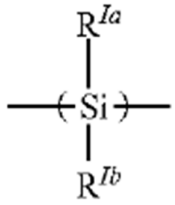
Patent Claims

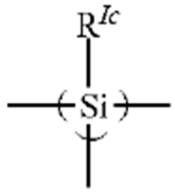
1. A method for producing a siliceous film, comprising:
applying a siliceous film forming composition comprising:
(a) a block copolymer comprising a linear and/or cyclic block A having a polysilane skeleton comprising 5 or more silicon and a block B having a polysilazane skeleton comprising 20 or more 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, and
(b) a solvent,
wherein the content of nitrogen in the block copolymer is 8 to 25 mass % based on the total mass of the block copolymer,
onto a substrate to form a coating film,
irradiating light having the wavelength of 248 to 436 nm after formation of the coating film, and
heating the coating film in an oxidizing atmosphere.

2. The method 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

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

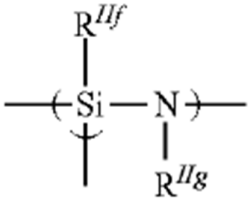
(II-1)



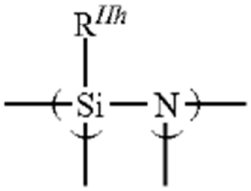
(II-2)



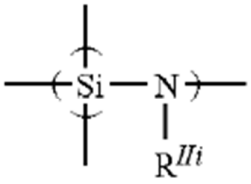
(II-3)



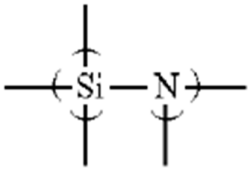
(II-4)



(II-5)



(II-6)



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

3. The method according to claim **1**, wherein the mass average molecular weight of the block copolymer is 1,100 to 25,000.

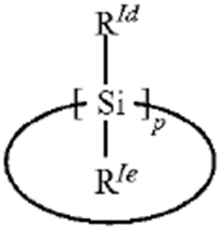
4. The method according to claim **2**, wherein all of R^{Ia}, R^{Ib} and R^{Ic} in the block A are hydrogen.

5. The method according to claim **2**, wherein all of R^{IIa} to R^{IIi} in the block B are hydrogen.

6. The method according to claim **1**, wherein the block copolymer comprises a main chain comprising the block B and a side chain comprising the block A.

7. The method according to claim **1**, wherein at least one of the block A is represented by the following formula (I-4):

(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.

8. The method according to claim **1**, wherein between the block A and another block A, between the block B and another block B, or between the block A and the block B in the block copolymer is connected by a crosslinking group comprising silicon.

9. The method according to claim **1**, wherein the relative dielectric constant of the solvent is 3.0 or less.

10. The method according to claim **1**, wherein the oxidizing atmosphere comprises oxygen at a pressure of 20 to 101 kPa and water vapor at a pressure of 0.5 to 101 kPa.

11. The method according to claim **1**, wherein the heating is performed at 200 to 1,000° C.

12. An electronic device, comprising the siliceous film produced by the method according to claim **1**.

13. The method according to claim **2**, wherein the block A in one molecule is 1 to 95 and the number of the repeating units in one block B is 20 to 330.

14. The method according to claim **2**, wherein the block A in one molecule is 3 to 90 and the number of the repeating units in one block B is 20 to 130.

15. The method according to claim **2**, wherein the block A is linear, the total number of repeating units of the formulae (I-1) to (I-3) constituting one block A is 5 to 20.

16. The method according to claim **2**, wherein the block A is linear, the total number of repeating units of the formulae (I-1) to (I-3) constituting one block A is 5 to 15.

17. The method according to claim **1**, wherein the content of nitrogen in the block copolymer is 8 to 25 mass % based on the total mass of the block copolymer.