UNDERLAYER COATING COMPOSITION AND PROCESS ~~FOR MANUFACTURING A MICROELECTRONIC DEVICE~~ THEREOF

The present invention relates to an absorbing underlayer coating composition comprising a polymer, where the polymer comprises at least one aminoplast group and in the backbone of the polymer at least a substituted or unsubstituted hydroxyaromatic with pendant fluoro or iodo moiety. The invention also relates to a process for forming an image using the absorbing underlayer composition. The process is especially useful for imaging photoresists using radiation in the deep ultraviolet, 100-260 nm (DUV) and extreme ultraviolet, 13.5 nm (EUV) region.

Photoresist compositions are used in microlithography processes for making miniaturized electronic components such as in the fabrication of computer chips and integrated circuits. Generally, in these processes, a thin coating of film of a photoresist composition is first applied to a substrate material, such as silicon based wafers used for making integrated circuits. The coated substrate is then baked to evaporate any solvent in the photoresist composition. The baked coated surface of the substrate is next subjected to an image-wise exposure to radiation.

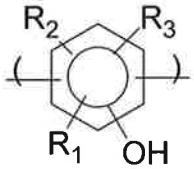
This radiation exposure causes a chemical transformation in the exposed areas of the coated surface. Ultraviolet (UV) light, electron beam and X-ray radiant energy are radiation types commonly used today in microlithographic processes. After this image-wise exposure, the coated substrate is treated with a developer solution to dissolve and remove either the radiation-exposed or the unexposed areas of the photoresist.

The trend towards the miniaturization of semiconductor devices has led to the use of new photoresists that are sensitive to lower and lower wavelengths of radiation and has also led to the use of sophisticated multilevel systems to overcome difficulties associated with such miniaturization.

Claims

1. An underlayer coating composition comprising a polymer, where the polymer comprises at least one hydroxyaromatic unit in the backbone of the polymer comprising a fluoro or iodo moiety, and at least one unit comprising an aminoplast.

~~2 The composition of claim 1~~, further where the hydroxyaromatic unit with the fluoro moiety has structure (1),



(1)

where, R_1 is ~~selected from an iodo moiety and~~ fluoro moiety, R_2 is fluoro moiety and R_3 ~~and independently~~ is selected from a group consisting of an iodo moiety, a fluoro moiety, hydrogen, hydroxyl, (C_1-C_4)alkyl, hydroxy(C_1-C_4)alkyl, OC_1-C_4alkyl, (C=O)(C_1-C_4)alkyl, C_1-C_4alkylO(C_1-C_4)alkyl, C_1-C_4alkyl(C=O)(C_1-C_4)alkyl, and C(O)O(C_1-C_4)alkyl ~~and R_2 and R_3 are connected to form hydroxyaromatic ring fused to the phenol~~.

~~3~~2. The composition of claim 1 ~~or 2~~, where the fluoro ~~or iodo~~ moiety is selected from ~~I,~~ F, C_1-C_4fluoroalkyl, C_1-C_4 hydroxyfluoroalkyl, OC_1-C_4fluoroalkyl C(O)(C_1-C_4)fluoroalkyl, and C(O)O(C_1-C_4)fluoroalkyl.

~~4~~ 3. The composition of ~~one of~~ claims 1 ~~to 3~~, where the unit comprising an aminoplast is derived from a glycoluril monomer ~~or from a urea/formaldehyde oligomer~~.

4. The composition of claim 1, where the unit comprising an aminoplast is derived from a urea/formaldehyde oligomer.

5. The composition of claim 1, where the polymer further comprises a phenolic unit free of a fluoro or iodo moiety.

6. The composition of claim 1, where the composition further comprises a thermal acid generator.

7. The composition of claim 1, where the composition further comprises a polyester polymer.

~~5~~8. The composition of ~~one of~~ claim~~s~~ 1 ~~to 4~~, where the ~~polymer further comprises a phenolic unit free of a fluoro or iodo moiety, a thermal acid generator, a polyester polymer, and/or~~ composition further comprises a glycoluril polymer different from the polymer of claim 1.

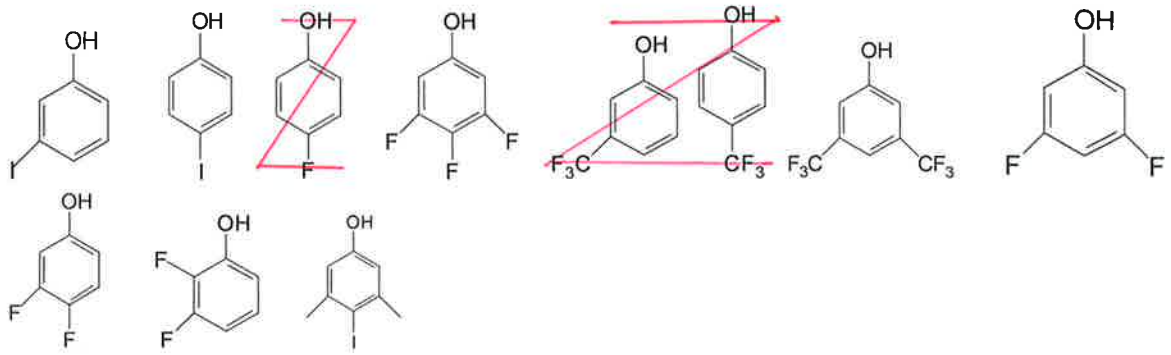
~~6~~9. The composition of ~~one of~~ claim~~s~~ 1 ~~to 5~~, wherein the hydroxyaromatic unit is naphthol.

~~7~~10. The composition of ~~one of~~ claim~~s~~ 1 ~~to 6~~ further comprising a solvent~~, and/or a secondary polymer~~.

11. The composition of claim 1 further comprising a secondary solvent.

~~8~~12. The composition or polymer of ~~one of~~ claim~~s~~ 1 ~~to 7~~ having a fluoro or iodo content in the range of 1% to 30% by weight.

~~9~~13. The composition of ~~one of~~ claim~~s~~ 1 ~~to 8~~, where the hydroxyaromatic unit is derived from



~~10~~14. The composition of ~~one of~~ claim~~s~~ 1 ~~to 9~~, where the composition is free of an external crosslinker.

~~11~~15. A process for manufacturing a microelectronic device, comprising;

a) providing a substrate with a layer of an underlayer coating composition from ~~one of~~ claim~~s~~ 1 ~~to 10~~;

b) coating a photoresist layer above the underlayer coating ;

c) imagewise exposing the photoresist layer;

d) developing the photoresist layer with an aqueous alkaline developing solution.

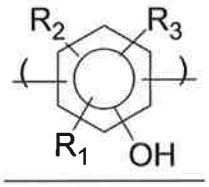
~~12~~16. The process of claim ~~11~~15, where the underlayer coating layer has k value in the range of ~~about~~ 0.05 to ~~about~~ 1.0.

~~13~~17. The process of claim ~~11 or 12~~15, where the underlayer coating layer has k value in the range of ~~about~~ 0.05 to ~~about~~ 0.5.

~~14~~18. The process of ~~one of~~ claim~~s 11 to 13~~15, where the photoresist is imageable with radiation from ~~about~~ 260 nm to ~~about~~ 12 nm.

~~15~~19. The process according to ~~one of~~ claim~~s 11 to 14~~15, where the developing solution is an aqueous solution comprising a hydroxide base.

20. The composition of claim 1, where the hydroxyaromatic unit with the iodo moiety has structure (1),



(1)

where, R_1 is selected from an iodo moiety, R_2 and R_3 are independently selected from an iodo moiety, a fluoro moiety, hydrogen, hydroxyl, (C_1-C_4)alkyl, hydroxy(C_1-C_4)alkyl, OC_1-C_4alkyl, (C=O)(C_1-C_4)alkyl, C_1-C_4alkylO(C_1-C_4)alkyl, C_1-C_4alkyl(C=O)(C_1-C_4)alkyl, C(O)O(C_1-C_4)alkyl and R_2 and R_3 are connected to form hydroxyaromatic ring fused to the phenol.