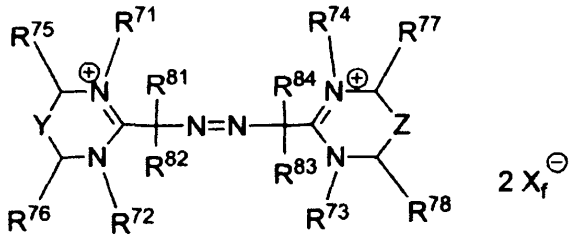
CLAIMS

1. A method for producing a gel particle, comprising performing radical polymerization reaction involving the cationic polymerization initiator having a chemical structure represented by General formula (I):



(I)

[wherein

Y represents a single bond,

Z represents a single bond,

R^{72}, R^{73}, R^{75}, R^{76}, R^{77} and R^{78} are each independently selected from the group consisting of hydrogen atom, and C_{1-6} alkyl group,

R^{81}, R^{82}, R^{83} and R^{84} are C_{1-4} alkyl group,

R^{71} and R^{74} each independently are C_{1-3} alkyl group, and

X_f^- is counter anion.],

and a monomer comprising carbon-carbon double bonds, and a crosslinker.

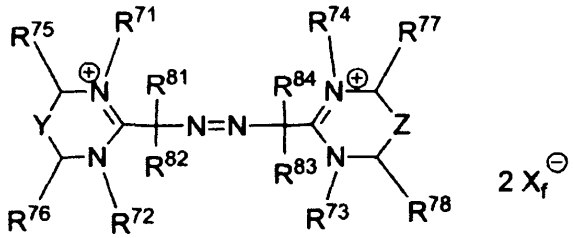
2. The method according to claim 1, wherein said R^{81}, R^{82}, R^{83}, and R^{84} are each independently selected from the group consisting of methyl group, ethyl group, and isobutyl group.

3. The method according to claim 1 or 2, wherein said R^{71} and R^{74} are a methyl group.

4. The method according to any one of claims 1 to 3, wherein said R^{72} and R^{73}, said R^{75} and R^{77}, said R^{76} and R^{78}, said R^{81} and R^{84}, said R^{82} and R^{83}, and said R^{71} and R^{74}, each represent an identical substituent.

5. The method according to claim 1, wherein said R^{71}, R^{72}, R^{73}, R^{74}, R^{81}, R^{82}, R^{83}, and R^{84} are a methyl group, and said R^{75}, R^{76}, R^{77} and R^{78} are a hydrogen atom, and said Y and Z are a single bond.

6. A method for producing a linear polymer at least one end of which is positively charged, comprising conducting a radical polymerization reaction using the cationic polymerization initiator having a chemical structure represented by General formula (I):



(I)

[wherein

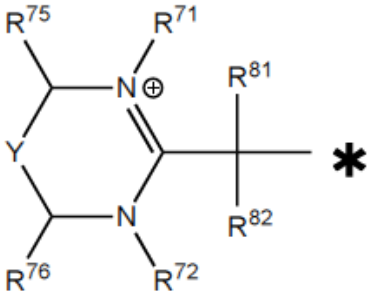
R^{71} and R^{74} are selected from C_{1-3} alkyl group,

R^{72} and R^{73} are selected from C_{1-6} alkyl group,

Y, Z, R^{75}, R^{76}, R^{77}, R^{78}, R^{81}, R^{82}, R^{83}, R^{84} and X_f^- are as defined in any one of claims 1 to 5.],

and a monomer comprising a carbon-carbon double bond.

7. A linear polymer at least one end of which is positively charged, consisting of a copolymer comprising a structure derived from a cationic polymerization initiator represented by formula (I'):

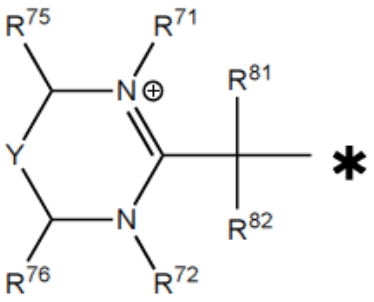


(I')

[wherein Y, R^{72}, R^{75}, R^{76}, R^{81}, R^{82}, and R^{71} are as defined in claim 6.]

on at least one end of the main chain, and subsequent repeat structures derived from a monomer comprising a carbon-carbon double bond.

8. A copolymer, comprising a structure derived from a cationic polymerization initiator represented in formula (I'):

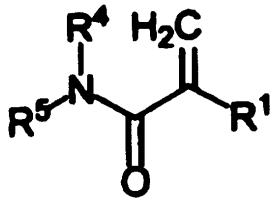


(I')

[wherein Y, R^{72}, R^{75}, R^{76}, R^{81}, R^{82}, and R^{71} are as defined in any one of claims 1 to 5.]

on at least one of the ends of a main chain,

subsequent repeat structures each derived from the corresponding monomers represented by formula (a) and formula (b):



(a)

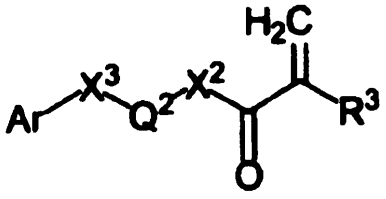
[wherein

R^1 is selected from hydrogen atom and C_{1-3} alkyl group;

R^4 and R^5 are independently selected from hydrogen atom and C_{1-20} alkyl group, wherein the alkyl group is optionally substituted with one or more substituents selected from hydroxyl group, C_{1-6} alkoxy group and aryl group, or

R^4 and R^5, together with nitrogen atom which is bonded to R^4 and R^5, form a 4-8 membered nitrogen-containing heterocycle, wherein the heterocycle is optionally substituted with one or more

substituents selected from C_{1-6} alkyl group, C_{1-6} alkoxy group, nitro group, halogen atom, C_{1-10} alkylcarbonylamino group and arylcarbonylamino group], and



(b)

[wherein

R^3 is selected from hydrogen atom and C_{1-3} alkyl group;

X^2 is O, S or N-R^{12};

X^3 is a direct bond, O, S, SO, SO_2, N(-R^{13}), CON(-R^{16}), N(-R^{16})CO, N(-R^{17})CON(-R^{18}), SO_2N(-R^{19}) or N(-R^{19})SO_2;

Q^2 is selected from C_{1-20} alkylene group, C_{3-20} alkenylene group and C_{3-20} alkynylene group, wherein O, S or phenylene group optionally is independently inserted to the alkylene group at one or more positions;

Ar is selected from 6-18 membered aromatic carbocyclic group or 5-18 membered aromatic heterocyclic group, wherein one or more rings contained in the aromatic carbocyclic group and the aromatic heterocyclic group may include a condensed ring which is an aromatic ring, and -CH_2- present as a ring atom in the aromatic carbocyclic ring group and the aromatic heterocyclic group is optionally substituted with -C(O)-, and the aromatic carbocyclic ring group and the aromatic heterocyclic group are optionally substituted with one or more substituents selected from halogen atom, C_{1-6} alkyl group, C_{1-6} alkoxy group, C_{1-6} alkylthio group, C_{1-6} alkylsulfinyl group, C_{1-6} alkylsulfonyl group, nitro group, cyano group, C_{1-6} alkylcarbonyl group, C_{1-6} alkoxycarbonyl group, carboxyl group, formyl group, -NR^6R^7 and -$SO_2NR^{14}R^{15}$ (wherein an alkyl group included in the C_{1-6} alkyl group, C_{1-6} alkoxy group, C_{1-6} alkylthio group, C_{1-6} alkylsulfinyl group, C_{1-6} alkylsulfonyl group, C_{1-6} alkylcarbonyl group and C_{1-6} alkoxycarbonyl group is optionally substituted with one or more substituents selected from halogen atom, C_{1-6} alkoxy group, hydroxyl group, amino group, C_{1-6} alkylamino group, di(C_{1-6} alkyl)amino group,

aryl group and carboxyl group);

R^6 and R^7 are independently selected from hydrogen atom, C_{1-10} alkyl group, aryl group, C_{1-10} alkylcarbonyl group, arylcarbonyl group, C_{1-10} alkylsulfonyl group, arylsulfonyl group, carbamoyl group, N-(C_{1-10} alkyl)carbamoyl group and N,N-di(C_{1-10} alkyl)carbamoyl group, wherein an alkyl group included in the C_{1-10} alkyl group, C_{1-10} alkylcarbonyl group, C_{1-10} alkylsulfonyl group, N-(C_{1-10} alkyl)carbamoyl group and N,N-di(C_{1-10} alkyl)carbamoyl group is optionally substituted with one or more substituents selected from halogen atom, C_{1-6} alkoxy group, hydroxyl group, amino group, C_{1-6} alkylamino group, di(C_{1-6} alkyl)amino group, aryl group and carboxyl group, and further an aryl group included in the aryl group, arylcarbonyl group and arylsulfonyl group is optionally substituted with one or more substituents selected from halogen atom, C_{1-6} alkyl group, C_{1-6} alkoxy group and carboxyl group; or

R^6 and R^7, together with nitrogen atom which is bonded to R^6 and R^7, form 4-8 membered nitrogen-containing heterocycle, wherein the heterocycle is optionally substituted with one or more substituents selected from C_{1-6} alkyl group, C_{1-6} alkoxy group, nitro group, halogen atom, C_{1-10} alkylcarbonylamino group and arylcarbonylamino group;

R^{12} is hydrogen atom, C_{1-6} alky group or -Q^2-X^3-Ar, wherein the alkyl group is optionally substituted with one or more substituents selected from hydroxyl group, halogen atom, C_{1-6} alkoxy group, C_{1-6} alkylthio group, C_{1-6} alkylsulfinyl group and C_{1-6} alkylsulfonyl group;

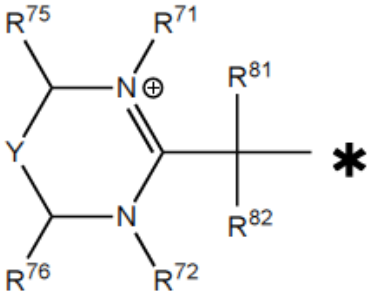
R^{13} is hydrogen atom or C_{1-6} alkyl group, wherein the alkyl group is optionally substituted with one or more substituents selected from hydroxyl group, halogen atom, C_{1-6} alkoxy group, C_{1-6} alkylthio group, C_{1-6} alkylsulfinyl group and C_{1-6} alkylsulfonyl group;

R^{14} and R^{15} are independently selected from hydrogen atom and C_{1-6} alkyl group; or R^{14} and R^{15}, together with nitrogen atom which is bonded to R^{14} and R^{15}, form 4-8 membered nitrogen-containing heterocycle;

R^{16}, R^{17}, R^{18} and R^{19} are independently selected from hydrogen atom and C_{1-6} alkyl group, wherein the alkyl group is optionally substituted with one or more substituents selected from hydroxyl

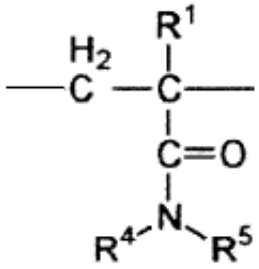
group, halogen atom, C_{1-6} alkoxy group, C_{1-6} alkylthio group, C_{1-6} alkylsulfinyl group and C_{1-6} alkylsulfonyl group.],
and a cross-linked structure derived from a crosslinker.

9. A copolymer, comprising a terminal structure represented by formula (I'), repeat units represented by formula (A) and formula (B):



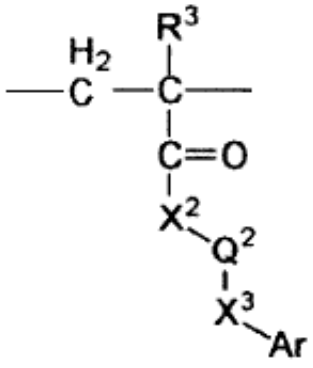
(I')

[wherein Y, R^{72}, R^{75}, R^{76}, R^{81}, R^{82}, and R^{71} are as defined in any one of claims 1 to 5.],



(A)

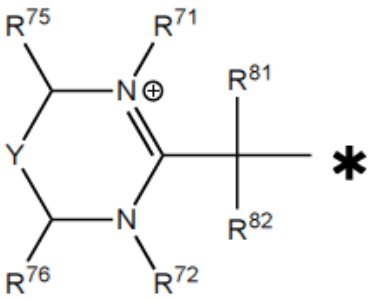
[wherein R^1, R^4 and R^5 are as defined in claim 8],



(B)

[wherein R^3, X^2, X^3, Q^2 and Ar are as defined in claim 8],
and a cross-linked structure derived from a crosslinker.

10. A copolymer, comprising a structure derived from a cationic polymerization initiator represented by formula (I'):

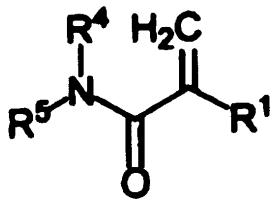


(I')

[wherein Y, R^{72}, R^{75}, R^{76}, R^{81}, R^{82}, and R^{71} are as defined in any one of claims 1 to 5.]

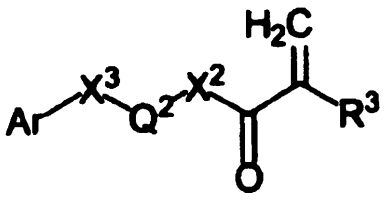
on at least one of the ends of a main chain,

subsequent repeat structures each derived from a monomer represented by formula (a), a monomer represented by formula (b), and a monomer represented by formula (c):



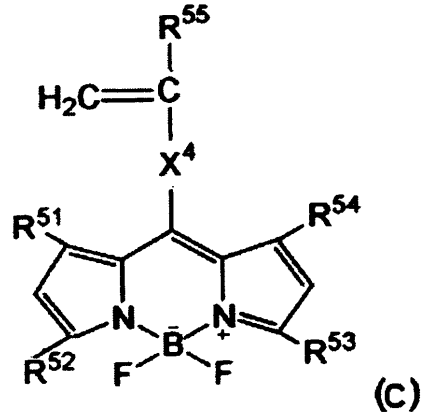
(a)

[wherein R^1, R^4 and R^5 are as defined in claim 8],



(b)

[wherein R^3, X^2, X^3, Q^2 and Ar are as defined in claim 8], and



(C)

[wherein

R^{55} is selected from hydrogen atom and C_{1-3} alkyl group;

R^{51}, R^{52}, R^{53} and R^{54} are independently selected from hydrogen atom and C_{1-6} alkyl group;

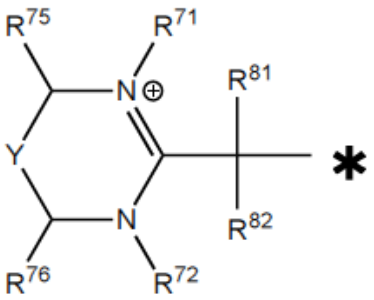
X^4 is a direct bond, phenylene group, -Q^4-O-C(=O)- (wherein Q^4 is directly bonded to the borondipyrromethene skeleton), -Q^4-N(-R^{61})-C(=O)- (wherein Q^4 is directly bonded to the borondipyrromethene skeleton);

R^{61} is selected from hydrogen atom and C_{1-6} alkyl group;

Q^4 is selected from C_{1-20} alkylene group, phenylene group and naphthylene group, wherein the phenylene group and the naphthylene group are optionally substituted with one or more substituents selected from halogen atom, C_{1-6} alkoxy group, hydroxyl group, amino group and carboxyl group],

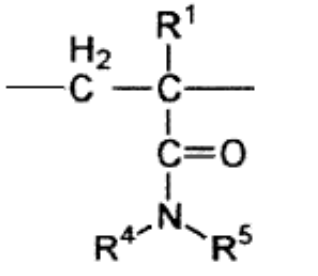
and a cross-linked structure derived from a crosslinker.

11. A copolymer, comprising a terminal structure represented by formula (I'), repeat units represented by formula (A), formula (B) and formula (C):



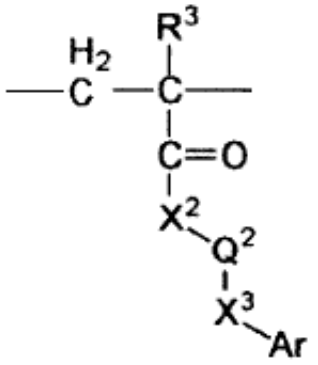
(I')

[wherein Y, R^{72}, R^{75}, R^{76}, R^{81}, R^{82}, and R^{71} are as defined in any one of claims 1 to 5.],



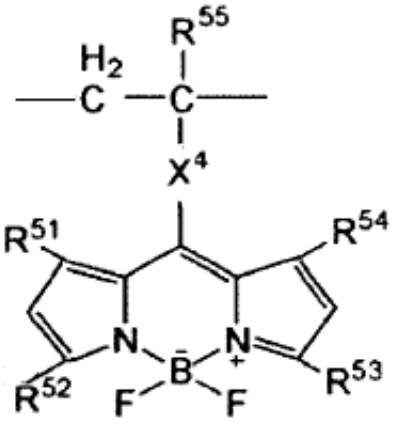
(A)

[wherein R^1, R^4 and R^5 are as defined in claim 8],



(B)

[wherein R^3, X^2, X^3, Q^2 and Ar are as defined in claim 8],



(C)

[wherein R^{55}, R^{51}, R^{52}, R^{53}, R^{54} and X^4 are as defined in claim 10],

and a cross-linked structure derived from a crosslinker.

12. A temperature-sensitive probe, comprising the copolymer according to any one of claims 8 to 11.

13. A method for measuring intracellular temperature, comprising the steps of:
(a) introducing the temperature-sensitive probe according to claim 12 into a cell; and
(b) measuring fluorescence intensity or fluorescence lifetime under irradiation of excitation light
(excluding the case where a human is diagnosed by introducing the temperature-sensitive probe into human cells in vivo).

14. A kit for measuring intracellular temperature, comprising the copolymer according to any one of claims 8 to 11, or the temperature-sensitive probe according to claim 12.