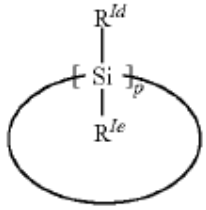
Patent Claims

1. A block copolymer comprising: a linear or cyclic block A having a polysilane skeleton comprisingprepared by irradiating irradiated with light a cyclic polysilane having the formula (I-4) whereby some of the cyclic polysilane skeleton has undergone ring opening:

(I-4)

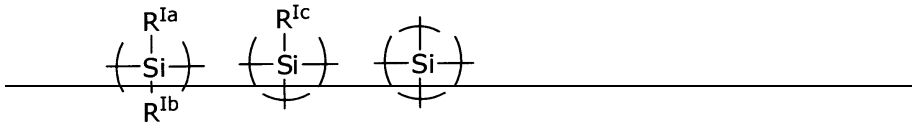


wherein R^{Id} and R^{Ie} are each independently hydrogen, halogen, C_{1-6} alkyl, C_{6-10} aryl or a single bond, provided that at least one of R^{Id} and R^{Ie} is a single bond, and p is an integer of 5 or more silicon; and

and wherein the cyclic block A is selected from the group consisting of silyl cyclopentasilane, silyl cyclohexasilane, disilyl cyclohexasilane and cyclohexasilane, and a block B having a polysilazane skeleton comprising 20 or more silicon, wherein at least one silicon in the block A and at least one silicon in the block B are connected by a single bond and/or a crosslinking group comprising silicon.

2. The block copolymer according to claim 1,

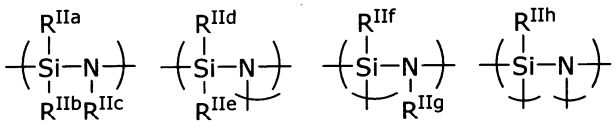
wherein the block A comprises 5 or more repeating units selected from the group consisting of the following formulae (I-1) to (I-3):



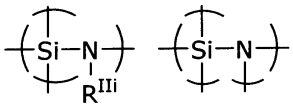
(I-1) (I-2) (I-3)

(wherein R^{Ia}, R^{Ib}, and R^{Ic} are each independently hydrogen, halogen, C_{1-6} alkyl or C_{6-10} aryl), and

wherein the block B comprises 20 or more repeating units selected from the group consisting of the following formulae (II-1) to (II-6):



(II-1) (II-2) (II-3) (II-4)



(II-5) (II-6)

~~(wherein R^{IIa} to R^{IIi} are each independently hydrogen or C_{1-4} alkyl).~~

~~3. The block copolymer according to claim 1 or 2, wherein the mass average molecular weight of the block polymer is 1,100 to 25,000.~~

~~4. The block copolymer according to any one of claims 1 to 3, wherein the ratio of the number of N atoms containing in the molecule to that of Si atoms containing in the molecule is 25 to 95%.~~

~~5. The block copolymer according to any one of claims 1 to 4, wherein the ratio of the total number of the repeating units of formulae (I-1) to (I-3) to that of the repeating units of the formulae (II-1) to (II-6) containing in the molecule is 8 to 100%.~~

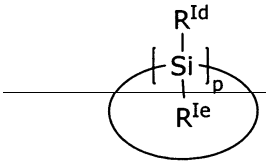
~~6. The block copolymer according to any one of claims 1 to 5, wherein all of R^{Ia}, R^{Ib} and R^{Ic} in the block A are hydrogen.~~

~~7. The block copolymer according to any one of claims 1 to 6, wherein all of R^{IIa} to R^{IIi} in the block B are hydrogen.~~

~~8. The block copolymer according to any one of claims 1 to 7~~, wherein the block copolymer comprises a main chain comprising the block B and a side chain comprising the block A.

~~9.~~ 2. The block copolymer according to ~~any one of claims~~claim 1 ~~to 8~~, wherein ~~at least one~~the mass average molecular weight of the block ~~A~~polymer

is ~~represented by the following formula (I-4):~~1,100 to 25,000.



(I-4)

~~(wherein R^{Id} and R^{Ie} are each independently hydrogen, halogen, C_{1-6} alkyl, C_{6-10} aryl or a single bond, provided that at least one of R^{Id} and R^{Ie} is a single bond, and~~

~~p is an integer of 5 or more).~~

~~10.~~

3. The block copolymer according to ~~any one of claims 1 to 9, wherein between~~ claim 1, wherein the ratio of the number of N atoms contained in the copolymer to that of Si atoms contained in the copolymer is 25 to 95%.

4. The block copolymer according to claim 1, wherein the block A and another block A, ~~between~~ the block B and another block B, or ~~between~~ the block A and the block B ~~is~~are connected by a crosslinking group comprising silicon.

~~11.~~ 5. The block copolymer according to claim 1, wherein the cyclic block A is cyclohexasilane.

6. A method for producing the block copolymer ~~according to any one of claims 1 to 10,~~ comprising:

a linear or cyclic block A having a polysilane skeleton comprising 5 or more silicon; and

a block B having a polysilazane skeleton comprising 20 or more silicon, wherein at least one silicon in the block A and at least one silicon in the block B are connected by a single bond and/or a crosslinking group comprising silicon, comprising:

(A) a step of irradiating a cyclic polysilane comprising 5 or more silicon with light;

(B) a step of preparing a mixture comprising the light-irradiated cyclic polysilane comprising 5 or more silicon and a polysilazane comprising 20 or

more silicon~~; and~~ and a crosslinking agent comprising halogenated silane compound; and

(C) a step of irradiating said mixture with light.

~~12.~~ 7. The method according to claim ~~11~~6, wherein said mixture in the step (B) further comprises a crosslinking agent comprising silicon.

~~13.~~ 8. The method according to claim ~~11 or 12~~6, wherein the mass average molecular weight of said polysilazane is 900 to 15,000.

~~14.~~ 9. The method according to claim ~~12 or 13, wherein said crosslinking agent is a halogenated silane compound.~~

~~15. The method according to any one of claims 11 to 14~~6, wherein the wavelength of the light in said step (C) is 172 to 405 nm.

~~16.~~ 10. The method according to ~~any one of claims 11 to 15~~claim 6, wherein the light energy in said step (C) is 25 to 500 J/~~cm~~^{2}cm.sup.2.

~~17.~~ 11. The method according to ~~any one of claims 11 to 16~~claim 6, wherein said steps (A) to (C) are performed under an inert gas atmosphere.

12. The method according to claim 6, wherein the cyclic polysilane is selected from the group consisting of silyl cyclopentasilane, silyl cyclohexasilane, disilyl cyclohexasilane and cyclohexasilane.

13. The method according to claim 6, wherein the cyclic polysilane is cyclohexasilane.