10 nm, at low temperatures (between 333 K and 603 K, and preferably between 373 K and 603 K).

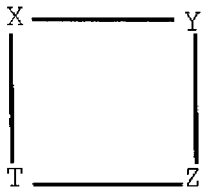
- The presence of entities resulting from monomers of the family of (I) silicon or germanium carbide precursors after plasma treatment or treatment by pyrolysis that makes it possible to obtain hard masks during the mask etching step.

- The orientation of the domains during the self-assembly of such block copolymers does not require preparation of the support (no neutralization layer), the orientation of the domains being governed by the thickness of the block copolymer film deposited.

Thus, these materials show a very great advantage for applications in nanolithography for the production of etching masks of very small dimensions and that have a good etching contrast, and also the production of porous membranes or else as catalyst support.

Summary:
There is provided a nanostructured assembly process using a composition comprising a block copolymer, at least one of the blocks of which consists of at least one monomer corresponding to the following formula (I):

I=



where X= $Si(R_1,R_2)$; $Ge(R_1,R_2)$

Z= $Si(R_3,R_4)$; $Ge(R_3,R_4)$; O; S; $C(R_3,R_4)$

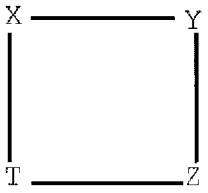
Y= O; S; $C(R_5,R_6)$

T= O; S; $C(R_7,R_8)$

with R_1= R_2 and R_3 = R_4 and R_5 = R_6 and R_7 = R_8 are selected from hydrogen, linear, branched or cyclic alkyl groups, with or without heteroatoms, and aromatic groups with or without heteroatoms and comprising the following steps:

- dissolving the block copolymer in a solvent,
- depositing this solution on a surface,
- annealing.

In an aspect, there is provided a nanostructured assembly process using a composition comprising a block copolymer, at least one of the blocks of which consists of at least one monomer corresponding to the following formula (I):

I= 

where X= $Si(R_1,R_2)$; $Ge(R_1,R_2)$

Z= $Si(R_3,R_4)$; $Ge(R_3,R_4)$; O; S; $C(R_3,R_4)$

Y= O; S; $C(R_5,R_6)$

T= O; S; $C(R_7,R_8)$

with R_1= R_2 and R_3 = R_4 and R_5 = R_6 and R_7 = R_8 are selected from hydrogen, linear, branched or cyclic alkyl groups, with or without heteroatoms, and aromatic groups with or without heteroatoms and comprising the following steps:

- dissolving the block copolymer in a solvent,
- depositing this solution on a surface,
- annealing allowing orientation of the block copolymer,

wherein the surface is selected from the group consisting of silicon, silicon having a native or thermal oxide layer, hydrogenated or halogenated silicon, germanium, hydrogenated or halogenated germanium, platinum and platinum oxide, tungsten and oxides, gold, titanium nitrides and graphenes.

In another aspect, there is provided the use of the process as defined above, in the field of lithography, or more generally in the field of surface nanostructuring for electronics.

In another aspect, there is provided a block copolymer mask obtained by the process as defined above.

Detailed description:

The term "surface" is understood to mean a surface which can be flat or non-flat.

The term "annealing" is understood to mean a step of heating at a certain temperature that enables the evaporation of the solvent, when it is present, and that allows the establishment of the desired nanostructuring in a given time (self-assembly).

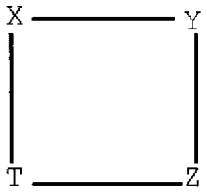
The term "annealing" is also understood to mean the establishment of the nanostructuring of the block copolymer film when said film is subjected to a controlled atmosphere of one or more solvent vapors, these vapors giving the polymer chains sufficient mobility to become organized by

themselves on the surface. The term "annealing" is also understood to mean any combination of the abovementioned two methods.

Any block copolymer, whatever its associated morphology, will be able to be used in the context of the invention,

Claims

1 A nanostructured assembly process using a composition comprising a block copolymer, at least one of the blocks of which consists of at least one monomer corresponding to the following formula (I):

I= 

where X= $Si(R_1,R_2)$; $Ge(R_1,R_2)$

Z= $Si(R_3,R_4)$; $Ge(R_3,R_4)$; O; S; $C(R_3,R_4)$

Y= O; S; $C(R_5,R_6)$

T= O; S; $C(R_7,R_8)$

with R_1= R_2 and R_3 = R_4 and R_5 = R_6 and R_7 = R_8 are selected from hydrogen, linear, branched or cyclic alkyl groups, with or without heteroatoms, and aromatic groups with or without heteroatoms and comprising the following steps:

- dissolving the block copolymer in a solvent,
- depositing this solution on a surface,
- annealing allowing orientation of the block copolymer,

wherein the surface is selected from the group consisting of silicon, silicon having a native or thermal oxide layer, hydrogenated or halogenated silicon, germanium, hydrogenated or halogenated germanium, platinum and platinum oxide, tungsten and oxides, gold, titanium nitrides and graphenes.

2 The process as claimed in claim 1, wherein the block copolymer is a diblock copolymer.

3 The process as claimed in claim 1, wherein X= $Si(R_1,R_2)$, Z= $C(R_3,R_4)$, Y= $C(R_5,R_6)$, T= $C(R_7,R_8)$.

4 The process as claimed in claim 3, wherein $R_1=R_2=CH_3$, $R_3=R_4=R_5=R_6=R_7=R_8=H$.

5 The process as claimed in claim 1, wherein the block or blocks not comprising formula (I) comprise methyl methacrylate in weight proportions of greater than 50%.

6 The process as claimed in claim 1, wherein the orientation of the block copolymer is carried out during a time of between 1 and 20 minutes, limits included.

7 The process as claimed in claim 1, wherein the orientation of the block copolymer is carried out at a temperature of between 333 K and 603 K.

8 The process as claimed in claim 1, wherein the annealing is carried out under a controlled atmosphere comprising solvent vapors, or a solvent atmosphere/temperature combination.

9 The process as claimed in claim 1, wherein the nanostructured assembly has a thickness of less than 100 nm.

10 The use of the process as claimed in one of claims 1 to 9, in the field of lithography, or more generally in the field of surface nanostructuring for electronics.

11 A block copolymer mask obtained as claimed in the process of one of claims 1 to 9.