been demanded.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide a protective film material for laser processing, by which, when the surface of a wafer is subjected to laser processing, it is possible to protect not only sections along streets but also the central portion of device chips by further securely coating the wafer surface with a protective film, and after the processing treatment such as dicing, debris can be removed together with the protective film by washing with water, and thus it becomes possible to obtain a clear wafer surface on which no attachment of debris is seen.

According to a first aspect of the present invention, there is provided a protective film material for laser processing, including a solution of a water-soluble adhesive and a water-soluble laser absorbent, wherein the water-soluble adhesive is a blend of polyvinyl alcohol and poly-N-vinyl acetamide at a ratio of 100 to 200:1 in the amounts of the respective components, and wherein the water-soluble laser beam absorbent is present in an amount effective to adjust absorbance at a wavelength of 355 nm (absorbance as calculated as a 200 times diluted solution) to 0.3 to 3.

According to a second aspect of the present invention, there is provided a wafer having a surface coated with the above protective film material, wherein the protective film material is applied to protect the surface of the wafer during a laser processing treatment carried out thereon, and is removable by washing with water from the surface of the wafer after completion of the laser processing treatment.

According to a third aspect of the present invention, there is provided a protective film for a laser processing treatment, in combination with a wafer having a surface provided with a

plurality of circuit devices separated by scribe streets, the protective film comprising a film of a water-soluble adhesive and a water-soluble laser beam absorbent present in an amount effective to adjust absorbance at a wavelength of 355 nm (absorbance as calculated as a 200-times diluted solution) to 0.3, to 3, the water-soluble adhesive comprising a blend of polyvinyl alcohol and poly-N-vinyl acetamide blended at a ratio of 100 to 200:1 in terms of amounts of the respective components, the protective film existing on the surface of the wafer during the laser processing treatment and being readily removable by water from the surface of the wafer, including the surfaces of circuit devices, after the laser processing treatment.

The water-soluble adhesive is preferably a blend of polyvinyl alcohol and poly-N-vinyl acetamide, and it is more preferred that the former and the latter are blended at a ratio of 100 to 200:1 in terms of amounts of respective components.

Further, the solution of the protective film material for laser processing preferably has a pH of 5 to 8.

Disclosed herein is a method for treating a wafer, which comprises coating a surface of a wafer with a protective film material for laser processing, and irradiating the surface of a wafer with a laser beam through the protective film material to accomplish the processing. In an example, the protective film material for laser processing contains a solution of a water-soluble adhesive and a water-soluble laser beam absorbent added to adjust absorbance at a wavelength of 355 nm to 0.3 to 3. In another example, in the protective film material for laser processing, the water-soluble adhesive is a blend of polyvinyl alcohol and poly-N-vinyl acetamide.

According to the above disclosure, after completion of the laser processing, the water-soluble protective film material can be removed together with the scattered debris by washing with water.

As the result, it becomes possible to obtain a clear wafer surface on which no debris is seen.

According to embodiments of the present invention, a laser processing operation such as scribing, dicing or grooving can be conducted under such condition that the wafer surface is coated and protected with the protective film material. By using the protective film material, it is possible to suppress the formation of debris generated by the laser processing operation and reduce the scattering of debris to the device chips on the wafer. Further, even if the debris is scattered, the device chips are protected by the protective film material, and then the debris can be removed easily together with the protective film material by washing with water. It is therefore possible to obtain a wafer having a clear surface without stains. It is also possible to narrow the width of the processing grooves and realize further efficient production of devices.

Further, embodiments of the present invention may be widely used for various types of laser processing operations in which re-attachment of foreign matter caused by various processing operations is anticipated. Embodiments of present invention may also be used for a grooving step by laser grooving of an insulating film such as a Low-k film.

Furthermore, the protective film material may be used for, for example, protection of the surface of various articles from being scratched, as a water-soluble protective film which can be removed easily by washing with water.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of the preferred embodiments of the invention, will be better understood when read in conjunction with the

CLAIMS

1. A protective film material for laser processing, comprising:

a solution of a water-soluble adhesive and a water-soluble laser absorbent,

wherein the water-soluble adhesive is a blend of polyvinyl alcohol and poly-N-vinyl acetamide at a ratio of 100 to 200:1 in the amounts of the respective components, and

wherein the water-soluble laser beam absorbent is present in an amount effective to adjust absorbance at a wavelength of 355 nm (absorbance as calculated as a 200 times diluted solution) to 0.3 to 3.

2. The protective film material for laser processing according to claim 1, wherein the poly-N-vinyl acetamide has an absolute molecular weight of about 10,000 to 1,800,000.

3. The protective film material for laser processing according to claim 1, wherein the solution of the protective film material for laser processing has a pH of 5 to 8.

4. A wafer having a surface coated with the protective film material as defined in claim 1, wherein the protective film material is applied to protect the surface of the wafer during a laser processing treatment carried out thereon, and is removable by washing with water from the surface of the wafer after completion of the laser processing treatment.

5. The wafer according to claim 4, wherein the poly-N-vinyl acetamide has an absolute molecular weight of about 10,000 to 1,800,000.

6. The wafer according to claim 4, wherein the solution of the protective film material for laser processing has a pH of 5 to 8.

7. A protective film for a laser processing treatment, in combination with a wafer having a surface provided with a plurality of circuit devices separated by scribe streets, the protective film comprising a film of a water-soluble adhesive and a water-soluble laser beam absorbent present in an amount effective to adjust absorbance at a wavelength of 355 nm (absorbance as calculated as a 200-times diluted solution) to 0.3, to 3, the water-soluble adhesive comprising a blend of polyvinyl alcohol and poly-N-vinyl acetamide blended at a ratio of 100 to 200:1 in terms of amounts of the respective components, the protective film existing on the surface of the wafer during the laser processing treatment and being readily removable by water from the surface of the wafer, including the surfaces of circuit devices, after the laser processing treatment.

8. The protective film according to claim 7, wherein the solution of the protective film material for laser processing has a pH of 5 to 8.