The resist composition may further include an additive selected from the group consisting of an alkali soluble quencher, an acid diffusion quencher, a surfactant, and any mixture thereof.

In accordance with another aspect of the present invention, there is provided a method of forming a resist pattern including forming a resist film by coating the resist composition on a substrate, heating the resist film, and exposing the resist film to light to form a predetermined pattern, and developing the exposed pattern.

The exposing may be performed using a light source selected from the group consisting of a KrF excimer laser, an ArF excimer laser, an extreme ultraviolet laser, an X-ray, and an electron beam.

Other aspects, features, and advantages of the present invention will be more clearly understood from the following detailed description.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter, the present invention will be described in detail. ~~However, descriptions of these example embodiments are only provided for illustrative purposes, and should not be construed as limiting the scope and spirit of the present invention.~~ The following detailed

Example 3	Polymer viii	3	90.2	72	48
Example 4	Polymer ix	4	92.4	72	46
Comparative Example	Polymer x	4	67	51	No pattern formed

Referring to Table 1, the resist films formed using the resist compositions including the resist additives prepared in Examples 1 to 4 had higher sliding angles and higher receding contact angles than that the resist film formed using the resist composition prepared in the comparative example. In addition, the resist films prepared in Examples 1 to 4 had excellent sensitivity after liquid immersion lithography, but a pattern was not formed in the resist film formed in the comparative example.

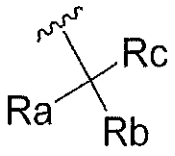
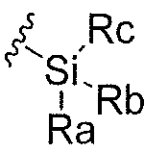
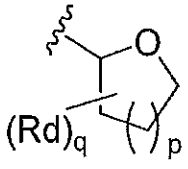
As is apparent from the above description, the present invention provides a resist additive added to the resist composition and disposed on the surface of the resist film while the resist film is formed. The resist additive improves hydrophobicity of the surface of the resist film to prevent materials from being leached in water during exposure of immersion lithography and is converted to have hydrophilicity by deprotection reaction during development. As a result, a micropattern of a resist film with excellent sensitivity and high resolution may be formed.

~~Although the preferred embodiments of the present~~

~~invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.~~

group, p is an integer of 0 to 3, and q is an integer of 0 to 10;

R_4 is selected from the group consisting of a hydrophobic group, and a C1-C20 alkyl group, a C3-C30 cycloalkyl group, an acyl group, a carboxyl group, a (C1-C20 alkyl)carboxyl group, a (C3-C30 cycloalkyl)carboxyl group, a C1-C20 heteroalkyl group, and a C2-C30 heterocycloalkyl group comprising the hydrophobic group, in which the hydrophobic group is selected from the group consisting of a halogen atom and a C1-C20 haloalkyl group;

R_5 is an acid labile group selected from the group consisting of , , and , wherein R_a, R_b, R_c and R_d are each independently selected from the group consisting of a C1-C20 alkyl group, a C3-C30 cycloalkyl group, a (C1-C10 alkyl)cycloalkyl group, a hydroxyalkyl group, a C1-C20 alkoxy group, a (C1-C10 alkoxy)alkyl group, an acetyl group, an acetylalkyl group, a carboxyl group, a (C1-C10 alkyl)carboxyl group, a (C3-C18 cycloalkyl)carboxyl group, and a C3-C30 heterocycloalkyl group or fused together between adjacent groups to form a C3-C30 saturated or unsaturated hydrocarbon ring or a C2-C20 heterocyclic group, p is an

integer of 0 to 3, and q is an integer of 0 to 10, or selected from the group consisting of a C1-C20 alkyl group, a C3-C30 cycloalkyl group, an acyl group, a carboxyl group, a (C1-C20 alkyl)carboxyl group, a (C3-C30 cycloalkyl)carboxyl group, a (C1-C20 alkyl)carboxyalkyl group, a C1-C20 heteroalkyl group, and a C2-C30 heterocycloalkyl group comprising the acid labile group; and

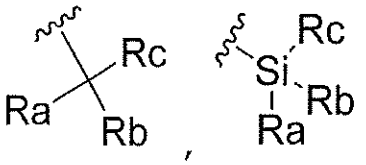
l, m, n and o are respectively numbers of the repeat units in a backbone, wherein $l+m+n+o=1$, $0<l/(l+m+n+o)<0.9$, $0<m/(l+m+n+o)\leq 0.2$, $0<n/(l+m+n+o)<0.9$, and $0\leq o/(l+m+n+o)<0.9$.

~~2. The resist additive of claim 1, wherein the hydrophobic group is selected from the group consisting of a halogen atom and a C1-C20 haloalkyl group.~~

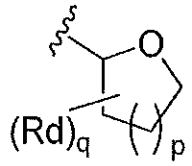
~~3~~2. The resist additive of claim 1, wherein in Formula 2, R_{31} is selected from the group consisting of a C1-C10 alkyl group, a (C1-C10 alkoxy)alkyl group, a C3-C14 monocyclic cycloalkyl group, a C8-C18 dicyclic cycloalkyl group, a C10-C30 tricyclic cycloalkyl group, a C10-C30 tetracyclic cycloalkyl group, a formyl group, a (C1-C10 alkyl)carbonyl group, a (C3-C18 cycloalkyl)carbonyl group, a (C1-C10 alkyl)carboxyl

group, and a (C3-C18 cycloalkyl)carboxyl group.

~~43~~43. The resist additive of claim 1, wherein in Formula 2, R_{31} is selected from the group consisting of a formyl group, an acetyl group, a methoxymethyl group, a t-butylcarbonyl group, a t-butyloxycarbonyl group, a cyclohexylcarbonyl group, a cyclopentylcarbonyl group, a cyclooctylcarbonyl group, an adamantylcarbonyl group, and a bicyclo[2,2,1]heptylmethyl carbonyl group.

~~54~~54. The resist additive of claim 1, wherein in Formula 2, R_{33} is selected from the group consisting of 

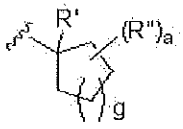
,

, and 

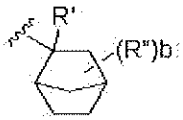
, wherein R_a, R_b, R_c, and R_d are each independently selected from the group consisting of a C1-C10 alkyl group, a C3-C14 monocyclic cycloalkyl group, a C8-C20 dicyclic cycloalkyl group, a C10-C30 tricyclic cycloalkyl group, a C10-C30 tetracyclic cycloalkyl group, a (C1-C5 alkyl)cycloalkyl group, a hydroxyalkyl group, a C1-C10 alkoxy group, a (C1-C5 alkoxy)alkyl group, an acetyl group, an acetylalkyl group, a carboxyl group, a (C1-C5 alkyl)carboxyl group, and a (C3-C10 cycloalkyl)carboxyl group or fused together between adjacent groups to form

a C6-C18 saturated or unsaturated hydrocarbon ring or a C5-C18 heterocyclic group, p is an integer of 0 to 3, and q is an integer of 0 to 5.

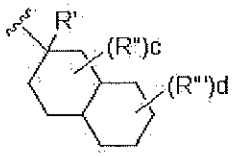
~~6~~5. The resist additive of claim 1, wherein in Formula 2, R_{33} is selected from the group consisting of a t-butyl group, a trimethylsilyl group, a hydroxy-2-ethyl group, a 1-methoxypropyl group, a 1-methoxy-1-methylethyl group, a 1-ethoxypropyl group, a 1-ethoxy-1-methylethyl group, a 1-methoxy-1-ethyl group, a 1-ethoxy-1-ethyl group, a t-butoxy-2-ethyl group, a 1-isobutoxy-1-ethyl group, and groups represented by Formulae 3a to 3k below:



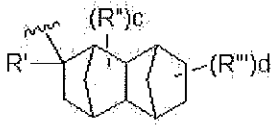
(3a)



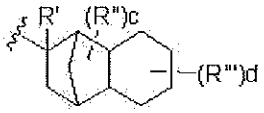
(3b)



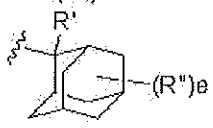
(3c)



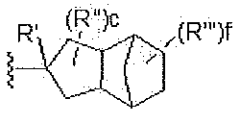
(3d)



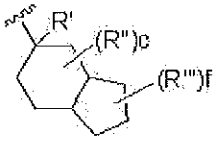
(3e)



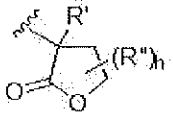
(3f)



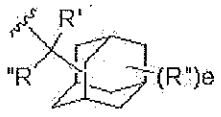
(3g)

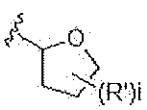


(3h)



(3i)





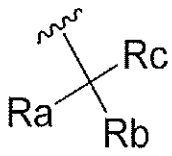
(3k)

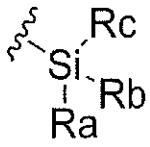
wherein R', R" and R"' are each independently a hydrogen atom or a C1-C10 alkyl group, a and e are each independently an integer of 0 to 15, b is an integer of 0 to 11, c and d are each independently an integer of 0 to 9, f is an integer of 0 to 7, g and i are each independently an integer of 0 to 6, h is an integer of 0 to 4, $0 \leq c+d \leq 17$, and $0 \leq c+f \leq 15$.

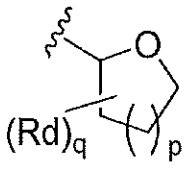
~~7~~6. The resist additive of claim 1, wherein in Formula 1, R_4 is selected from the group consisting of: a C1-C20 fluoroalkyl group; and a C1-C20 alkyl group, a C3-C14 monocyclic cycloalkyl group, a C8-C18 dicyclic cycloalkyl group, a C10-C30 tricyclic cycloalkyl group, a C10-C30 tetracyclic cycloalkyl group, a (C1-C10 alkyl)carbonyl group, a (C3-C30 cycloalkyl)carbonyl group, a (C1-C10 alkyl)carboxyl group, a (C1-C20 alkoxy)alkyl group, and a (C3-C30 cycloalkyl)oxyalkyl group comprising at least one functional group selected from the group consisting of a fluoro group and a fluoroalkyl group.

~~8~~7. The resist additive of claim 1, wherein in Formula 1, R_4 is selected from the group consisting of a trifluoromethyl group, a di(trifluoromethyl)isopropyl group, a pentafluoroethyl group, and a heptafluoropropyl

group.

~~9~~8. The resist additive of claim 1, wherein in Formula 1, R_5 is an acid labile group selected from the group consisting of 

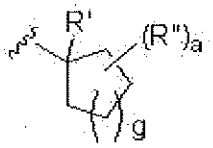
, 

, and 

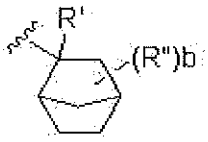
, wherein R_a, R_b, R_c, and R_d are each independently selected from the group consisting of a C1-C10 alkyl group, a C3-C14 monocyclic cycloalkyl group, a C8-C20 dicyclic cycloalkyl group, a C10-C30 tricyclic cycloalkyl group, a C10-C30 tetracyclic cycloalkyl group, a (C1-C5 alkyl)cycloalkyl group, a hydroxyalkyl group, a C1-C10 alkoxy group, a (C1-C5 alkoxy)alkyl group, an acetyl group, an acetylalkyl group, a carboxyl group, a (C1-C5 alkyl)carboxyl group, and a (C3-C10 cycloalkyl)carboxyl group or fused together between adjacent groups to form a C6-C18 saturated or unsaturated hydrocarbon ring or a C5-C18 heterocyclic group, p is an integer of 0 to 3, and q is an integer of 0 to 5, or selected from the group consisting of a C1-C10 alkyl group, a C3-C14 monocyclic cycloalkyl group, a C8-C18 dicyclic cycloalkyl group, a C10-C30 tricyclic cycloalkyl group, a C10-C30 tetracyclic cycloalkyl group, a formyl group, a (C1-C20 alkyl)carbonyl group, a (C3-C30 cycloalkyl)carbonyl

group, a carboxyl group, a (C1-C10 alkyl)carboxyl group, a (C3-C18 cycloalkyl)carboxyl group, and a (C1-C10 alkyl)carboxyalkyl group comprising the acid labile group.

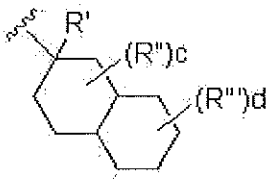
~~109~~. The resist additive of claim 1, wherein in Formula 1, R_5 is selected from the group consisting of a t-butyl group, a trimethylsilyl group, a hydroxy-2-ethyl group, a 1-methoxypropyl group, a 1-methoxy-1-methylethyl group, a 1-ethoxypropyl group, a 1-ethoxy-1-methylethyl group, a 1-methoxy-1-ethyl group, a 1-ethoxy-1-ethyl group, a t-butoxy-2-ethyl group, a 1-isobutoxy-1-ethyl group, and groups represented by Formulae 3a to 3k below:



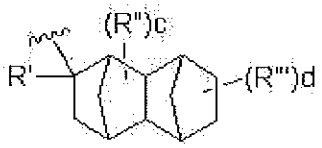
(3a)



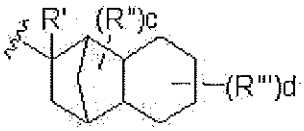
(3b)



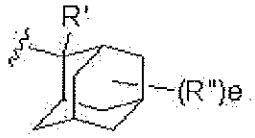
(3c)



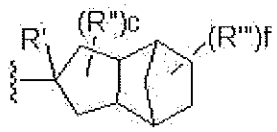
(3d)



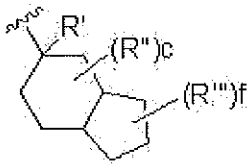
(3e)



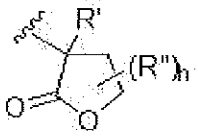
(3f)



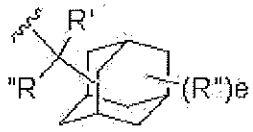
(3g)

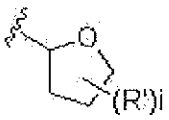


(3h)



(3i)





(3k)

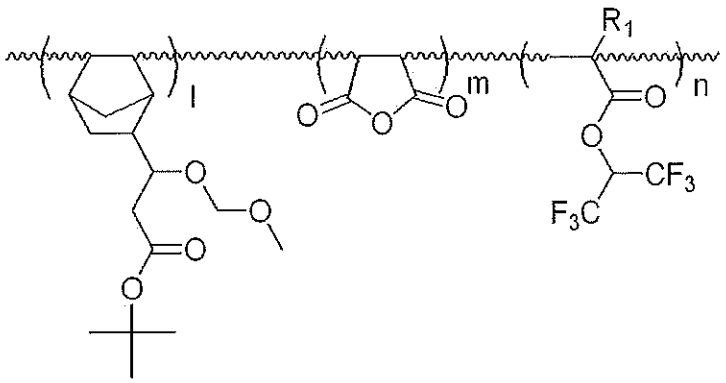
wherein R', R" and R"' are each independently a hydrogen atom or a C1-C10 alkyl group, a and e are each independently an integer of 0 to 15, b is an integer of 0 to 11, c and d are each independently an integer of 0 to 9, f is an integer of 0 to 7, g and i are each independently an integer of 0 to 6, h is an integer of 0 to 4, $0 \leq c+d \leq 17$, and $0 \leq c+f \leq 15$.

~~11~~10. The resist additive of claim 1, wherein in

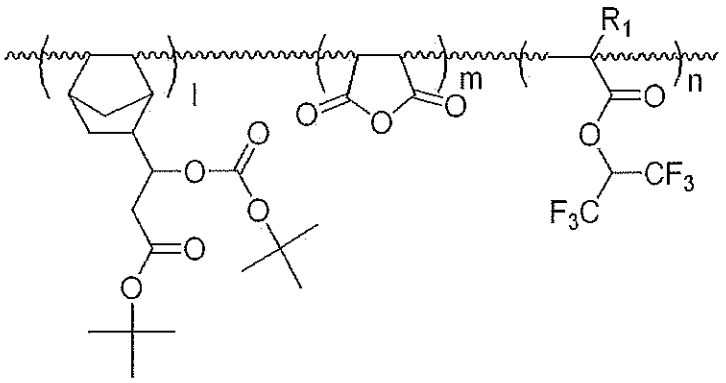
Formula 1, a repeat unit m is comprised in a copolymer of the resist additive in an amount of 5 to 15 mol%.

~~12~~11. The resist additive of claim 1, wherein the resist additive is selected from the group consisting of compounds represented by Formulae 5 to 10 below:

Formula 5



Formula 6



Formula 7

$0<n/(1+m+n+o)<0.9$, and $0\leq o/(1+m+n+o)<0.9$.

~~13~~12. The resist additive of claim 1, wherein a polystyrene equivalent weight average molecular weight of the resist additive measured using gel permeation chromatography is in the range of 1,000 to 50,000 g/mol.

~~14~~13. The resist additive of claim 1, wherein a weight average molecular weight/number average molecular weight ratio of the resist additive is in the range of 1 to 5.

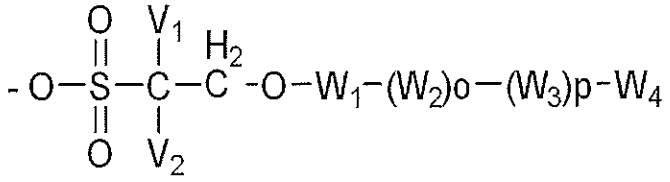
~~15~~14. A resist composition comprising a resist additive according to any one of claims 1 to ~~14~~13, a resist base polymer, an acid generator, and a solvent.

~~16~~15. The resist composition of claim ~~15~~14, wherein the amount of the resist additive is in the range of 0.05 to 5% by weight based on the total weight of the resist composition.

~~17~~16. The resist composition of claim ~~15~~14, wherein the acid generator comprises at least one compound selected from the group consisting of compounds represented by Formulae 14 and 15 below:

Z, which denotes an anion, is OSO_2CF_3, $OSO_2C_4F_9$, $OSO_2C_8F_{17}$, $N(CF_3)_2$, $N(C_2F_5)_2$, $N(C_4F_9)_2$, $C(CF_3)_3$, $C(C_2F_5)_3$, $C(C_4F_9)_3$, or a functional group represented by Formula 16 below:

Formula 16



wherein V_1 and V_2 are each independently a halogen atom,

W_1 is -(C=O)- or -(SO_2)-,

W_2 is a C1-C10 alkanediyl group,

W_3 is selected from the group consisting of a C3-C30 cycloalkyl group, a C6-C30 aryl group, a C7-C30 aralkyl group, a C6-C30 aryloxy group, a C6-C30 arylthio group, and a C5-C30 heterocyclic group,

W_4 is selected from the group consisting of a hydrogen atom, a halogen group, a C1-C10 alkyl group, a C1-C10 alkoxy group, a C1-C10 haloalkyl group, a C1-C10 alkylthio group, a C6-C30 aryl group, and any combination thereof,

o is an integer of 0 to 1, and

p is an integer of 0 to 2.

~~18~~17. The resist composition of claim ~~15~~14, wherein the amount of the acid generator is in the range of 0.3

to 10 parts by weight based on 100 parts by weight of solids of the resist composition.

~~19~~18. The resist composition of claim ~~15~~14, further comprising an additive selected from the group consisting of an alkali soluble quencher, an acid diffusion quencher, a surfactant, and any mixture thereof.

~~20~~19. A method of forming a resist pattern, the method comprising:

forming a resist film by coating the resist composition according to claim ~~15~~14 on a substrate;

heating the resist film, and exposing the resist film to light to form a predetermined pattern; and

developing the exposed pattern.

~~21~~20. The method of claim ~~20~~19, wherein the exposing is performed using a light source selected from the group consisting of a KrF excimer laser, an ArF excimer laser, an extreme ultraviolet laser, an X-ray, and an electron beam.