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Method Of Mounting And Demounting A Semiconductor Wafer And Substance Mixture Suitable For Carrying Out The Method

The invention relates to a method of mounting and demounting a semiconductor wafer, in which a temperature-dependently adhesive and curing joint is provided by a substance mixture between the semiconductor wafer and a carrier plate and the substance mixture contains a colophonium resin which is chemically modified and esterified, and the cured joint is released again after polishing the semiconductor wafer. In addition, the invention relates to a water-dissolved substance mixture which is temperature-dependently adhesive and curing in a dried state and which contains a colophonium resin which is chemically modified and esterified and is suitable for carrying out the method.

To polish a front side of a semiconductor wafer, the semiconductor wafer is mounted by means of the rear side on a carrier plate. The joint between the semiconductor wafer and the carrier plate is provided by means of a thin layer of a temperature-dependently adhesive and curing adhesive. Exceptional requirements have to be imposed on the adhesive for the polishing to be successful. The carrier plate must be capable of being uniformly coated with the adhesive. The adhesive action of the adhesive must be limited to a narrow temperature range. Under the polishing conditions, the adhesive must be and remain solid so that the semiconductor wafer remains attached to the carrier plate. The use of the adhesive must not, in particular, have an adverse effect on the shape of the polished semiconductor wafer. The surface of the polished semiconductor wafer must be as flat as possible. After polishing, the adhesive should be capable of being removed again from the carrier plate and the semiconductor wafer without special effort. Finally, the adhesive should not give off any substances, in particular

metal traces, which contaminate the semiconductor wafer.

Colophonium resins and their derivatives are known for having a temperature dependent adhesive action. Hitherto, however, it has not yet been possible to specify an adhesive based thereon which can fulfil the requirements mentioned to the full extent.

The invention relates to a method of mounting and demounting a semiconductor wafer, in which a temperature-dependently adhesive and curing joint is provided by a substance mixture between the semiconductor wafer and a carrier plate and the substance mixture contains a colophonium resin which is chemically modified and esterified, and the cured joint is released again after polishing the semiconductor wafer. The method comprises releasing the joint again with water. In addition, the invention relates to the substance mixture, which contains an amine of the formula $NR^1R^2R^3$ which saponifies the colophonium resin, at least one of the radicals R^1, R^2 and R^3 being the radical of an aliphatic alcohol and the boiling point of the amine being higher than 150°C at a pressure of 1000 mbar.

In particular, the invention is notable for the fact that no flammable solvents or gases harmful to health are released on mixing and heating the substance mixture and expensive safety precautions aimed at such substances can be dispensed with. In addition, the substance mixture can be converted to an adhesive state by heating to comparatively low temperatures and can be dissolved completely in water even in the cured state. In addition, the method does not leave behind any corrugation in the submicrometre range ("waviness") on the surface of the polished semiconductor wafer.

The substance mixture contains chemically modified and esterified colophonium resin. This product is also available commercially. The colophonium resin is preferably obtained by vacuum distillation from crude tall oil. Particularly preferably, a doubly vacuum-distilled fraction of the crude tall oil having a narrow molecular-

weight distribution is used for the substance mixture. The colophonium resin ("tall oil rosin") obtained in this way is chemically modified and esterified. It is preferable that the colophonium resin is modified by reaction with a compound selected from a group comprising maleic acid, maleic acid anhydride and fumaric acid. The modified resin is then preferably esterified with an alcohol selected from a group comprising glycerol and pentaerythritol. The chemically modified and esterified colophonium resin should have an acid number from 50 to 250, preferably 100 to 140 [mg KOH/g resin] and a softening point of 60 to 180°C, preferably 90 to 140°C. Particularly preferred is a resin from Arizona Chemicals, Sweden, which is obtainable commercially under the trade name Bergvik M-1XX, XX being a serial batch number, for example 00, 01 etc.

According to the invention, the modified and esterified colophonium resin is used to produce a substance mixture which contains an amine of the formula $NR^1R^2R^3$, at least one of the radicals R^1, R^2 and R^3 being the radical of an aliphatic alcohol and the boiling point of the amine being higher than 150°C at a pressure of 1000 mbar. Particularly preferable is the use of triethanolamine. Particularly suitable, furthermore, are: triisopropanolamine, diisopropanolamine and diethanolamine. The colophonium resin is saponified in the presence of the amine dissolved in water; under these circumstances, the resin soap dissolves in the aqueous phase.

According to a particularly preferred formulation, the substance mixture has the following composition:
15 to 20% by weight of chemically modified and esterified colophonium resin;
5 to 10% by weight of triethanolamine;
up to 2% by weight of non-ionic surfactant, in particular nonyl phenol polyether, which acts as a plasticizer;
up to 10% by weight of alcoholic solubilizer, in particular isopropanol;

up to 0.05% by weight of a dye, in particular crystal violet, fluorescent dyestuffs such as rhodamine B and eosin, and intensely coloured, water-soluble foodstuff dyes such as malachite green; and

water in an amount making up the sum of the amounts specified to 100% by weight.

The viscosity of the substance mixture has been adjusted so as to enable carrier plates to be coated homogeneously with the substance mixture. After coating, the substance mixture dries to form a temperature-dependently adhesive and curing mass. The adhesive action of the mass develops only within a narrow temperature range (adhesion zone, "sticking zone") of preferably 45 to 85°C. As in the case of a hot melt adhesive, the adhesive action decreases if the mass is heated above an upper temperature in the sticking zone. To produce a curing joint between a semiconductor wafer and the carrier plate, the carrier plate is heated to a temperature which is within the sticking zone, and one or more semiconductor wafers are placed on the carrier plate. When the carrier plate cools, the mass cures and consequently provides a firm joint between the semiconductor wafer and the carrier plate. Said joint remains firm even under the temperature conditions of 30 to 50°C normally prevailing during polishing. After the semiconductor wafer has been polished, the joint between the semiconductor wafer and the carrier plate is released again. This is done by exposure to water which preferably is at a temperature of 15 to 25°C. Water is capable of being able to release the residues of the substance mixture completely from the semiconductor wafer and the carrier plate.

The preparation of the substance mixture is clear from the examples below.

Example 1)

While stirring at room temperature, 139.26 kg of deionized water, 14.74 kg of triethanolamine (80% by weight), 4.52 kg of nonyl phenol polyether, 19.64 kg of

pure isopropanol and 0.1 kg of crystal violet were added in sequence to 35.74 kg of Bergvik M-106 resin. After the solids have dissolved, the mixture is filtered through a 5 ìm bag filter and poured into canisters. The viscosity of the solution was 22 mm^2/s at 25°C. The sticking zone of the dried substance mixture was in a temperature range from 49 to 72°C.

Example 2)

While stirring at room temperature, 138.50 kg of deionized water, 14.4 kg of triethanolamine (80% by weight), 4.50 kg of nonyl phenol polyether, 19.7 kg of pure isopropanol and 0.1 kg of malachite green were added in sequence to 35.74 kg of Bergvik M-106 resin. After the solids had dissolved, the mixture was filtered through a 5 ìm bag filter and poured into canisters. The viscosity of the solution was 22 mm^2/s at 25°C. The sticking zone of the dried substance mixture was in a temperature range of 60 to 80°C.

Example 3)

While stirring at room temperature 276.50 kg of deionized water, 23.12 kg of triethanolamine (80% by weight), 8.42 kg of nonyl phenol polyether, 25 kg of pure isopropanol and 0.185 kg of rhodamine B were added in sequence to 66.28 kg of Bergvik M-106 resin. After the solids had dissolved, the mixture was filtered through a 5 ìm bag filter and poured into canisters. The viscosity of the solution was 22 mm^2/s at 25°C. The sticking zone of the dried substance mixture was in a temperature range of 66 to 79°C.

Patent Claims:

1. A method of mounting and demounting a semiconductor wafer, in which a temperature-dependently adhesive and curing joint is provided by a substance mixture between the semiconductor wafer and a carrier plate and the substance mixture contains a colophonium resin which is chemically modified and esterified, and the cured joint is released again after polishing the semiconductor wafer, which method comprises releasing the cured joint with water.

2. The method as claimed in claim 1, wherein the substance mixture has, in a dried state, an adhesive action which develops only within a temperature range of 45 to 85°C.

3. The method as claimed in claim 1 or 2, wherein the cured joint is released with water without residues from the joint remaining on the carrier plate or the semiconductor wafer.

4. A water-dissolved substance mixture which temperature-dependently adheres and cures in a dried state and contains a colophonium resin which is chemically modified and esterified, wherein the substance mixture contains an amine of the formula $NR^1R^2R^3$ which saponifies the colophonium resin, at least one of the radicals R^1, R^2 and R^3 being the radical of an aliphatic alcohol and the boiling point of the amine being higher than 150°C at a pressure of 1000 mbar.

5. A substance mixture as claimed in claim 4, wherein the amine is selected from a group comprising triethanolamine, triisopropanolamine, diisopropanolamine and diethanolamine.

6. A substance mixture as claimed in claim 4 or 5, wherein the colophonium resin is chemically modified by

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reaction with a compound selected from a group comprising maleic acid, maleic anhydride and fumaric acid.

7. A substance mixture as claimed in one of claims 4 to 6, wherein the colophonium resin is esterified with an alcohol selected from a group comprising glycerol and pentaerythritol.

8. A substance mixture as claimed in one of Claims 4 to 7, which has the following composition:
15 to 20% by weight of chemically modified and esterified colophonium resin;
5 to 10% by weight of triethanolamine;
up to 2% by weight of non-ionic surfactant;
up to 10% by weight of alcoholic solubilizer;
up to 0.05% by weight of a dyestuff; and
water in an amount making the sum of the amounts specified up to 100% by weight.