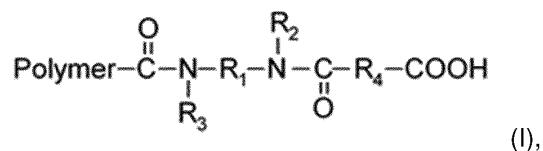


Patent claims:

1. A carboxyterminated polymer according to general formula (I),



5 wherein

the "polymer" contains at least one carbon-carbon double bond;

R₂, R₃ are identical or different and represent saturated or unsaturated organic radicals which may contain one or more heteroatoms; and

10 R₁, R₄ are identical or different and represent saturated or unsaturated divalent organic radicals which, in addition to C and H, may contain one or more heteroatoms.

2. The carboxyterminated polymer according to claim 1, wherein the "polymer" is obtainable by

- homo- or copolymerization of dienes; or
- 15 - copolymerization of dienes with vinylaromatic monomers.

3. The carboxyterminated polymer according to claim 2, wherein the "polymer" is obtainable by

- homo- or copolymerization of 1,3-butadiene, isoprene, 1,3-pentadiene, 2,3-dimethylbutadiene, 1-phenyl-1,3-butadiene or 1,3-hexadiene; or
- 20 - copolymerization of
 - (i) 1,3-butadiene, isoprene, 1,3-pentadiene, 2,3-dimethylbutadiene, 1-phenyl-1,3-butadiene and/or 1,3-hexadiene with
 - (ii) styrene, o-, m- and/or p-methylstyrene, p-tert-butylstyrene, methylstyrene,
 - 25 vinylnaphthalene, divinylbenzene, trivinylbenzene and/or divinylnaphthalene.

4. The carboxyterminated polymer according to claim 3, wherein the "polymer" is obtainable by copolymerization of 1,3-butadiene with styrene; or isoprene with styrene; preferably 1,3-butadiene with styrene.

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5. The carboxyterminated polymer according to any of the preceding claims, wherein

R_2 , R_3 are identical or different and represent saturated or unsaturated organic radicals which may contain one or more heteroatoms independently of one another selected from the group consisting of O, N, S and Si; preferably $-CH_3$; and

R_1 , R_4 are identical or different and represent saturated or unsaturated divalent organic radicals which, in addition to C and H, may contain one or more heteroatoms independently of one another selected from the group consisting of O, N, S and Si; preferably R_1 means $-CH_2-CH_2-$ and R_4 is selected from $-CH_2-CHC_kH_{2k+1}-$ wherein k is an integer of from 8 to 16; $-CH_2CH((CH_2)_{1-5}Si(OC_1-C_4-alkyl)_3)$; $-CH=CC_1-C_4-alkyl-$, and $-(CH_2)_{2-4}-$; more preferably R_1 means $-CH_2-CH_2-$ and R_4 is selected from $-CH_2-CHC_{12}H_{23}-$, $-CH_2CH(CH_2CH_2CH_2Si(OCH_3)_3)$, $-CH=CCH_3-$, and $-CH_2CH_2-CH_2-$.

6. The carboxyterminated polymer according to any of claims 1 to 4, wherein

- R_1 is selected from the group consisting of
 - (i) $-C_1-C_6-alkylene-$, saturated or unsaturated, unsubstituted, mono- or polysubstituted;
 - (ii) $-C_1-C_6-heteroalkylene-$, saturated or unsaturated, unsubstituted, mono- or polysubstituted; and
 - (iii) 6-14-membered arylene, unsubstituted, mono- or polysubstituted;
 and/or
- R_2 is selected from the group consisting of
 - (i) $-C_1-C_{24}-alkyl$, saturated or unsaturated, unsubstituted, mono- or polysubstituted; or
 - (ii) $-C_1-C_{24}-heteroalkyl$, saturated or unsaturated, unsubstituted, mono- or polysubstituted;
 - (iii) 6-24-membered aryl, unsubstituted, mono- or polysubstituted, wherein said 6-24-membered aryl is optionally connected through $-C_1-C_6-alkylene-$ or $-C_1-C_6-heteroalkylene-$, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted;
 - (iv) 5-24-membered heteroaryl, unsubstituted, mono- or polysubstituted; wherein said 5-24-membered heteroaryl is optionally connected through $-C_1-C_6-alkylene-$ or $-C_1-C_6-heteroalkylene-$, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted;
 - (v) 3-24-membered cycloalkyl, saturated or unsaturated, unsubstituted, mono- or polysubstituted; wherein said 3-24-membered cycloalkyl is optionally connected

through -C₁-C₆-alkylene- or -C₁-C₆-heteroalkylene-, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted; and

- (vi) 3-24-membered heterocycloalkyl, saturated or unsaturated, unsubstituted, mono- or polysubstituted; wherein said 3-24-membered heterocycloalkyl is optionally connected through -C₁-C₆-alkylene- or -C₁-C₆-heteroalkylene-, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted;

and/or

- R₃ is selected from the group consisting of

- (i) -C₁-C₂₄-alkyl, saturated or unsaturated, unsubstituted, mono- or polysubstituted;

- (ii) -C₁-C₂₄-heteroalkyl, saturated or unsaturated, unsubstituted, mono- or polysubstituted;

- (iii) 6-24-membered aryl, unsubstituted, mono- or polysubstituted, wherein said 6-24-membered aryl is optionally connected through -C₁-C₆-alkylene- or -C₁-C₆-heteroalkylene-, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted;

- (iv) 5-24-membered heteroaryl, unsubstituted, mono- or polysubstituted; wherein said 5-24-membered heteroaryl is optionally connected through -C₁-C₆-alkylene- or -C₁-C₆-heteroalkylene-, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted;

- (v) 3-24-membered cycloalkyl, saturated or unsaturated, unsubstituted, mono- or polysubstituted; wherein said 3-24-membered cycloalkyl is optionally connected through -C₁-C₆-alkylene- or -C₁-C₆-heteroalkylene-, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted; and

- (vi) 3-24-membered heterocycloalkyl, saturated or unsaturated, unsubstituted, mono- or polysubstituted; wherein said 3-24-membered heterocycloalkyl is optionally connected through -C₁-C₆-alkylene- or -C₁-C₆-heteroalkylene-, in each case saturated or unsaturated, unsubstituted, mono- or polysubstituted;

and/or

- R₄ is selected from the group consisting of

- (i) -C₁-C₆-alkylene-, saturated or unsaturated, unsubstituted, mono- or polysubstituted;

- (ii) -C₁-C₆-heteroalkylene-, saturated or unsaturated, unsubstituted, mono- or polysubstituted; and

(iii) 6-14-membered arylene, unsubstituted, mono- or polysubstituted;

wherein "*mono- or polysubstituted*" in each case independently means substituted with one or more substituents independently of one another selected from -F, -Cl, -Br, -I, -CN, =O, -CF₃, -CF₂H, -CFH₂, -CF₂Cl, -CFCl₂, -C₁-C₁₈-alkyl, saturated or unsaturated, unsubstituted and -C₁-C₁₈-heteroalkyl, saturated or unsaturated, unsubstituted.

7. The carboxyterminated polymer according to claim 6, wherein

- R₁ is (i) -C₁-C₆-alkylene-, saturated or unsaturated, unsubstituted; or (ii) -C₁-C₃-alkylene, saturated or unsaturated, unsubstituted; and/or
- R₂ is (i) -C₁-C₆-alkyl, saturated or unsaturated, unsubstituted; or (ii) -C₁-C₂-alkyl, saturated or unsaturated, unsubstituted; and/or
- R₃ is (i) -C₁-C₆-alkyl, saturated or unsaturated, unsubstituted; or (ii) -C₁-C₂-alkyl, saturated or unsaturated, unsubstituted; and/or
- R₄ is (i) -C₁-C₆-alkylene-, saturated or unsaturated, unsubstituted, mono- or polysubstituted; or (ii) -C₁-C₃-alkylene-, saturated or unsaturated, unsubstituted, mono- or polysubstituted;

wherein in each case "*mono- or polysubstituted*" means substituted with one or more substituents independently of one another selected from

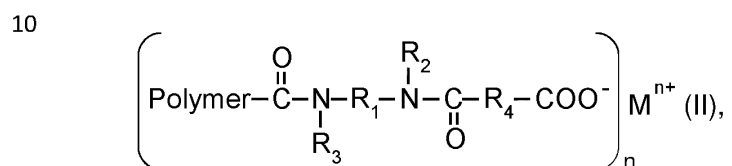
-F, -Cl, -Br, -I, -CN, -CF₃, -CF₂H, -CFH₂, -CF₂Cl, -CFCl₂,
 -C₁-C₁₈-alkyl, saturated or unsaturated, unsubstituted, and
 -C₁-C₁₈-heteroalkyl, saturated or unsaturated, unsubstituted.

8. The carboxyterminated polymer according to any of the preceding claims, wherein

- the "polymer" is obtainable by copolymerization of 1,3-butadiene with styrene;
- R₁ is -C₁-C₃-alkylene-, saturated or unsaturated, unsubstituted; preferably -CH₂CH₂-;
- R₂ is -C₁-C₂-alkyl, saturated or unsaturated, unsubstituted; preferably -CH₃;
- R₃ is -C₁-C₂-alkyl, saturated or unsaturated, unsubstituted; preferably -CH₃; and
- R₄ is -C₁-C₃-alkylene-, saturated or unsaturated, unsubstituted, mono- or polysubstituted; preferably R₄ is selected from -CH₂-CHC_kH_{2k+1}- wherein k is an integer of from 8 to 16; -CH₂CH((CH₂)₁₋₅Si(OC₁-C₄-alkyl)₃); -CH=CC₁-C₄-alkyl-, and -(CH₂)₂₋₄-; more preferably R₄ is selected from -CH₂-CHC₁₂H₂₃-, -CH₂CH(CH₂CH₂CH₂Si(OCH₃)₃), -CH=CCH₃-, and -CH₂CH₂-CH₂-;

wherein in each case "*mono- or polysubstituted*" means substituted with one or more substituents independently of one another selected from -C₁-C₁₈-alkyl, saturated or unsaturated, unsubstituted, and -C₁-C₁₈-heteroalkyl, saturated or unsaturated, unsubstituted; preferably selected from -C₁-C₁₈-alkyl, saturated or unsaturated, unsubstituted or -C₁-C₆-alkyl-Si(O-C₁-C₆-alkyl)₃ saturated or unsaturated, unsubstituted.

9. The carboxyterminated polymer according to any of the preceding claims, which is present as a carboxylate according to general formula (II),



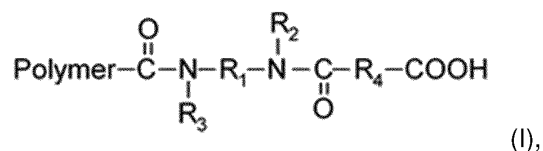
wherein

"polymer", R₁, R₂, R₃ and R₄ are as defined in any of the preceding claims;

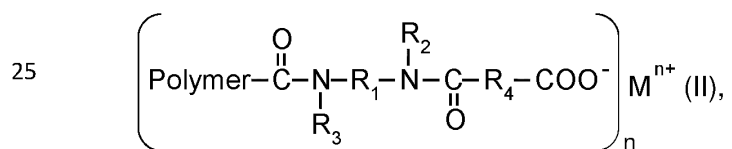
n is an integer from 1 to 4; and

M is a metal or semi-metal of valency 1 to 4, preferably Li, Na, K, Mg, Ca, Zn, Fe, Co, Ni, Al, Nd, Ti, Sn, Si, Zr, V, Mo or W.

10. A method for the preparation of a carboxyterminated polymer according to general formula (I),



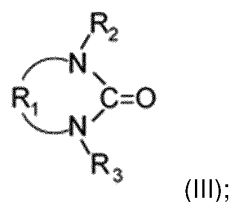
or of a carboxylate according to general formula (II),



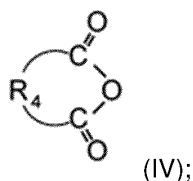
the method comprising the following steps of:

(a) providing a "polymer" containing at least one carbon-carbon double bond;

(b) providing a cyclic urea derivative of the general formula (III)



(c) providing a cyclic carboxylic anhydride of the general formula (IV)



- 5 (d) adding the cyclic urea derivative of general formula (III) to the "polymer" as a first functionalization reagent to form a functionalized polymer intermediate; and
- (e) subsequently adding the cyclic carboxylic anhydride of the general formula (IV) to the functionalized polymer intermediate as a second functionalization reagent to form the carboxyterminated polymer according to general formula (I) or the carboxylate according to general formula (II);

10 wherein "polymer", n, M, R₁, R₂, R₃ and R₄ are as defined in any of claims 1 to 9.

11. The method according to claim 10, wherein step (a) is performed by

- an anionic solution polymerization, or
 - a polymerization using a coordination catalyst, wherein the coordination catalyst is
- 15 preferably a Ziegler-Natta catalyst or a monometallic catalyst system.

12. The method according to claim 10 or 11, wherein step (a) is performed in the presence of

- a solvent, wherein the solvent is preferably selected from the group consisting of
- 20 cyclohexane, methylcyclopentane, n-hexane and mixtures thereof; and/or
- an initiator, which is preferably n-butyllithium or sec-butyllithium.

13. The method according to any of claims 10 to 12, wherein step (a) is performed within a period of 10 minutes to 8 hours, preferably 20 minutes to 4 hours.

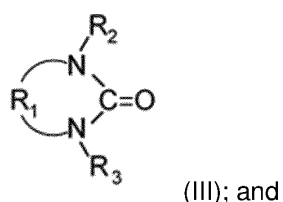
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14. The method according to any of claims 10 to 13, which comprises the additional step(s) of adding

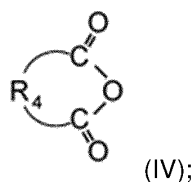
- (f) a coupling reagent before, together with or after addition of the cyclic urea derivative of general formula (III), wherein the coupling reagent is preferably selected from the group consisting of silicon tetrachloride, methyltrichlorosilane, dimethyldichlorosilane, tin tetrachloride, dibutyltin dichloride, tetraalkoxysilanes, ethylene glycol diglycidyl ether and 1,2,4-tris(chloromethyl)benzene; and/or
- (g) an antioxidant after the cyclic urea derivative of the general formula (III) and the cyclic carboxylic anhydride of general formula (IV) have been added, wherein the antioxidant is preferably selected from the group consisting of sterically hindered phenols, aromatic amines, phosphites and thioethers; and/or
- (h) an extender oil, wherein the extender oil is preferably selected from the group consisting of a TDAE (Treated Distillate Aromatic Extract)-, a MES (Mild Extraction Solvates)-, a RAE (Residual Aromatic Extract)-, a TRAE (Treated Residual Aromatic Extract)-, a naphthenic and a heavy naphthenic oil; and/or
- (i) a filler, which is preferably carbon black or silica; and/or
- (j) rubbers and/or rubber additives.

15. Successive use of

- a cyclic urea derivative of the general formula (III) as a first functionalization reagent

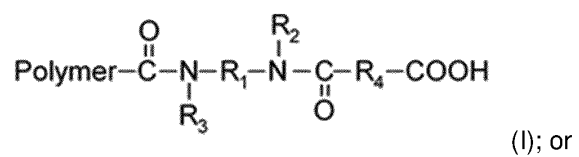


- a cyclic carboxylic anhydride of the general formula (IV) as a subsequent second functionalization reagent

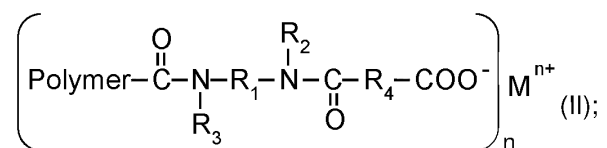


for the preparation of a

- carboxyterminated polymer according to general formula (I),



- a carboxylate according to formula (II),



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wherein in each case "polymer", n , M , R_1 , R_2 , R_3 and R_4 are as defined in any of claims 1 to 9.