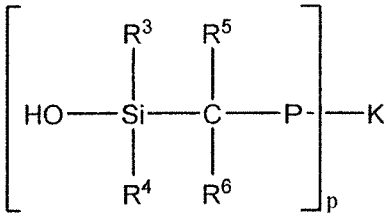
CLAIMS

1. A modified macromolecular compound of the following Formula A:



Formula A

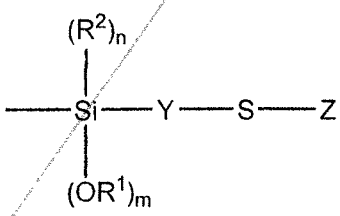
wherein

R^3 and R^4 are each independently selected from –OH, (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

R^5 and R^6 are each independently selected from hydrogen, (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

P is an elastomeric diene polymer chain comprising monomer units derived from at least one of the following monomers: butadiene, isoprene, styrene and alpha-methylstyrene; and

K represents a hydrogen atom or



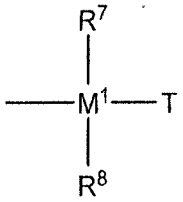
wherein

R^1 is independently selected from a hydrogen atom and (C_1-C_4) alkyl;

R^2 is independently selected from (C_1-C_{18}) alkyl;

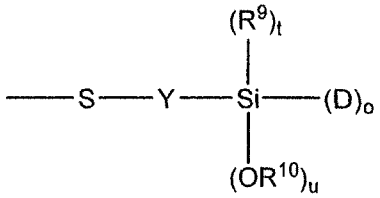
Y is at least divalent and is (C_1-C_{18}) alkyl, which may be substituted with one or more of the following groups: tertiary amine group, silyl group, (C_7-C_{18}) aralkyl group and (C_6-C_{18}) aryl group; and

Z represents hydrogen or



wherein

M^1 is a silicon atom or a tin atom; R^7 and R^8 are independently selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl; and T represents R^{11} or



wherein

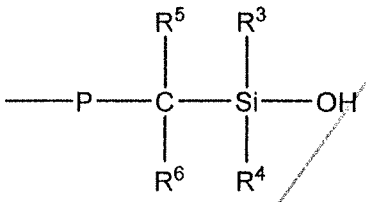
Y is as defined above;

R^9 is independently selected from (C_1-C_{18}) alkyl;

R^{10} is independently selected from a hydrogen atom and (C_1-C_4) alkyl;

R^{11} is selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl; and

D represents OR^1 or

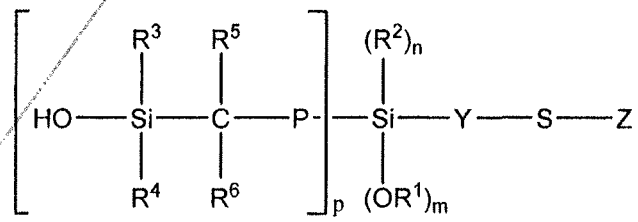


wherein

R^1, P, R^3, R^4, R^5 and R^6 are as defined above; and

p and o are each independently selected from an integer of 1, 2 and 3; m, n, t and u are each independently selected from an integer of 0, 1 and 2; and wherein p is 1 if K is H and otherwise p+m+n=3 and t+u+o=3.

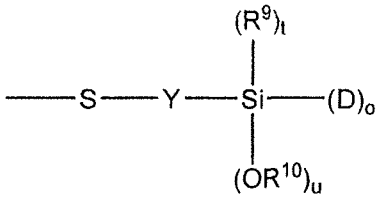
2. The modified macromolecular compound according to Claim 1, which has the following Formula 1:



Formula 1

wherein R^1, R^2, R^3, R^4, R^5, R^6, Y, P and Z; and n, m and p are as defined in Claim 1.

3. The modified macromolecular compound according to Claim 2, wherein R^3 is selected from –OH and (C_1-C_{18}) alkyl; Z is represented by $-M^1(R^7)(R^8)(T)$; M^1 is a silicon atom or a tin atom; R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl; and T is represented by



wherein Y, R^9, R^{10} and D, and t, u und o are as defined in Claim 1.

4. The modified macromolecular compound according to Claim 2, wherein R^3 is selected from –OH and (C_1-C_{18}) alkyl; Z is represented by $-M^1(R^7)(R^8)(T)$; M^1 is a silicon atom or a tin atom; R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl; and T is represented by R^{11}, wherein R^{11} is selected from (C_1-C_{18}) alkyl.

5. The modified macromolecular compound according to any one of Claims 1 to 4, wherein M^1 is a silicon atom.

6. The modified macromolecular compound according to any one of Claims 1 to 4, wherein M^1 is a tin atom.

7. The modified macromolecular compound according to any one of Claims 1 to 6, wherein Y is divalent and is (C_1-C_{18}) alkyl.

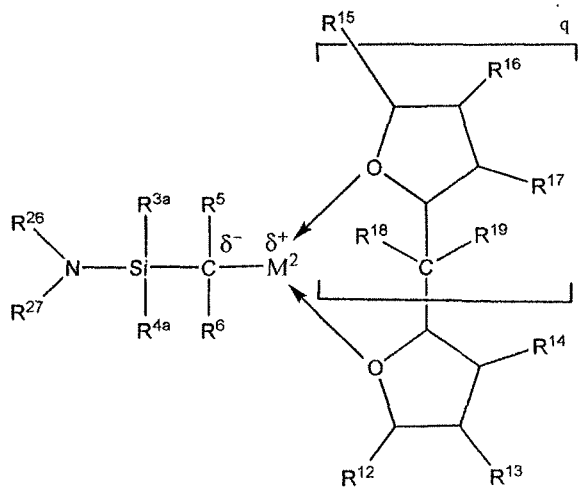
8. The modified macromolecular compound according to any one of Claims 1 to 7, wherein R^3 and R^4 are each independently selected from –OH and (C_1-C_{18}) alkyl; R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl; and R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl.

9. The modified macromolecular compound according to Claim 8, wherein R^3, R^4, R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl; and R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl.

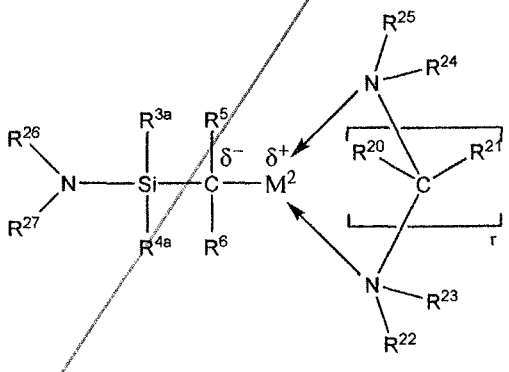
10. The modified macromolecular compound according to any one of Claims 1 to 9, wherein p and o are each independently selected from an integer of 1 and 2; m and u are each independently selected from an integer of 2 and 3; and n and t are each independently selected from and integer of 0 and 1.

11. A method of making the modified macromolecular compound as defined in any one of Claims 1 to 10, comprising the steps of:

(i) polymerizing in solution at least one elastomeric diene monomer with at least one amino silane polymerization initiator compound of Formula 4 or Formula 5



Formula 4



Formula 5

or Lewis base adducts thereof, wherein

R^{3a} is independently selected from $-N(R^{28})R^{29}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^{4a} is independently selected from $-N(R^{30})R^{31}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^5 and R^6 are as defined in Claim 1;

M^2 is lithium, sodium or potassium;

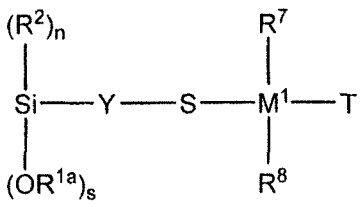
R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from hydrogen, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^{26}, R^{27}, R^{28}, R^{29}, R^{30} and R^{31} are each independently selected from $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

q is selected from an integer of 1, 2, 3, 4 and 5; and

r is selected from an integer of 1, 2 and 3;

(ii) optionally reacting the polymer resulting from step (i) in solution with a chain end-modifying compound of Formula 6



Formula 6

wherein

R^{1a} is independently selected from (C_1-C_4) alkyl;

R^2 is independently selected from (C_1-C_{18}) alkyl;

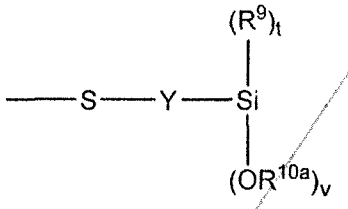
R^7 and R^8 are independently selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

Y is at least divalent and is (C_1-C_{18}) alkyl, which may be substituted with one or more of the following groups: tertiary amine group, silyl group, (C_7-C_{18}) aralkyl group and (C_6-C_{18}) aryl group; R^2, R^7, R^8 and n are as defined above;

M^1 is a silicon atom or a tin atom;

n is an integer selected from 0, 1 and 2; s is an integer selected from 1, 2 and 3; and n+s=3; and

T represents R^{11} or



wherein

Y is as defined above;

R^9 is independently selected from (C_1-C_{18}) alkyl;

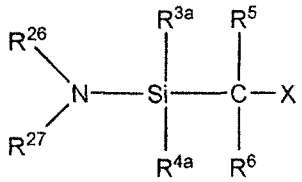
R^{10a} is independently selected from (C_1-C_4) alkyl;

t is an integer selected from 0, 1 and 2; v is an integer selected from 1, 2 and 3; and t+v=3; and

(iii) optionally contacting the polymer resulting from step (i) or (ii) with a protonating agent.

12. The method according to Claim 11, further comprising the following step for making the amino silane polymerization initiator compound of Formula 4 or Formula 5:

(ia) reacting a compound of the following Formula 9



Formula 9

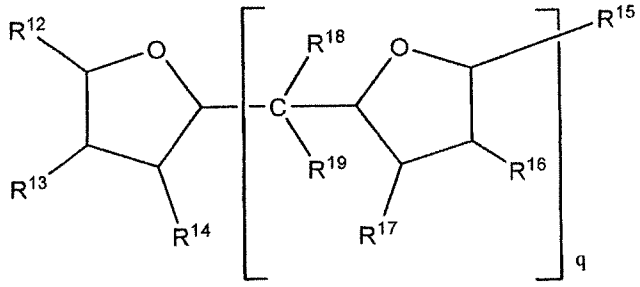
wherein

X is a chlorine atom, a bromine atom or a iodine atom; and

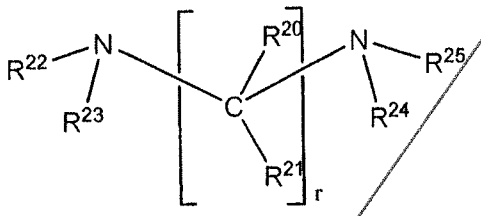
R^{3a}, R^{4a}, R^5, R^6, R^{26} and R^{27} are as defined in Claim 11;

an alkali metal selected from lithium, sodium and potassium; and

a compound selected from Formula 10 and Formula 11



Formula 10

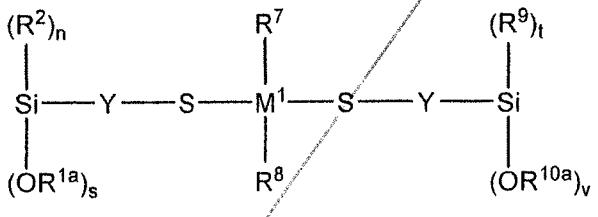


Formula 11

wherein

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25}, q and r are as defined in Claim 11.

13. The method according to Claim 11 or 12, wherein the chain end-modifying compound used in step (ii) has the following Formula 7



Formula 7

wherein

M^1, Y, R^{1a}, R^2, n and s are as generally defined for Formula 6;

R^7, R^8 and R^9 are each independently selected from (C_1-C_{18}) alkyl;

R^{10a} is independently selected from (C_1-C_4) alkyl;

t is selected from an integer of 0, 1 and 2; v is selected from an integer of 1, 2 and 3; and t+v=3.

14. The method according to Claim 13, wherein M^2 is lithium.

15. The method according to Claim 13 or 14, wherein R^{3a} is selected from $-N(R^{28})R^{29}$ and (C_1-C_{18}) alkyl, wherein R^{28} and R^{29} are each independently selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl.

16. The method according to any one of Claims 13 to 15, wherein R^{3a}, R^{4a}, R^{22}, R^{23}, R^{24}, R^{25}, R^{26} and R^{27} are each independently selected from (C_1-C_{18}) alkyl and R^5, R^6, R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and (C_1-C_{18}) alkyl and R^{12}, R^{13}, R^{14}, R^{15}, R^{16} and R^{17} are each independently selected from hydrogen and (C_1-C_6) alkyl.

17. The method according to any one of Claims 13 to 16, wherein Y is divalent and is (C_1-C_{18}) alkyl.

18. The method according to any one of Claims 13 to 17, wherein q is 1 and r is 2.

19. The method according to any one of Claims 13 to 18, wherein s and v are each independently selected from an integer of 2 and 3; and n and t are each independently selected from an integer of 0 and 1.

20. A polymer composition comprising at least one modified macromolecular compound as defined in any one of Claims 1 to 10 and one or more further components selected from components which are added to or formed as a result of the polymerization process used for making the modified macromolecular compound and components which remain after solvent removal from the polymerization process.

21. The polymer composition according to claim 20, which comprises an oil.

22. The polymer composition according to Claim 20 or 21, which comprises at least one filler.

23. The polymer composition according to Claim 22, wherein the filler is one or more selected from carbon black, silica, carbon-silica dual-phase-filler, clay, calcium carbonate, magnesium carbonate, lignin, and glass particles.

24. The polymer composition according to Claim 23, wherein the filler comprises silica.

25. The polymer composition according to any one of Claims 20 to 24, which comprises a vulcanization agent.

26. The polymer composition according to any one of Claims 20 to 25, which comprises at least one polymer selected from the group consisting of polybutadiene, butadiene-styrene copolymers, butadiene-isoprene copolymers, polyisoprene and butadiene-styrene-isoprene terpolymers.

27. A vulcanized polymer composition comprising the reaction product of at least the following:

1) at least one vulcanization agent; and

2) the polymer composition as defined in any one of Claims 20 to 26.

28. A method for making a vulcanized polymer composition comprising reacting at least the following components:

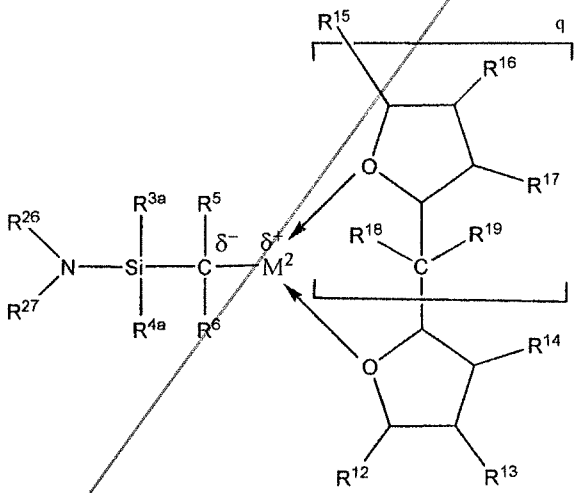
1) at least one vulcanization agent; and

2) the polymer composition as defined in any one of Claims 20 to 26.

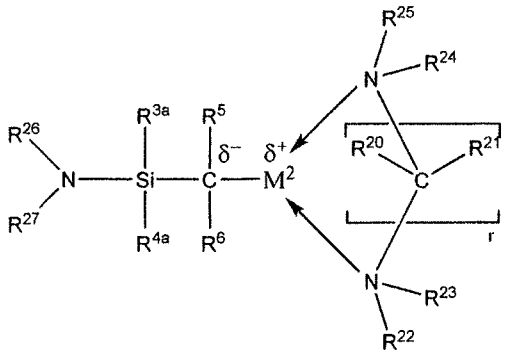
29. An article comprising at least one component formed from the vulcanized polymer composition as defined in Claim 27.

30. The article according to Claim 29, which is selected from the group consisting of a tire, a tire tread, a tire side wall, a tire carcass, a belt, a hose, a vibration damper, and a footwear component.

31. An amino silane polymerization initiator compound of the following Formula 4 or Formula 5:



Formula 4



Formula 5

or Lewis base adducts thereof, wherein

R^{3a} is independently selected from $-N(R^{28})R^{29}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^{4a} is independently selected from $-N(R^{30})R^{31}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$

aralkyl;

R^5 and R^6 are as defined in Claim 1;

M^2 is lithium, sodium or potassium;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from hydrogen, (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

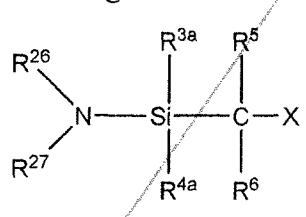
R^{26}, R^{27}, R^{28}, R^{29}, R^{30} and R^{31} are each independently selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

q is selected from an integer of 1, 2, 3, 4 and 5; and

r is selected from an integer of 1, 2 and 3.

32. A method of making the amino silane polymerization initator of Formula 4 or Formula 5 as defined in Claim 31, said method comprising the step of

reacting a compound of the following Formula 9



Formula 9

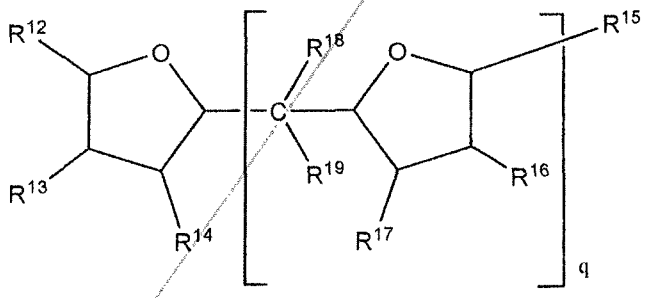
wherein

X is a chlorine atom, a bromine atom or a iodine atom; and

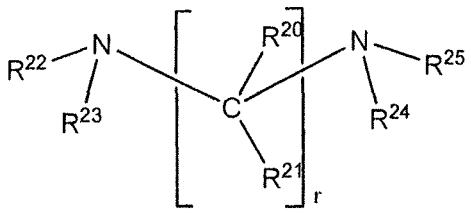
R^{3a}, R^{4a}, R^5, R^6, R^{26} and R^{27} are as defined in Claim 31;

an alkali metal selected from lithium, sodium and potassium; and

a compound selected from the following Formula 10 and the following Formula 11



Formula 10



Formula 11

wherein

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25}, q and r are as defined in Claim 31.

33. The amino silane polymerization initiator compound according to Claim 31 or method according to Claim 32, wherein

X is a chlorine or bromine atom;

R^{3a} is selected from $-N(R^{28})R^{29}$ and $(C_1\text{-}C_{18})$ alkyl;

R^{4a} is selected from $-N(R^{30})R^{31}$ and $(C_1\text{-}C_{18})$ alkyl;

R^5 and R^6 are each independently selected from hydrogen and $(C_1\text{-}C_{18})$ alkyl;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16} and R^{17} are each independently selected from hydrogen and $(C_1\text{-}C_6)$ alkyl;

R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and $(C_1\text{-}C_{18})$ alkyl;

R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from $(C_1\text{-}C_{18})$ alkyl;

R^{26}, R^{27}, R^{28}, R^{29}, R^{30} and R^{31} are each independently selected from $(C_1\text{-}C_{18})$ alkyl; and

q is 1 and r is 2.

34. The amino silane polymerization initiator compound or method according to Claim 33, wherein

X is a chlorine or bromine atom;

R^{3a} is selected from $-N(R^{28})R^{29}$ and $(C_1\text{-}C_{18})$ alkyl;

R^{4a} is selected from $(C_1\text{-}C_{18})$ alkyl;

R^5 and R^6 are each independently selected from hydrogen and $(C_1\text{-}C_{18})$ alkyl;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16} and R^{17} are each independently selected from hydrogen and $(C_1\text{-}C_6)$ alkyl;

R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and $(C_1\text{-}C_{18})$ alkyl;

R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from $(C_1\text{-}C_{18})$ alkyl;

R^{26}, R^{27}, R^{28} and R^{29} are each independently selected from $(C_1\text{-}C_{18})$ alkyl; and

q is 1 and r is 2.

35. The amino silane polymerization initiator compound or method according to Claim 34, wherein

X is a chlorine atom;

R^{3a} and R^{4a} are selected from $(C_1\text{-}C_{18})$ alkyl;

R^5 and R^6 are each independently selected from hydrogen and $(C_1\text{-}C_{18})$ alkyl;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and $(C_1\text{-}C_4)$ alkyl;

R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from $(C_1\text{-}C_4)$ alkyl;

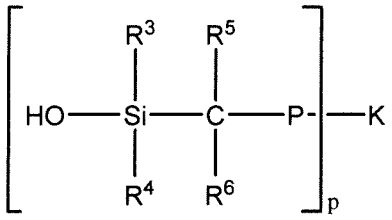
R^{26} and R^{27} are each independently selected from (C_1-C_{18}) alkyl;

q is 1 and r is 2; and

the alkali metal is lithium.

CLAIMS

1. A modified macromolecular compound of the following Formula A:



Formula A

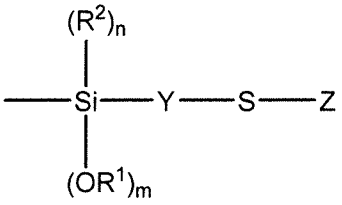
wherein

R^3 and R^4 are each independently selected from –OH, (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

R^5 and R^6 are each independently selected from hydrogen, (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

P is an elastomeric diene polymer chain comprising monomer units derived from at least one of the following monomers: butadiene, isoprene, styrene and alpha-methylstyrene; and

K represents a hydrogen atom or



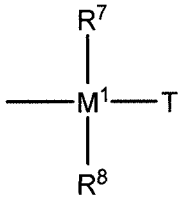
wherein

R^1 is independently selected from a hydrogen atom and (C_1-C_4) alkyl;

R^2 is independently selected from (C_1-C_{18}) alkyl;

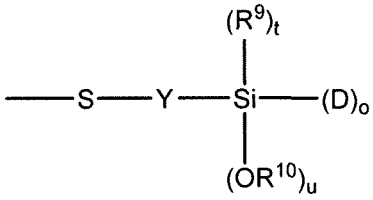
Y is at least divalent and is (C_1-C_{18}) alkyl, which may be substituted with one or more of the following groups: tertiary amine group, silyl group, (C_7-C_{18}) aralkyl group and (C_6-C_{18}) aryl group; and

Z represents hydrogen or



wherein

M^1 is a silicon atom or a tin atom; R^7 and R^8 are independently selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl; and T represents R^{11} or



wherein

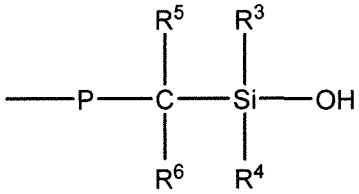
Y is as defined above;

R^9 is independently selected from (C_1-C_{18}) alkyl;

R^{10} is independently selected from a hydrogen atom and (C_1-C_4) alkyl;

R^{11} is selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl; and

D represents OR^1 or

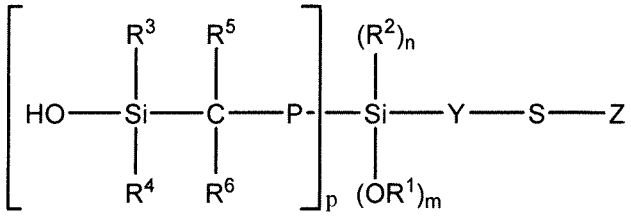


wherein

R^1, P, R^3, R^4, R^5 and R^6 are as defined above; and

p and o are each independently selected from an integer of 1, 2 and 3; m, n, t and u are each independently selected from an integer of 0, 1 and 2; and wherein p is 1 if K is H and otherwise p+m+n=3 and t+u+o=3.

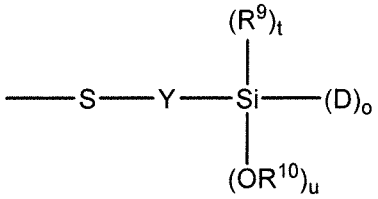
2. The modified macromolecular compound according to claim 1, which has the following Formula 1:



Formula 1

wherein R^1, R^2, R^3, R^4, R^5, R^6, Y, P and Z; and n, m and p are as defined in claim 1.

3. The modified macromolecular compound according to claim 2, wherein R^3 is selected from –OH and (C_1-C_{18}) alkyl; Z is represented by $-M^1(R^7)(R^8)(T)$; M^1 is a silicon atom or a tin atom; R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl; and T is represented by



wherein Y, R^9, R^{10} and D, and t, u und o are as defined in claim 1.

4. The modified macromolecular compound according to claim 2, wherein R^3 is selected from –OH and (C_1-C_{18}) alkyl; Z is represented by $-M^1(R^7)(R^8)(T)$; M^1 is a silicon atom or a tin atom; R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl; and T is represented by R^{11}, wherein R^{11} is selected from (C_1-C_{18}) alkyl.

5. The modified macromolecular compound according to claim 1, wherein M^1 is a silicon atom.

6. The modified macromolecular compound according to claim 1, wherein M^1 is a tin atom.

7. The modified macromolecular compound according to claim 1, wherein Y is divalent and is (C_1-C_{18}) alkyl.

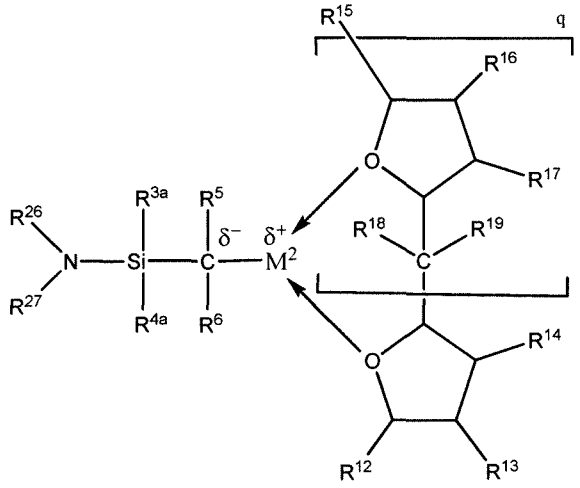
8. The modified macromolecular compound according to claim 1, wherein R^3 and R^4 are each independently selected from –OH and (C_1-C_{18}) alkyl; R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl; and R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl.

9. The modified macromolecular compound according to claim 8, wherein R^3, R^4, R^7 and R^8 are each independently selected from (C_1-C_{18}) alkyl; and R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl.

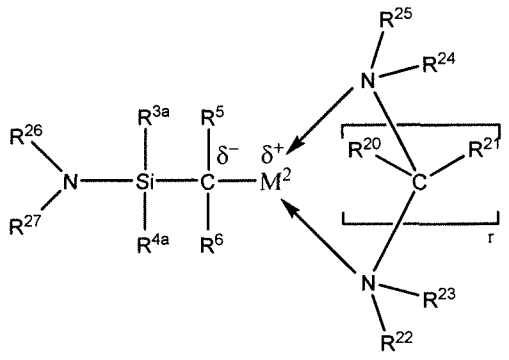
10. The modified macromolecular compound according to claim 1, wherein p and o are each independently selected from an integer of 1 and 2; m and u are each independently selected from an integer of 2 and 3; and n and t are each independently selected from and integer of 0 and 1.

11. A method of making the modified macromolecular compound as defined in claim 1, comprising the steps of:

(i) polymerizing in solution at least one elastomeric diene monomer with at least one amino silane polymerization initiator compound of Formula 4 or Formula 5



Formula 4



Formula 5

or Lewis base adducts thereof, wherein

R^{3a} is independently selected from –N(R^{28})R^{29}, (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl;

R^{4a} is independently selected from $-N(R^{30})R^{31}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^5 and R^6 are as defined in claim 1;

M^2 is lithium, sodium or potassium;

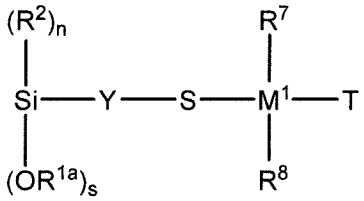
R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from hydrogen, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^{26}, R^{27}, R^{28}, R^{29}, R^{30} and R^{31} are each independently selected from $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

q is selected from an integer of 1, 2, 3, 4 and 5; and

r is selected from an integer of 1, 2 and 3;

(ii) optionally reacting the polymer resulting from step (i) in solution with a chain end-modifying compound of Formula 6



Formula 6

wherein

R^{1a} is independently selected from $(C_1\text{-}C_4)$ alkyl;

R^2 is independently selected from $(C_1\text{-}C_{18})$ alkyl;

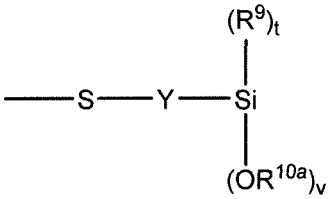
R^7 and R^8 are independently selected from $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

Y is at least divalent and is $(C_1\text{-}C_{18})$ alkyl, which may be substituted with one or more of the following groups: tertiary amine group, silyl group, $(C_7\text{-}C_{18})$ aralkyl group and $(C_6\text{-}C_{18})$ aryl group; R^2, R^7, R^8 and n are as defined above;

M^1 is a silicon atom or a tin atom;

n is an integer selected from 0, 1 and 2; s is an integer selected from 1, 2 and 3; and n+s=3; and

T represents R^{11} or



wherein

Y is as defined above;

R^9 is independently selected from (C_1-C_{18}) alkyl;

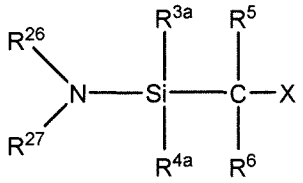
R^{10a} is independently selected from (C_1-C_4) alkyl;

t is an integer selected from 0, 1 and 2; v is an integer selected from 1, 2 and 3; and t+v=3; and

(iii) contacting the polymer resulting from step (i) or (ii) with water.

12. The method according to claim 11, further comprising the following step for making the amino silane polymerization initiator compound of Formula 4 or Formula 5:

(ia) reacting a compound of the following Formula 9



Formula 9

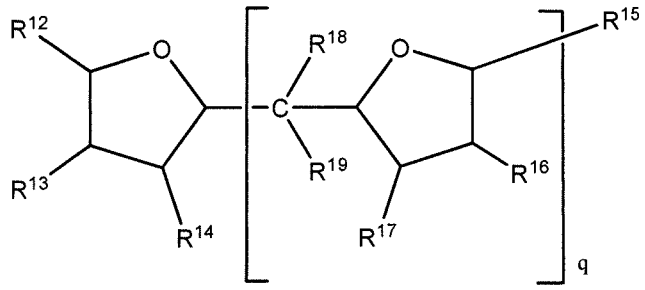
wherein

X is a chlorine atom, a bromine atom or a iodine atom; and

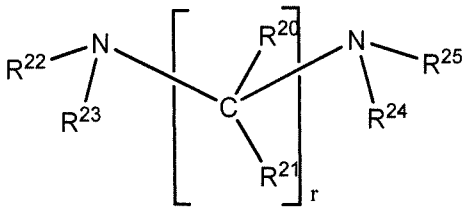
R^{3a}, R^{4a}, R^5, R^6, R^{26} and R^{27} are as defined in claim 11;

an alkali metal selected from lithium, sodium and potassium; and

a compound selected from Formula 10 and Formula 11



Formula 10



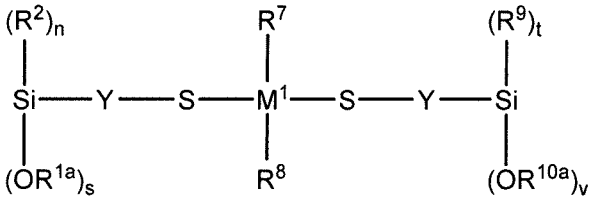
Formula 11

wherein

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25},

q and r are as defined in claim 11.

13. The method according to claim 11, wherein the chain end-modifying compound used in step (ii) has the following Formula 7



Formula 7

wherein

M^1, Y, R^{1a}, R^2, n and s are as generally defined for Formula 6;

R^7, R^8 and R^9 are each independently selected from (C_1-C_{18}) alkyl;

R^{10a} is independently selected from (C_1-C_4) alkyl;

t is selected from an integer of 0, 1 and 2; v is selected from an integer of 1, 2 and 3; and t+v=3.

14. The method according to claim 13, wherein M^2 is lithium.

15. The method according to claim 13, wherein R^{3a} is selected from $-N(R^{28})R^{29}$ and (C_1-C_{18}) alkyl, wherein R^{28} and R^{29} are each independently selected from (C_1-C_{18}) alkyl, (C_6-C_{18}) aryl and (C_7-C_{18}) aralkyl.

16. The method according to claim 13, wherein R^{3a}, R^{4a}, R^{22}, R^{23}, R^{24}, R^{25}, R^{26} and R^{27} are each independently selected from (C_1-C_{18}) alkyl and R^5, R^6, R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and (C_1-C_{18}) alkyl and R^{12}, R^{13}, R^{14}, R^{15}, R^{16} and R^{17} are each independently selected from hydrogen and (C_1-C_6) alkyl.

17. The method according to claim 13, wherein Y is divalent and is (C_1-C_{18}) alkyl.

18. The method according to claim 13, wherein q is 1 and r is 2.

19. The method according to claim 13, wherein s and v are each independently selected from an integer of 2 and 3; and n and t are each independently selected from an integer of 0 and 1.

20. A polymer composition comprising at least one modified macromolecular compound as defined in claim 1 and one or more further components selected from components which are added to or formed as a result of the polymerization process used for making the modified macromolecular compound and components which remain after solvent removal from the polymerization process.

21. The polymer composition according to claim 20, further comprising an oil.

22. The polymer composition according to claim 20 further comprising at least one filler.

23. The polymer composition according to claim 22, wherein the filler is one or more selected from carbon black, silica, carbon-silica dual-phase-filler, clay, calcium carbonate, magnesium carbonate, lignin, and glass particles.

24. The polymer composition according to claim 23, wherein the filler comprises silica.

25. The polymer composition according to claim 20 further comprising a vulcanization agent.

26. The polymer composition according to claim 20, further comprising at least one polymer selected from the group consisting of polybutadiene, butadiene-styrene copolymers, butadiene-isoprene copolymers, polyisoprene and butadiene-styrene-isoprene terpolymers.

27. A vulcanized polymer composition comprising the reaction product of at least the following:

1) at least one vulcanization agent; and

2) the polymer composition as defined in claim 20.

28. A method for making a vulcanized polymer composition comprising reacting at least the following components:

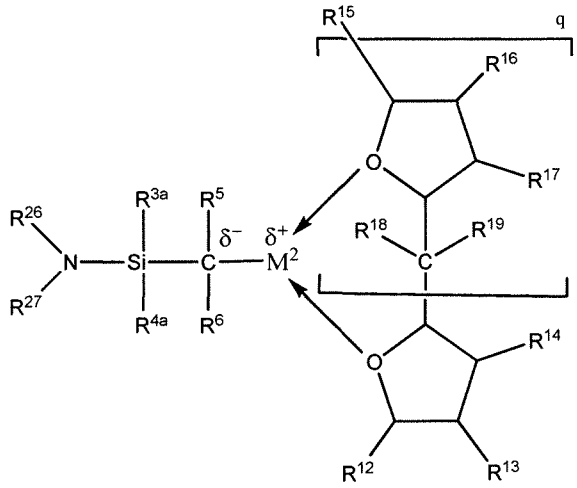
1) at least one vulcanization agent; and

2) the polymer composition as defined in claim 20.

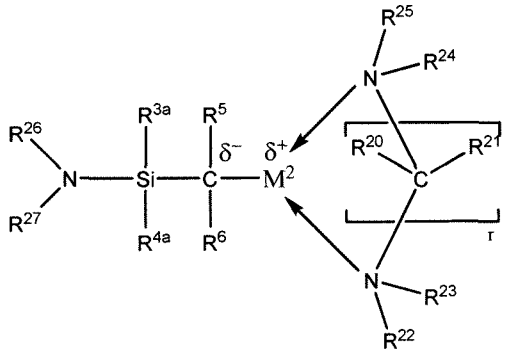
29. An article comprising at least one component formed from the vulcanized polymer composition as defined in claim 27.

30. The article according to claim 29, which is selected from the group consisting of a tire, a tire tread, a tire side wall, a tire carcass, a belt, a hose, a vibration damper, and a footwear component.

31. An amino silane polymerization initiator compound of the following Formula 4 or Formula 5:



Formula 4



Formula 5

or Lewis base adducts thereof, wherein

R^{3a} is independently selected from $-N(R^{28})R^{29}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^{4a} is independently selected from $-N(R^{30})R^{31}$, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

R^5 and R^6 are as defined in claim 1;

M^2 is lithium, sodium or potassium;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from hydrogen, $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

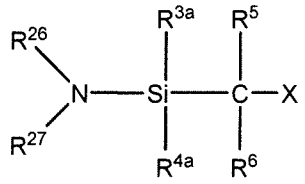
R^{26}, R^{27}, R^{28}, R^{29}, R^{30} and R^{31} are each independently selected from $(C_1\text{-}C_{18})$ alkyl, $(C_6\text{-}C_{18})$ aryl and $(C_7\text{-}C_{18})$ aralkyl;

q is selected from an integer of 1, 2, 3, 4 and 5; and

r is selected from an integer of 1, 2 and 3.

32. A method of making the amino silane polymerization initiator of Formula 4 or Formula 5 as defined in claim 31, said method comprising the step of

reacting a compound of the following Formula 9



Formula 9

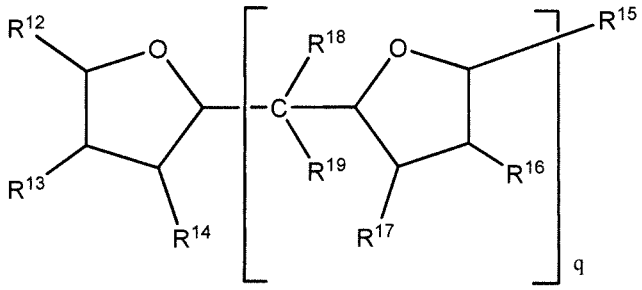
wherein

X is a chlorine atom, a bromine atom or a iodine atom; and

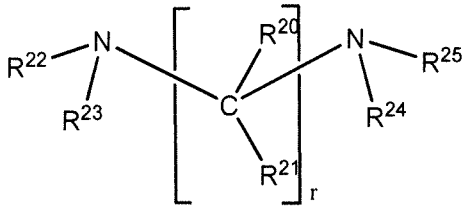
R^{3a}, R^{4a}, R^5, R^6, R^{26} and R^{27} are as defined in claim 31;

an alkali metal selected from lithium, sodium and potassium; and

a compound selected from the following Formula 10 and the following Formula 11



Formula 10



Formula 11

wherein

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20}, R^{21}, R^{22}, R^{23}, R^{24} and R^{25}, q and r are as defined in claim 31.

33. The amino silane polymerization initiator compound according to claim 31, wherein

X is a chlorine or bromine atom;

R^{3a} is selected from $-N(R^{28})R^{29}$ and (C_1-C_{18}) alkyl;

R^{4a} is selected from $-N(R^{30})R^{31}$ and (C_1-C_{18}) alkyl;

R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16} and R^{17} are each independently selected from hydrogen and (C_1-C_6) alkyl;

R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and (C_1-C_{18}) alkyl;

R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from (C_1-C_{18}) alkyl;

R^{26}, R^{27}, R^{28}, R^{29}, R^{30} and R^{31} are each independently selected from (C_1-C_{18}) alkyl; and

q is 1 and r is 2.

34. The amino silane polymerization initiator compound according to claim 33, wherein

X is a chlorine or bromine atom;

R^{3a} is selected from $-N(R^{28})R^{29}$ and (C_1-C_{18}) alkyl;

R^{4a} is selected from (C_1-C_{18}) alkyl;

R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16} and R^{17} are each independently selected from hydrogen and (C_1-C_6) alkyl;

R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and (C_1-C_{18}) alkyl;

R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from (C_1-C_{18}) alkyl;

R^{26}, R^{27}, R^{28} and R^{29} are each independently selected from (C_1-C_{18}) alkyl; and

q is 1 and r is 2.

35. The amino silane polymerization initiator compound according to claim 34, wherein

X is a chlorine atom;

R^{3a} and R^{4a} are selected from (C_1-C_{18}) alkyl;

R^5 and R^6 are each independently selected from hydrogen and (C_1-C_{18}) alkyl;

R^{12}, R^{13}, R^{14}, R^{15}, R^{16}, R^{17}, R^{18}, R^{19}, R^{20} and R^{21} are each independently selected from hydrogen and (C_1-C_4) alkyl;

R^{22}, R^{23}, R^{24} and R^{25} are each independently selected from (C_1-C_4) alkyl;

R^{26} and R^{27} are each independently selected from (C_1-C_{18}) alkyl;

q is 1 and r is 2; and

the alkali metal is lithium.