monomer selected from the group consisting of thiiranes, glycidyl ethers, and other epoxides.

41. The copolymer of claim **32** wherein one or more aromatic rings of the copolymer are sulfonated.

42. A dispersant composition comprising a carrier and the copolymer of claim **32**.

43. The dispersant composition of claim **42** wherein the carrier is water.

44. The dispersant composition of claim **43** further comprising a pH adjusting agent.

45. A dispersion comprising a solid, water, a pH adjusting agent, and the copolymer of claim **32**.

46. The dispersion of claim **45** wherein the solid is a pigment.

47. The dispersion of claim **46** wherein the pigment is a monoazo yellow, a quinacridone violet, a phthalocyanine blue, or a carbon black.

48. A wettable polymer composition comprising at least one agricultural active, an anionic surfactant, and the copolymer of claim **32**.

49. The composition of claim **48** comprising 80 to 95 wt.% of the agricultural active, 0.1 to 5 wt.% of the anionic surfactant, and 1 to 20 wt.% of the copolymer.

50. A suspension concentrate comprising at least one agricultural active, a carrier, and the copolymer of claim **32**.

51. The suspension concentrate of claim **50** wherein the carrier is water and the concentrate comprises 20 to 60 wt.% of the agricultural active, 25 to 75 wt.% of water, and 0.5 to 3.5 wt.% of the copolymer.

52. A water-dispersible granule or a seed coating comprising an agricultural active and the copolymer of claim **32**.

53. A method which comprises stabilizing flow properties of an emulsion latex polymer against temperature-induced changes in the properties that occur within the range of -20°C to 50°C by combining the emulsion latex polymer with an effective amount of the dispersant composition of claim **17**.

54. A method which comprises stabilizing flow properties of an emulsion latex polymer against temperature-induced changes in the properties that occur within the range of -20°C to 50°C by combining the emulsion latex polymer with an effective amount of the dispersant composition of claim **43**.

55. A method of enhancing the hydrophobic character of an alkyd coating, comprising combining an alkyd resin with an effective amount of the dispersant composition of claim **16**.

56. A method of enhancing the hydrophobic character of an alkyd coating, comprising combining an alkyd resin with an effective amount of the dispersant composition of claim **42**.

57. A method for making a dispersant, comprising:

(a) reacting a di- or polyfunctional glycidyl ether with a monofunctional nucleophilic initiator selected from the group consisting of alcohols, secondary amines, and thiols to give a hydroxy-functional intermediate;

(b) reacting the intermediate with 1 to 30 equivalents of a phenyl glycidyl ether to produce a hydrophobe; and

(c) reacting the hydrophobe with 1 to 100 equivalents of one or more alkylene oxides selected from the group consisting of ethylene oxide, propylene oxide, butylene oxides, and combinations thereof.

58. A dispersant made by the method of claim **57**.

59. A reverse synthesis method for producing a dispersant, comprising:

(a) reacting an ether-capped polyoxyalkylene glycol alkoxide with 1 to 30 equivalents of a phenyl glycidyl ether to produce a monofunctional dispersant; and

(b1) optionally, quenching hydroxyl groups of the monofunctional dispersant by reacting the dispersant with an equivalent amount of a di- or polyfunctional carboxylic

acid, anhydride, or acid halide, or with a di- or polyisocyanate, or with a di- or polyfunctional aryl sulfonyl halide; or

(b2) optionally, further reacting the monofunctional dispersant with an epoxide or a glycidyl ether other than a phenyl glycidyl ether.

60. The method of claim **59** wherein the dispersant from step (a) or step (b2) is further reacted with a capping group.

61. The method of claim **59** wherein prior to step (a), the ether-capped polyoxyalkylene glycol alkoxide is reacted with an epoxide or a glycidyl ether other than a phenyl glycidyl ether.

62. A reverse synthesis method for producing a dispersant, comprising:

(a) reacting an ether-capped polyoxyalkylene glycol alkoxide with an equivalent amount of a di- or polyfunctional glycidyl ether to produce a hydroxy-functional intermediate;

(b) reacting the hydroxy-functional intermediate with 1 to 30 equivalents of a phenyl glycidyl ether to give the dispersant; and

(c) optionally, further reacting the dispersant from step (b) with an epoxide or a glycidyl ether other than a phenyl glycidyl ether;

(d) optionally, further reacting the dispersant from step (b) or step (c) with a capping group.

63. The method of claim **62** wherein prior to step (b), the hydroxy-functional intermediate is reacted with an epoxide or a glycidyl ether other than a phenyl glycidyl ether.