

1

ACTINIC-RAY—OR RADIATION-SENSITIVE RESIN COMPOSITION AND METHOD OF FORMING PATTERN USING THE COMPOSITION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from prior Japanese Patent Application No. 2010-019284, filed Jan. 29, 2010, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an actinic-ray- or radiation-sensitive resin composition that when exposed to actinic rays or radiation, makes a reaction to thereby change its properties and a method of forming a pattern using the composition. More particularly, the present invention relates to an actinic-ray- or radiation-sensitive resin composition for use in a semiconductor production process for an IC and the like, a circuit board production for a liquid crystal, a thermal head and the like, the fabrication of an imprint mold structure, other photofabrication processes, a lithographic printing plate and an acid-hardenable composition and also relates to a method of forming a pattern with the use of the composition.

In the present invention, the terms “actinic rays” and “radiation” mean, for example, brightline spectra from a mercury lamp, far ultraviolet represented by an excimer laser, extreme ultraviolet, X-rays, soft X-rays, an electron beam and the like. In the present invention, the term “light” means actinic rays or radiation.

2. Description of the Related Art

A resist composition of chemical amplification type is a pattern forming material that is capable of, upon exposure to far ultraviolet or other radiation, generating an acid in exposed areas and, by a reaction catalyzed by the acid, changing the solubility in a developer between the areas having been exposed to actinic radiation and the nonexposed areas to thereby attain pattern formation on a substrate.

When a KrF excimer laser is used as an exposure radiation source, a resin whose fundamental skeleton is formed of a poly(hydroxystyrene) exhibiting a low absorption mainly in the region of 248 nm is employed as a major component of a resist composition. Accordingly, there can be attained a high sensitivity, high resolution and favorable pattern formation. Thus, a system superior to the conventional naphthoquinone diazide/novolac resin system is realized.

However, in using a radiation source of a further shorter wavelength, for example, an exposure radiation source of an ArF excimer laser (193 nm), as the compounds containing aromatic groups inherently exhibit a sharp absorption in the region of 193 nm, the above-mentioned chemical amplification system has not been satisfactory.

Consequently, resists for ArF excimer laser containing a resin with an alicyclic hydrocarbon structure have been developed.

It is generally known to use a triphenylsulfonium salt as a photoacid generator being a major component of any of chemical amplification resists (see, for example, patent reference 1).

In this connection, when use is made of, for example, a radiation source capable of emitting an electron beam, X-rays or EUV, the exposure is carried out in vacuum. This might cause any low-boiling-point compounds, such as solvents,

2

and resist materials decomposed by high energy to evaporate to thereby dirty the exposure apparatus. This outgassing problem is becoming serious. In recent years, various researches have been conducted toward the reduction of the outgassing, and various improvements have been proposed for photoacid generators (see, for example, patent reference 2).

There is a demand in the art for the development of a photosensitive composition that not only can reduce outgassing but also is enhanced in sensitivity, resolution, pattern configuration, roughness characteristic, etc. through the improvement of a photoacid generator (see, for example, patent references 3 and 4).

In particular, the roughness characteristic and resolution become important in accordance with the reduction of pattern dimension. In the field of lithography using X-rays, an electron beam or EUV, as the formation of a fine pattern of several tens of nanometers is targeted, it is required to realize, in particular, excellent resolution and roughness characteristic.

Further, the microfabrication using a resist composition is not only directly used in the manufacturing of integrated circuits but also, in recent years, finds application in the fabrication of so-called imprint mold structures, etc. (see, for example, patent references 5 and 6 and non-patent reference 1). Therefore, in the use of X-rays, soft X-rays or an electron beam as an exposure radiation source as well, it is an important task to simultaneously realize high sensitivity, high resolution, favorable pattern configuration and favorable roughness characteristic, and it is now needed to resolve the task.

PRIOR ART REFERENCE

Patent Reference

Patent reference 1: U.S. Pat. No. 6,548,221,
Patent reference 2: European Patent No. 1480078,
Patent reference 3: Jpn. Pat. Appln. KOKAI Publication No. (hereinafter referred to as JP-A-) 2007-94356,
Patent reference 4: JP-A-H11-30856,
Patent reference 5: JP-A-2004-158287, and
Patent reference 6: JP-A-2008-162101.

Non-Patent Reference

[Non-patent reference 1] “Fundamentals of nanoimprint and its technology development/application deployment—technology of nanoimprint substrate and its latest technology deployment” edited by Yoshihiko Hirai, published by Frontier Publishing (issued in June, 2006).

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide an actinic-ray- or radiation-sensitive resin composition exhibiting enhanced resolution, roughness characteristic, pattern configuration and outgassing performance without detriment to sensitivity. It is another object of the present invention to provide a method of forming a pattern using the composition.

The above objects are attained by employing as a photoacid generator a novel compound characterized in that an electron donating group is introduced in the sulfonium cation thereof and that the acid generated thereby exhibits a low diffusion.

Namely, the above problem can be solved by the present invention identified by the following features.

(1) An actinic-ray- or radiation-sensitive resin composition comprising an arylsulfonium salt that when exposed to actinic rays or radiation, generates an acid, the arylsulfonium salt containing at least one aryl ring on which there are a total