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Process for treating a polished semiconductor wafer immediately after the semiconductor wafer has been polished

The invention relates to a process for treating a polished semiconductor wafer immediately after the semiconductor wafer has been polished. Polishing the semiconductor wafer represents the final step in the production of the semiconductor wafer and has a decisive influence on the shaping of the semiconductor wafer. The aim of the polishing is to create a surface which is as planar, smooth and defect-free as possible on at least one of the two sides of the semiconductor wafer. Such a surface is absolutely imperative if it is to be possible to accommodate functioning electronic structures in high density on the semiconductor wafer. Certain defects on the surface of the semiconductor wafer, which may later lead to an electronic component failing, can be recognized by a characteristic light scattering behaviour and can be indicated in terms of size and number as so-called LPDs (light point defects).

Single side and double side polishing processes are usually employed to polish a semiconductor wafer. In the case of single side polishing (SSP), after the rear side of the semiconductor wafer has been mounted on a suitable support only the front side is polished using a polishing cloth stretched over a polishing plate. On mounting, a form- and force-fitting connection is produced between the rear side and the support, for example by adhesion, adhesive bonding, cementing or the application of a vacuum. Single side polishing processes and devices are usual for single wafer polishing or for polishing batches of wafers. In the case of double side polishing (DSP), front side and rear side are polished simultaneously, by guiding a plurality of semiconductor wafers between two, upper and lower, polishing plates over which polishing cloths are stretched. In this case, the semiconductor wafers are positioned in thin wafer carriers, which are also [phrase missing] used in similar

form when lapping semiconductor wafers.

The polished surface of a semiconductor wafer has hydrophobic properties. It is very sensitive to uncontrolled chemical attack from an etching agent and it promotes the deposition of particles. Both of these problems can lead to a relatively rapid rise in the number of LPDs. Such a rise can be avoided by ensuring that the environment is as far as possible free of particles, and uncontrolled chemical attack from residues of polishing abrasive is suppressed by transferring the semiconductor wafer into a flushing or cleaning bath immediately after the polishing.

On the other hand, it is still possible to observe a rise in the number of LPDs over time even if the semiconductor wafer is stored in deionized water immediately after polishing and is only subsequently subjected to a conventional cleaning procedure. However, in mass production of semiconductor wafers, waiting times between the polishing and the cleaning of a polished semiconductor wafer are frequently desirable for technical and economic reasons. If every semiconductor wafer had to be cleaned immediately after polishing, single wafer polishing would be necessary, and it is very technically complex to achieve this in the manner of a batch polishing and the process is correspondingly expensive.

The present invention achieves the object of counteracting a considerable increase in the number of LPDs when a polished semiconductor wafer is not cleaned immediately after the polishing, but rather is stored beforehand.

The subject-matter of the invention is a process for treating a polished semiconductor wafer immediately after the semiconductor wafer has been polished, which is characterized in that the semiconductor wafer is brought into contact with an aqueous treatment agent and its polished surface is oxidized by the action of the treatment agent.

The polished surface of the semiconductor wafer

is then coated with a thin film of oxide and has hydrophilic properties. As a result, the semiconductor wafer is less sensitive to residues of polishing abrasive and particles. After the oxidizing treatment, it can be stored and cleaned in the usual way only at a later time without the risk of the number of LPDs rising considerably during the storage time.

The treatment agent proposed is an aqueous, oxidizing and alkaline solution. The action of such a solution results in a thin, passivative film of oxide on the polished surface of the semiconductor wafer. It is preferred for the aqueous treatment agent to contain hydrogen peroxide (H_2O_2) as oxidizing agent and an alkaline component. This component is preferably selected from a group comprising the compounds tetramethylammonium hydroxide, ammonium hydroxide, potassium hydroxide, sodium hydroxide, potassium carbonate and mixtures of these compounds. It is particularly preferred to use a treatment agent which contains the oxidizing agent in a concentration of from 0.02 to 3.0% by volume and the alkaline component in a concentration of from 0.01 to 2.0% by weight and is at a temperature of from 18 to 65°C.

Furthermore, it has been found that a certain degree of passivation of the polished surface of the semiconductor wafer also occurs if the semiconductor wafer is treated with a surfactant-containing cleaning agent or medium.

The semiconductor wafer can be brought into contact with the treatment agent in various ways. This can take place while the semiconductor wafer is still lying on the polishing plate. On the other hand, the semiconductor wafer may also first be removed from the polishing plate and then transferred to a different base or into a holder. Accordingly, the oxidizing treatment preferably takes place in the polishing machine or in an unloading station which is connected thereto. The oxidizing treatment can be performed by bringing the polished surface of the semiconductor wafer into contact with a

cloth which is moistened with the treatment agent or by spraying the polished surface with the treatment agent. The semiconductor wafer can also be dipped into a bath of the treatment agent. Treatment using a moistened cloth is preferably carried out in the same way as a polishing operation, the cloth which has been moistened with the treatment agent taking the place of the polishing cloth and a polishing abrasive being dispensed with.

It is expedient to flush the treatment agent off the semiconductor wafer after the oxidizing treatment, preferably using deionized water. The semiconductor wafer is sufficiently protected against undesired attack by polishing abrasive and can be stored until it is cleaned in the usual manner, preferably also in deionized water. The storage time is preferably 15 to 180 min, particularly preferably 15 to 30 min. The semiconductor wafer is then cleaned. It is preferred to begin cleaning by treating the semiconductor wafer with dilute hydrofluoric acid, which removes the film of oxide. The further cleaning of the semiconductor wafer may then comprise, for example, the known RCA cleaning or a variant of this process.

The invention was tested on silicon wafers. To do so, test wafers were treated according to the invention immediately after a standard polishing operation and were then stored in deionized water. The wafers were subsequently subjected to final cleaning, were dried and were examined for LPDs using a commercially available analysis apparatus. Further silicon wafers, as comparative wafers, were polished in the same way, stored in deionized water and cleaned. These wafers were not treated according to the invention immediately after polishing.

The following table lists the results of the LPD determination. The number given represents the total LPDs > 0.12 μm found. The reference parameter is the number of LPDs found on the comparative wafers of type I, normalized to 100%.

Table:

Type of wafer	Length of storage	LPDs [%]
Test wafers I	no storage	136
Comparative wafers I	no storage	100
Test wafers II	3 hours	96
Comparative wafers II	3 hours	400
Test wafers III	5 hours	727
Comparative wafers III	5 hours	1,878

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Patent Claims:

1. Process for treating a polished semiconductor wafer immediately after the semiconductor wafer has been polished, characterized in that the semiconductor wafer is brought into contact with an aqueous treatment agent and its polished surface is oxidized by the action of the treatment agent.

2. Process according to Claim 1, characterized in that the semiconductor wafer is brought into contact with a treatment agent which contains an oxidizing agent and an alkaline component.

3. Process according to Claim 1 or Claim 2, characterized in that the treatment agent is brought into contact with the semiconductor wafer in a manner which encompasses spraying the semiconductor wafer with the treatment agent, dipping the semiconductor wafer into the treatment agent and applying the treatment agent to the polished surface of the semiconductor wafer by means of a cloth which has been moistened with the treatment agent.

4. Process according to one of Claims 1 to 3, characterized in that the semiconductor wafer is brought into contact with the treatment agent in a polishing machine or in the unloading station of a polishing machine.

5. The process as claimed in one of Claims 1 to 4, characterized in that the semiconductor wafer is stored in deionized water after the treatment agent has taken effect.

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