Claims

1. A directed self-assembly lithography method, said method comprising a step of depositing a block copolymer film on a layer (20) neutral with respect to each of the blocks of the block copolymer, said block copolymer film being for use as a lithography mask, said lithography method being characterized in that it comprises the following steps of:
- depositing said neutral layer (20) directly on a surface of a substrate (10), said neutral layer (20) being of the carbon or fluoro-carbon type (n-SOC) deposited to a thickness greater than 1.5 times the thickness of said block copolymer film (40),
- crosslinking all or part of said carbon or fluoro-carbon neutral layer,
- depositing said block copolymer film on said crosslinked carbon or fluoro-carbon neutral layer (30), said block copolymer comprising at least one silylated block,
- subjecting the stack of layers thus created to an assembly temperature in order to nanostructure said block copolymer,
- removing (G1) at least one of the nano-domains (41, 42) from said nanostructured block copolymer film (40), in order to create a pattern intended to be transferred by etching (G2) into the carbon or fluoro-carbon neutral layer, and then (G3, G4) into the thickness of the underlying substrate (10).

2. The lithography method according to claim 1, characterized in that the carbon or fluoro-carbon neutral layer (20) comprises reactive groups of the epoxy type and/or unsaturations in its polymer chain either directly in the body of the polymer chain itself, or as a pendant group therein.

3. The lithography method according to claim 2, characterized in that the minimum rate of reactive groups of the epoxy type and/or of unsaturations in the polymer chain of the carbon or fluoro-carbon neutral layer is between 5% and 90%, preferably between 10% and 70%, and more preferably between 20% and 35% by weight.

4. The lithography method according to one of the preceding claims, characterized in that the carbon or fluoro-carbon neutral layer (20) further comprises a latent crosslinking agent selected from derivatives of the organic peroxide type, or derivatives having a chemical function of the azo type such as azobisisobutyronitrile, or derivatives of the alkyl halide type, or chemical derivatives for generating a thermally activated acid proton, such as ammonium salts such as ammonium triflate,

ammonium trifluoroacetate, or ammonium trifluoromethane sulfonate, pyridinium salts such as pyridinium para-toluenesulfonate, phosphoric or sulfuric or sulfonic acids, or onium salts such as iodonium or phosphonium salts, or imidazolium salts, or photo-generated acids or photo-generated bases.

5. The lithography method according to one of the preceding claims, characterized in that the carbon or fluoro-carbon neutral layer (20) has, in whole or in part, a chemical structure of the acrylate or methacrylate type based on comonomers selected from (meth)acrylic monomers such as hydroxyalkyl acrylates such as 2-hydroxyethyl acrylate, glycidyl acrylates, dicyclopentenyloxyethyl acrylates, fluorinated methacrylates such as 2,2,2-trifluoroethyl methacrylate, tert-butyl acrylate or methacrylate, alone or as a mixture of at least two of the aforementioned comonomers.

6. The lithography method according to one of the preceding claims, characterized in that the carbon or fluoro-carbon neutral layer (20) comprises hydroxy groups promoting its solubility in polar solvents selected from at least one of the following solvents or solvent mixtures: MIBK, methanol, isopropanol, PGME, ethanol, PGMEA, ethyl lactate, cyclohexanone, cyclopentanone, anisole, alkyl acetate, n-butyl acetate, iso-amyl acetate.

7. The lithography method according to one of the preceding claims, characterized in that the carbon or fluoro-carbon neutral layer (20) comprises at least three co-monomers of the glycidyl (meth)acrylate type (G), the hydroxyalkyl (meth)acrylate (H) type, and the fluoroalkyl (meth)acrylate (F) type, and in that the proportion of each monomer G, H, F is between 10 and 90% by weight, with the sum of the 3 monomers being equal to 100%.

8. The lithography method according to one of the preceding claims, characterized in that the method may comprise a step of depositing a third layer (TC) on a surface of the block copolymer, and in that, prior to the step of nano-structuring the block copolymer film, this third layer is crosslinked in whole or in part.

~~9. The lithography method according to the claim 8, characterized in that the carbon or fluoro-carbon neutral layer (20) may have a chemical structure identical to that of said third layer~~

~~10.~~9. The lithography method according to ~~the~~ claim 8 ~~or 9~~, characterized in that the third layer comprises a latent crosslinking agent selected from: chemical derivatives for generating a thermally activated acid proton, such as ammonium salts such as ammonium triflate, ammonium trifluoroacetate, or ammonium trifluoromethane sulfonate, or onium salts such as iodonium or sulfonium salts, such as triphenylsulfonium triflate, or phosphonium or imidazolium salts, or a photo-generated acid (PAG) or a photo-generated base (PBG).

~~11.~~10. The lithography method according to one of the preceding claims, characterized in that the step of crosslinking the carbon or fluoro-carbon neutral layer (n-SOC) and/or the third layer (TC) is carried out by light irradiation, exposure to self-thermalization, electrochemical process, plasma, ion bombardment, electron beam, mechanical stress, exposure to a chemical species, or any combination of the aforementioned techniques.

~~12.~~11. The lithography method according to claim 10~~1~~, characterized in that the step of crosslinking the carbon or fluoro-carbon neutral layer (20) is carried out by exposure to thermalization, at a temperature between 0 °C and 450 °C, preferably between 100 and 300 °C, and more preferably between 200 and 250 °C for a period of less than or equal to 15 minutes, preferably less than or equal to 2 minutes.

~~13.~~12. The lithography method according to one of claims 1 to 11~~2~~, characterized in that a pattern can be drawn in the neutral layer (20) by exposure to light radiation or an electron beam.

~~14.~~13. The lithography method according to ~~one of~~ claim~~s~~ 8 ~~to 10~~, characterized in that a pattern can be drawn in the third layer (TC), by exposure to light radiation or an electron beam.

~~15.~~14. The lithography method according to claim 12~~3~~ or 13~~4~~, characterized in that when the pattern is drawn by exposure to light radiation, at least the carbon or fluoro-carbon neutral and the block copolymer have anti-reflection properties.

~~16.~~15. The lithography method according to claim 12~~3~~ or 13~~4~~, characterized in that when the pattern is drawn by exposure to light radiation, a bottom anti-reflection coating (BARC) is dispensed on the substrate, prior to the deposition of said carbon or fluoro-carbon neutral underlayer.

~~17.~~16. The lithography method according to one of preceding claims, characterized in that the step of depositing the neutral layer (20) directly on the surface of the subtract (10) comprises a direct contact between said neutral layer and the substrate.

~~18.~~17. The lithography method according to one of the preceding claims, characterized in that the step of depositing the block copolymer film on the crosslinked carbon or fluoro-carbon neutral layer (30) comprises a direct contact between said crosslinked carbon or fluoro-carbon neutral layer and the block copolymer film.

~~19.~~18. The lithography method according to one of the preceding claims, characterized in that said lithography method does not comprise the use of intermediate layer such as Si-ARC/SOG, SOC, and neutral layer.

~~20.~~19. Lithography stack obtained by a directed self-assembly lithography method, said stack comprising a substrate (10) to the surface of which is deposited a neutral layer, said neutral layer being covered by a block copolymer film (40), said block copolymer film being for use as a lithography mask, and said neutral layer being neutral with respect to each of the blocks of the block copolymer, said stack being characterized in that

the neutral layer is in direct contact with the underlying substrate (10), and the neutral layer being of the carbon or fluoro-carbon type (n-SOC), crosslinked in whole or in part, deposited to a thickness greater than 1.5 times the thickness of said block copolymer film (40), and

said block copolymer film (40) comprising at least one silylated block, and being in direct contact with said crosslinked carbon or fluoro-carbon neutral layer (30), and

said block copolymer film having been nanostructured for example by treatment at an assembly temperature and being a discontinuous film, in order to create a pattern capable of being transferred by etching in the carbon or fluoro-carbon neutral layer then in the thickness of the underlying substrate (10).

~~21.~~20. Use of the method according to one of the claims 1 to 1~~8~~9 in the manufacture of a lithography mask intended to allow the etching of patterns at depths between 10 nm and 400 nm.