

MEANS FOR SOLVING THE PROBLEMS

[0012]

As a result of investigations to solve the problems, the
5 inventors have found that the objects can be achieved with the
polishing pad described below, and have completed the
invention.

[0013]

That is, the present invention relates to a polishing pad
10 having a polishing layer that is formed of a polyurethane foam
having fine cells, wherein

the polyurethane foam is a reaction cured body of a chain
extender and an isocyanate-terminated prepolymer which is
obtained by reacting a prepolymer starting material composition
15 that contains an isocyanate component, a high molecular weight
polyol and an aliphatic diol, wherein

the high molecular weight polyol contains a polyalkylene
glycol A that has a peak value of weight fraction ~~the molecular~~
~~weight distribution~~ within the range of a molecular weight of
20 200 to 300 in the molecular distribution and a polyalkylene
glycol B that has a peak value of weight fraction ~~the molecular~~
~~weight distribution~~ within the range of a molecular weight of
800 to 1200 in the molecular weight distribution.

[0014]

25 The present inventor has found that a polyurethane with

tough and extensible properties can be obtained by using a polyalkylene glycol A that has a peak value of the molecular weight distribution weight fraction within the range of a molecular weight of 200 to 300 in the molecular weight distribution in combination with a polyalkylene glycol B that has a peak value of the molecular weight distribution weight fraction within the range of a molecular weight of 800 to 1200 in the molecular weight distribution (that is, to use polyalkylene glycols having two ~~peaks~~ peak value of weight fraction in the molecular weight distribution), as a high molecular weight polyol starting material for polyurethane. The polishing pad (polishing layer) formed from the polyurethane is excellent in service life characteristics because of its superior wear resistance.

[0015]

If the peak value of weight fraction in the molecular weight distribution of the polyalkylene glycol A is out of the range of a molecular weight of 200 to 300, the strength (hardness or breaking strength) becomes excessive or insufficient. When the strength is too high, the polyurethane foam becomes hard and brittle and the service life of the polishing pad is reduced. When the strength is too low, deterioration due to water absorption is likely to occur in a hygroscopic environment, so that the polishing properties and service life of the polishing pad are reduced. In addition, if the peak value of weight

fraction in the molecular weight distribution of the polyalkylene glycol B is out of the range of a molecular weight of 800 to 1200, the elongation, i.e., the elasticity of the polishing pad becomes excessive or insufficient. When the
5 elongation is too large, it becomes difficult to dress the surface of the polishing pad, resulting in deterioration of the surface renewal property. When the elongation is too small, the polyurethane foam becomes hard and brittle and thus the service life of the polishing pad

producing a polishing pad, comprising the steps of:

(C) synthesizing an isocyanate-terminated prepolymer and

(D) mixing a first component containing the

isocyanate-terminated prepolymer with a second component

5 containing a chain extender and curing the mixture to prepare a polyurethane foam, wherein:

the step (C) comprises reacting an isocyanate component with an aliphatic diol and a polyalkylene glycol A that has a

10 peak value of weight fraction~~the molecular weight distribution~~ within the range of a molecular weight of 200 to 300 in the
molecular weight distribution to synthesize a prepolymer

precursor and then reacting the prepolymer precursor with a

polyalkylene glycol B that has a peak value of weight
fraction~~the molecular weight distribution~~ within the range of
15 a molecular weight of 800 to 1200 in the molecular weight
distribution to synthesize the isocyanate-terminated
prepolymer, and

the step (D) comprises adding 3 to 10 parts by weight

of a silicone-based surfactant based on 100 parts by weight of

20 the isocyanate-terminated prepolymer, to the first component containing the isocyanate-terminated prepolymer, further

stirring the first component together with a non-reactive gas

to form a cell dispersion liquid in which the non-reactive gas

is dispersed in the form of fine cells, then mixing the second

25 component containing the chain extender into the cell

dispersion liquid, and curing the mixture to prepare a polyurethane foam.

[0024]

them, an aromatic diisocyanate is preferably used in combination with an aliphatic diisocyanate and/or an alicyclic diisocyanate, and in particular, toluene diisocyanate is preferably used in combination with isophorone diisocyanate.

5 [0030]

As the high molecular weight polyol, there are used a polyalkylene glycol A that has a peak value of weight fraction
~~the molecular weight distribution~~ within the range of a
molecular weight of 200 to 300 in the molecular weight
10 distribution and a polyalkylene glycol B that has a peak value
of weight fraction~~the molecular weight distribution~~ within the
range of a molecular weight of 800 to 1200 in the molecular weight
distribution.

[0031]

15 The polyalkylene glycol A has preferably a peak value
of weight fraction~~the molecular weight distribution~~ within the
range of a molecular weight of 230 to 270 in the molecular weight
distribution, and the polyalkylene glycol B has preferably a
peak value of weight fraction~~the molecular weight distribution~~
20 within the range of a molecular weight of 950 to 1050 in the
molecular weight distribution.

[0032]

The polyalkylene glycols A and B include, for example,
polyethylene glycol, polypropylene glycol, polytetramethylene
25 glycol, and polyhexamethylene glycol.

[0033]

The number average molecular weight of the polyalkylene glycol A is preferably 200 to 300, more preferably 230 to 270, from the viewpoint of maintaining the strength of the

5 polyurethane.

[0034]

[0042]

Examples of the alcohol amine include monoethanolamine, 2-(2-aminoethylamino)ethanol, monopropanolamine, etc. These may be used singly or in combination of two or more.

5 [0043]

In the production of the isocyanate-terminated prepolymer, the isocyanate component, the high molecular weight polyol, the aliphatic diol and so on are blended in such a manner that the NCO index falls within the range of 1.7 to 2.1. The
10 NCO index is preferably 1.95 to 2.05.

[0044]

The isocyanate-terminated prepolymer is synthesized by reacting an isocyanate component with an aliphatic diol and a polyalkylene glycol A that has a peak value of weight
15 fraction~~the molecular weight distribution~~ within the range of a molecular weight of 200 to 300 in the molecular weight
distribution to synthesize a prepolymer precursor, and then reacting the prepolymer precursor with a polyalkylene glycol
B that has a peak value of weight fraction~~the molecular weight~~
20 ~~distribution~~ within the range of a molecular weight of 800 to 1200 in the molecular weight distribution. It is preferred to react the isocyanate component with the aliphatic diol at first and then react the reacted isocyanate component with the
polyalkylene glycol A that has a peak value of weight
25 fraction~~the molecular weight distribution~~ within the range of

a molecular weight of 200 to 300 in the molecular weight distribution, thereby to synthesize the prepolymer precursor.

By adopting the above-described synthetic method, a theoretically perfect isocyanate-terminated prepolymer with a reduced polymerization degree is obtained. In other words, the isocyanate-terminated prepolymer of the present invention includes a main chain portion containing a polyalkylene glycol

A that has a peak value of weight fraction~~the molecular weight distribution~~ within the range of a molecular weight of 200 to 300 in the molecular weight distribution and a main chain portion containing a polyalkylene glycol B that has a peak value of weight fraction~~the molecular weight distribution~~ within the range of a molecular weight of 800 to 1200 in the molecular weight distribution.

[0045]

It is preferable to add about 1% by weight of a heat stabilizer (for example, triphenyl phosphite, etc.) to the resulting isocyanate-terminated prepolymer. Thereby, it becomes possible to suppress the reaction between the isocyanate-terminated prepolymer and moisture during storage, as well as to inhibit the aging caused by heat that is secondarily applied to the polyurethane foam prepared with use of the isocyanate-terminated prepolymer.

[0046]

A chain extender is an organic compound having at least

two active hydrogen groups and examples of the active hydrogen group include: a hydroxyl group, a primary or secondary amino group, a thiol group (SH) and the like. Concrete examples of the chain extender include: polyamines such as

- 5 4,4'-methylenebis(o-chloroaniline) (MOCA),
- 2,6-dichloro-p-phenylenediamine,
- 4,4'-methylenebis(2,3-dichloroaniline),

specific limitation is placed on a flow rate of the slurry, a polishing load, a polishing platen rotation number and a wafer rotation number, which are properly adjusted.

[0073]

5 Protrusions on the surface of the semiconductor wafer 4 are thereby removed and polished flatly. Thereafter, a semiconductor device is produced therefrom through dicing, bonding, packaging etc. The semiconductor device is used in an arithmetic processor, a memory etc.

10

Examples

[0074]

Description will be given of the invention with examples, while the invention is not limited to description in the
15 examples.

[0075]

[Measurement and Evaluation Method]

(Measurement of Molecular Weight of Peaks Value of Weight Fraction in Molecular Weight Distribution of Polyalkylene Glycols A, B, and C)

20 The molecular weight distribution of the prepared isocyanate-terminated prepolymer was measured by GPC (gel permeation chromatography), and the molecular weight of peak value of weight fraction of the polyalkylene glycol A having
25 an isocyanate group at each end, the molecular weight of peak

value of weight fraction of the polyalkylene glycol B having
an isocyanate group at each end, and the molecular weight of
peak value of weight fraction of the polyalkylene glycol C
having an

toluene diisocyanate (a mixture of toluene 2,4-diisocyanate/toluene 2,6-diisocyanate=80/20) and 11.00 parts by weight of isophorone diisocyanate, and the mixture was adjusted to 50°C with stirring. Thereafter, 2.68 parts by weight of 1,4-butanediol were added to the reaction vessel and the temperature of the reaction vessel was adjusted to 75°C. Then, the temperature of the reaction vessel was lowered to 55°C, and 2.68 parts by weight of 1,4-butanediol were further added. After the temperature of the reaction vessel was adjusted to 75°C, the temperature was lowered to 55°C and 10.7 parts by weight of polytetramethylene glycol A having a number molecular weight of 250 (molecular weight of peak value of weight fraction in molecular weight distribution: 250) were added thereto. The reaction was carried out for 30 minutes while adjusting the temperature of the reaction vessel to 80°C. Thereafter, the temperature of the reaction vessel was lowered to 55°C and 10.7 parts by weight of polytetramethylene glycol A having a number average molecular weight of 250 were further added. After adjusting the temperature of the reaction vessel to 80°C, the reaction was carried out for 30 minutes. After that, the temperature of the reaction vessel was lowered to 60°C, and 73.24 parts by weight of polytetramethylene glycol B having a number average molecular weight of 1000 (molecular weight of peak value of weight fraction in molecular weight distribution: 1000). Then, the temperature of the reaction vessel was adjusted to

80°C, and the reaction was carried out for one hour to synthesize an isocyanate-terminated

[0088]

Comparative Example 1

(Synthesis of Isocyanate-terminated prepolymer)

To a reaction vessel were added 77 parts by weight of
5 polytetramethylene glycol B having a number average molecular
weight of 1000 (molecular weight of peak value of weight
fraction in molecular weight distribution: 1000), 13 parts by
weight of polytetramethylene glycol C having an average
molecular weight of 650 (molecular weight of peak value of
10 weight fraction in molecular weight distribution: 650), and 10
parts by weight of diethylene glycol, and the mixture was
dehydrated for 2 hours under reduced pressure with stirring.
Then, nitrogen was introduced into the reaction vessel so that
the atmosphere was replaced by nitrogen, and 62 parts by weight
15 of toluene diisocyanate and 10 parts by weight of
dicyclohexylmethane diisocyanate were added thereto. The
reaction mixture was stirred until completion of the reaction
while maintaining the temperature of the reaction system at
about 70°C. Thereafter, the product was defoamed under reduced
20 pressure for 2 hours to obtain an isocyanate-terminated
prepolymer.

[0089]

(Production of Polishing Pad)

To a reaction vessel were added 100 parts by weight of
25 the isocyanate-terminated prepolymer and 5 parts by weight of

a silicone-based surfactant (L5340 manufactured by NUC Corporation), and the mixture was blended, adjusted to 80°C,

CLAIMS

1. A polishing pad having a polishing layer that is formed of a polyurethane foam having fine cells, wherein

5 the polyurethane foam is a reaction cured body of a chain extender and an isocyanate-terminated prepolymer which is obtained by reacting a prepolymer starting material composition that contains an isocyanate component, a high molecular weight polyol and an aliphatic diol, wherein

10 the high molecular weight polyol contains a polyalkylene glycol A that has a peak value of weight fraction ~~the molecular weight distribution~~ within the range of a molecular weight of 200 to 300 in the molecular weight distribution and a polyalkylene glycol B that has a peak value of weight fraction ~~the molecular weight distribution~~ within the range of a
15 molecular weight of 800 to 1200 in the molecular weight distribution.

2. The polishing pad according to claim 1, wherein the
20 blending amount of the polyalkylene glycol A is 25 to 35 parts by weight based on 100 parts by weight of the polyalkylene glycol B.

3. The polishing pad according to claim 1 or 2, wherein
25 the aliphatic diol is 1,4-butanediol.

4. The polishing pad according to any one of claims 1 to 3, wherein the blending amount of the aliphatic diol is 1 to 7% by weight in the prepolymer starting material composition.

5

5. The polishing pad according to any one of claims 1 to 4, wherein the isocyanate component contains an aromatic diisocyanate and an aliphatic diisocyanate and/or an alicyclic diisocyanate.

10

6. The polishing pad according to any one of claims 1 to 5, wherein the polyurethane foam contains 3 to 10 parts by weight of a silicone-based surfactant based on 100 parts by weight of the isocyanate-terminated prepolymer.

15

7. The polishing pad according to any one of claims 1 to 6, wherein the polyurethane foam has an average cell diameter of 20 to 70 μm and a cut rate of 2 $\mu\text{m}/\text{min}$ or less.

20

8. The polishing pad according to any one of claims 1 to 7, wherein the polyurethane foam has a hardness reduction rate of 20% or less at water absorption and a breaking strength reduction rate of 20% or less at water absorption.

25

9. A method for producing a polishing pad, comprising

the steps of:

(C) synthesizing an isocyanate-terminated prepolymer and

(D) mixing a first component containing the

isocyanate-terminated prepolymer with a second component

5 containing a chain extender and curing the mixture to prepare
a polyurethane foam, wherein:

the step (C) comprises reacting an isocyanate component
with an aliphatic diol and a polyalkylene glycol A that has a

10 peak value of weight fraction ~~the molecular weight distribution~~
within the range of a molecular weight 200 to 300 in the molecular
weight distribution to synthesize a prepolymer precursor and
then reacting the prepolymer precursor with a polyalkylene
glycol B that has a peak value of weight fraction ~~the molecular~~
~~weight distribution~~ within the range of a molecular weight of
15 800 to 1200 in the molecular weight distribution to synthesize
the isocyanate-terminated prepolymer, and

the step (D) comprises adding 3 to 10 parts by weight
of a silicone-based surfactant based on 100 parts by weight of
the isocyanate-terminated prepolymer, to the first component
20 containing the isocyanate-terminated prepolymer, further
stirring the first component together with a non-reactive gas
to form a cell dispersion liquid in which the non-reactive gas
is dispersed in the form of fine cells, then mixing the second
component containing the chain extender into the cell
25 dispersion liquid, and curing the mixture to prepare a

polyurethane foam.

10. A method for manufacturing a semiconductor device,
comprising the step of polishing a surface of a semiconductor
5 wafer using the polishing pad according to any one of claims
1 to 8.