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**PATTERN FORMING METHOD, ELECTRON
BEAM-SENSITIVE OR EXTREME
ULTRAVIOLET RAY-SENSITIVE RESIN
COMPOSITION, RESIST FILM, AND
METHOD FOR MANUFACTURING
ELECTRONIC DEVICE, AND ELECTRONIC
DEVICE USING THE SAME**

**CROSS-REFERENCE TO RELATED
APPLICATION**

This is a continuation of International Application No. PCT/JP2013/072485 filed on Aug. 16, 2013, and claims priority from Japanese Patent Application Nos. 2012-181892 filed on Aug. 20, 2012, and 2013-054401 filed on Mar. 15, 2013, the entire disclosures of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a pattern forming method using a developer containing an organic solvent, which is suitably used in a super micro lithography process such as a manufacturing process of a super LSI or high capacity microchip or other photofabrication processes, an electron beam-sensitive or an extreme ultraviolet ray-sensitive resin composition, and a resist film, and a method for manufacturing an electronic device, and an electronic device using the same. More specifically, the present invention relates to a pattern forming method using a developer containing an organic solvent, which is suitably used in a micromachining process of semiconductor device using an electron beam or EUV ray (wavelength: near 13 nm), an electron beam-sensitive or an extreme ultraviolet ray-sensitive resin composition, and a resist film, and a method for manufacturing an electronic device, and an electronic device using the same.

BACKGROUND ART

A micromachining by a lithography using a photoresist composition has been conducted in a conventional manufacturing process of a semiconductor device such as an IC or LSI. Recently, an ultrafine pattern formation of a submicron region or a quarter micron region has been required, because an integration level of an integrated circuit becomes higher. Accordingly, an exposure wavelength has a tendency to become shorter from g line to i line, and further to a KrF excimer laser ray. Furthermore, development of a lithography using an electron beam or X-ray or EUV ray other than the excimer laser ray is now progressing.

These electron beam or X-ray or EUV ray lithography takes a position as a pattern forming technique of the next generation or the next of the next generation, and a resist composition of a high sensitivity and high resolution is desired. Particularly, a high sensitization is a very important problem to be solved for shortening of a processing time of wafer. However, when intending to the high sensitization, a resolution which is represented by a pattern shape or limiting resolution line width is prone to be reduced. Thus, the development of a resist composition which is capable to satisfy these characteristics at the same time is highly demanded.

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A high sensitivity, a high resolution and a good pattern shape are in a relationship of a tradeoff therebetween, and thus it is very important how to satisfy them at the same time.

In order to solve the problems, for example, Japanese Patent Application Laid-Open No. 2005-91712 discloses a positive type resist composition using a resin having a certain repeating unit of an acid-decomposable group having an alicyclic group and a certain polystyrene repeating unit. According to the document, the resolution and the sensitivity are said to be improved.

However, in a positive type image forming method, an isolated line or dot pattern may be formed well, but the shapes of patterns are easy to deteriorate when an isolated space or fine hole patterns are formed.

In addition, a pattern forming method using a developer containing an organic solvent has been developed recently (for example, see Japanese Patent Application Laid-Open No. 2010-217884). According to this method, it is said that the stable formation of a micro pattern in high precision is possible. Further, in recent years, the needs of the formation of fine isolated space patterns and the refinement of hole patterns are rapidly increasing. Because of this, a further performance improvement on sensitivity, resolution, and space width roughness performance is required in the formation of fine isolated space patterns having a space width of 100 nm or less. Similarly, in the case of forming a hole pattern having fine pore diameter (for example, 50 nm or less), a further performance improvement on high resolution, good exposure latitude (EL), and the uniformity of local pattern dimension (Local-CDU) is required.

An object of the present invention is to provide a pattern forming method, an electron beam-sensitive or an extreme ultraviolet ray-sensitive resin composition, and a resist film, and a method for manufacturing an electronic device, and an electronic device using the same, in which the pattern forming method provides an excellent sensitivity, resolution, and space width roughness performance in the formation of fine isolated space patterns having a space width of 100 nm or less, and also provides a high resolution, a good exposure latitude (EL), and an excellent uniformity of local pattern dimension (Local-CDU) in the case of forming a hole pattern having fine pore diameter (for example, 50 nm or less).

SUMMARY OF INVENTION

The present invention is as follows.

[1] A pattern forming method, including:

(a) forming a film by using an electron beam-sensitive or extreme ultraviolet ray-sensitive resin composition containing a resin (A) having a repeating unit represented by Formula (1-0) and a repeating unit represented by Formula (1-2);

(b) exposing the film by using an electron beam or extreme ultraviolet ray; and

(c) developing the exposed film by using a developer containing an organic solvent to form a negative pattern,

wherein a content of the repeating unit represented by Formula (1-0) is 45 mol % or more based on a whole repeating units in the resin (A);