

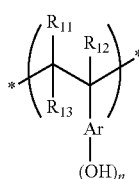
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In a case where Rc is the substituent and L₁ is the linking group, Rc and L₁ may be bonded to each other to form a ring. X represents a group capable of leaving by the action of an acid.

<4> The pattern forming method as described in <3>, in which the group represented by X in General Formula (1-1) has a total number of carbon atoms and oxygen atoms of 4 or less.

<5> The pattern forming method as described in any one of <1> to <4>, in which the content of the repeating unit capable of decomposing by the action of an acid to generate an acid having a pKa of 3.0 or less is 55% to 100% by mole with respect to all the repeating units of the resin.

<6> The pattern forming method as described in any one of <1> to <5>, in which the resin further has a repeating unit represented by General Formula (2).



In the formula,

R₁₁ and R₁₂ each independently represent a hydrogen atom, an alkyl group, a cycloalkyl group, a halogen atom, a cyano group, or an alkoxy carbonyl group. R₁₃ represents a hydrogen atom, an alkyl group, a cycloalkyl group, a halogen atom, a cyano group, or an alkoxy carbonyl group, or is bonded to Ar below to form a ring structure. Ar represents an aromatic cyclic group. n represents an integer of 1 to 4.

<7> The pattern forming method as described in any one of <1> to <6>, in which the resin does not contain a fluorine atom.

<8> The pattern forming method as described in any one of <1> to <7>, in which the actinic ray-sensitive or radiation-sensitive resin composition contains a compound capable of generating an acid with actinic rays or radiation.

<9> The pattern forming method as described in any one of <1> to <8>, in which the organic solvent includes an ester-based solvent.

<10> The pattern forming method as described in any one of <1> to <9>, in which the step (2) is a step of exposing the film using electron beams, X-rays, or extreme ultraviolet rays.

<11> A method for manufacturing an electronic device, comprising:

the pattern forming method as described in any one of <1> to <10>.

According to the present invention, it is possible to provide a pattern forming method having excellent performance of resolution and line width roughness as well as reduction in film shrinkage (PEB shrinkage) in a PEB process, particularly in the formation of an ultrafine pattern (for example, a pattern having a line width of 20 nm hp or less). In addition, according to the present invention, it is possible to provide a method for manufacturing an electronic device, including the pattern forming method.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereafter, embodiments of the present invention will be described in detail.

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In citations for a group (atomic group) in the present specification, in a case where the group is denoted without specifying whether it is substituted or unsubstituted, the group includes both a group not having a substituent and a group having a substituent. For example, an “alkyl group” includes not only an alkyl group not having a substituent (unsubstituted alkyl group), but also an alkyl group having a substituent (substituted alkyl group).

“Actinic rays” or “radiation” in the present specification means, for example, a bright line spectrum of a mercury lamp, far ultraviolet rays represented by an excimer laser, extreme ultraviolet rays, X-rays, electron beams (EB), or the like. In addition, in the present invention, light means actinic rays or radiation.

Unless otherwise specified, “exposure” in the present specification includes not only exposure by a bright line spectrum of a mercury lamp, far ultraviolet rays represented by an excimer laser, extreme ultraviolet rays, X-rays, extreme ultraviolet rays, or the like, but also writing by particle rays such as electron beams and ion beams.

In the present specification, a “(meth)acrylic monomer” means at least one of monomers having a structure of “CH₂=CH—CO—” or “CH₂=C(CH₃)—CO—”. Similarly, “(meth)acrylate” and “(meth)acrylic acid” means “at least one of acrylate or methacrylate” and “at least one of acrylic acid or methacrylic acid”.

In the present specification, the weight-average molecular weight of the resin is a value measured in terms of polystyrene by a GPC method. GPC follows a method using HLC-8120 (manufactured by Tosoh Corporation), TSK gel Multipore HXL-M (manufactured by Tosoh Corporation, 7.8 mmID×30.0 cm) as a column, and tetrahydrofuran (THF) or N-methyl-2-pyrrolidone (NMP) as an eluent.

Hereafter, the pattern forming method of the present invention will be described in detail.

<Pattern Forming Method>

The pattern forming method of the present invention includes:

a step (1) of forming a film using an actinic ray-sensitive or radiation-sensitive resin composition (hereinafter also referred to as a “composition”) including a resin (hereinafter also referred to as a “resin (A)”) having an acid-decomposable repeating unit capable of decomposing by the action of an acid to generate an acid having a pKa of 3.0 or less,

a step (2) of exposing the film using actinic rays or radiation, and

a step (3) of carrying out development using a developer including an organic solvent after the exposure to form a negative tone pattern.

According to the present invention, it is possible to provide a pattern forming method having excellent performance of resolution and line width roughness as well as reduction in film shrinkage (PEB shrinkage) in a PEB process, particularly in the formation of an ultrafine pattern (for example, a pattern having a line width of 20 nm hp or less).

The reason thereof is not clear, but presumed as follows, for example.

For example, it is thought that in a case where a film is formed using a composition including a resin having an acid-decomposable repeating unit capable of decomposing by the action of an acid to generate methacrylic acid, and is developed using a developer including an organic solvent after the exposure to form a negative tone pattern, the developer including an organic solvent permeates into the pattern part, and thus, performance of resolution performance and line width roughness is deteriorated. In contrast,