

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a polishing apparatus and a polishing method for semiconductor wafers, which can effectively prevent heavy metal contamination of semiconductor wafers in the polishing process, especially, in the mirror polishing process.

2. Description of the Related Art

A polishing apparatus having a turn table assembly provided with a turn table for polishing semiconductor wafers is known. Such a polishing apparatus is used in the polishing process such as the mirror polishing process of semiconductor wafers. Generally, the mirror polishing is carried out by pressing a wafer on a polishing pad adhered on the turn table. In that case, the turn table is rotated, and a strong alkaline solution containing dispersed colloidal silica (hereinafter, referred to as "polishing slurry" or simply "slurry") is supplied on the turn table to supply it between the wafer and the polishing pad. Namely, the slurry is supplied from a polishing slurry tank (hereinafter, may be referred to as "slurry tank") onto the turn table under pressure by a pump. After used for polishing, the slurry is directly thrown away or returned to the slurry tank to be used again from an economical viewpoint (hereinafter, the reuse of slurry may be referred to as "circulation use").

In the polishing apparatus, there are many metallic parts or portions which the slurry may touch. Therefore, the wafer to be polished may be contaminated by heavy metal ions which dissolve from the polishing apparatus and is concentrated in the slurry by the circulation use. Moreover, the existing polishing apparatus has no special means for preventing wafer contamination when the slurry is contaminated unexpectedly by such heavy metal ions. Especially, Cu^{2+} and Ni^{2+} ions may largely contaminate the wafer because of their relatively high diffusion coefficient in silicon. Therefore, it has been desired to decrease the concentration of such ions in the wafer polishing process.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a polishing apparatus and a polishing method for semiconductor wafers, which can effectively prevent the heavy metal contamination of semiconductor wafers in the polishing process, especially in the mirror polishing process.

The apparatus for polishing semiconductor wafers of the present invention includes a turn table assembly having a rotatably fixed turn table and a polishing slurry tank for storing polishing slurry to be supplied onto the turn table through a polishing slurry supplying member,

wherein the polishing slurry supplying member is provided with means for eliminating heavy metal ions from the polishing slurry. The means for eliminating heavy metal ions in the polishing slurry may be a metal ion capturing high-molecular weight compound or resin.

As the metal ion capturing high-molecular weight compound or resin, cation-exchange resins and chelate resins can be mentioned. Especially, it is preferred to use iminodiacetic acid-type chelate resins which can strongly capture Cu^{2+} and Ni^{2+} for eliminating Cu^{2+} and Ni^{2+} which are apt to be contaminate the wafer.

The metal ion capturing resin which is enclosed and filled up in a heavy metal capturing means such as a column or the like can capture the heavy metal ions mixed in the slurry by dissolution from the polishing apparatus or other unexpected contamination. Thus, the polishing slurry to be supplied onto the turn table contains almost no heavy metal ions, thereby suppressing the heavy metal contamination of wafers.

Further, it is advantageous from an economical viewpoint that the polishing apparatus can carry out the circulation use of the polishing slurry by repeatedly returning the slurry to the slurry tank after finishing each polishing process, whereby the polishing slurry may be usable repeatedly.

For example, a polishing slurry supplying tube may be used as the polishing slurry supplying means. Further, if the heavy metal ion capturing column is disposed in close vicinity of the polishing slurry supplying opening end of the polishing slurry supplying tube, the polishing slurry which is purified by passing through the heavy metal ion column can be supplied to the polishing area immediately after passing through the heavy metal ion capturing column. Therefore, the possibility of recontamination of the purified polishing slurry by the travel from the ion capturing column to the polishing slurry supplying opening end can be advantageously reduced.

In the polishing method of semiconductor wafers of the present invention, semiconductor wafers are polished using the above-mentioned polishing apparatus to eliminate heavy metal ions from the polishing slurry.

The above and other objects, features and advantages of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the accompanying sheets of drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic side view of one embodiment of a polishing apparatus for semiconductor wafers according to the present invention.

Fig. 2 is a graph showing impurity concentration on wafers of Example 1 (after setting of a chelate resin column) and Comparative Example 1 (before setting of the chelate resin column).

Fig. 3 is a graph showing impurity concentration on wafers of Example 2 (with a chelate resin column) and Comparative Example 2 (without a chelate resin col-

umn).

DETAILED DESCRIPTION

The present invention will be described below with reference to a preferred embodiment illustrated in the accompanying drawings. Fig. 1 is a schematic side elevation of one embodiment of a polishing apparatus for semiconductor wafers according to the present invention.

In Fig. 1, reference numeral 12 designates a polishing apparatus of wafers according to the present invention, which includes a turn table assembly 14 and a polishing slurry tank 18 for storing polishing slurry (a strong alkaline solution containing dispersed colloidal silica) 16 to be used in the turn table assembly 14.

The turn table assembly 14 has a fiat-bottomed slurry receiver 20 which opens upwardly. A rotary shaft 22 extends upwardly from the central portion of the slurry receiver 20. At the upper end of the rotary shaft 22 a turn table body 24a is attached. Further, a polishing pad 26 is adhered on all the upper surface of the turn table body 24a. A turn table 24 is composed of the turn table body 24a and the polishing pad 26.

Reference numeral 28 designates a dead weight which functions to press a wafer(W) placed on the turn table 24 downwardly to the polishing pad 26. A polishing slurry supplying tube 30 has a bottom end opening 31 positioned in the lower part of the slurry tank 18, a distal end opening to be used as a polishing slurry supplying opening 32 and a pump means (P) disposed at an intermediate portion of the tube 30. Thus, the polishing slurry 16 stored in the slurry tank 18 is supplied via the slurry supplying tube 30 from the polishing slurry supplying opening 32 to the polishing area on the turn table 24 of the turn table assembly 14.

Numeral reference 34 designates means for eliminating heavy metal ions disposed at intermediate portion of the polishing slurry supplying tube 30, specifically speaking, a column in which a high-molecular weight compound having heavy metal ion capturing groups is enclosed and filled up. Preferably, the heavy metal eliminating means 34 is positioned in as close as possible vicinity to the polishing slurry supplying opening 32 to reduce the possibility of recontamination of the polishing slurry already purified by the heavy metal eliminating means 34.

As the high-molecular weight compound for capturing metal ions, there can be mentioned cation-exchange resins and chelate resins. Especially, it is preferred to use iminodiacetic acid-type chelate resins strongly capturing Cu^{2+} and Ni^{2+} for the purpose of effectively eliminating Cu^{2+} and Ni^{2+} which are apt to contaminate the wafer.

Numeral reference 36 designates a polishing slurry collecting tube which has a bottom end opening 36a communicating with the slurry receiver 20 and a distal end opening 36b extending over the polishing slurry tank 18.

With the arrangement described above, for the mirror polishing of wafer (W), polishing slurry 16 is supplied from the polishing slurry supplying opening 32 to the turn table 24 under pressure by pump (P), the wafer (W) being pressed on the turn table 24 by dint of the dead weight 28.

In the polishing apparatus 12 of the present invention, heavy metal ions which are dissolved from the polishing apparatus 12 into the polishing slurry 16 or mixed unexpectedly therewith are captured or eliminated by the heavy metal eliminating means 34 when the slurry 16 passes therethrough. Thus, polishing slurry 16 containing substantially no heavy metal ions is supplied onto the turn table 24. Therefore, the contamination of the wafer(W) to be polished in virtue of heavy metal ions can be suppressed.

The invention will be further described by way of the following examples which should be construed illustrative rather than restrictive.

[Example 1 (elimination of heavy metal ions with an iminodiacetic acid-type chelate resin) and Comparative Example 1]

Condition:

- Sample wafers: Czochralski-grown p-type, resistivity; about $0.008 \Omega\text{-cm}$, 8-inch-diameter, silicon wafer
- Polishing slurry: 10 vol% of AJ-1325 [SiO_2 2 wt%, pH11, trade name for a colloidal silica polishing agent manufactured by NISSAN CHEMICAL INDUSTRIES LTD.] and pure water (the rest).
- Polishing load: 400g/cm^2
- Polishing time: 10 min.

With the polishing apparatus 12 shown in Fig. 1 in which the heavy metal ion eliminating means (column) was prepared in the following procedure, the following respective experiments were conducted using the above-mentioned sample wafers and the polishing slurry.

An iminodiacetic acid-type chelate resin was immersed in water all day and all night, and then its conditioning was carried out several times with hydrochloric acid and ammonia water of proper concentrations. Thereafter, the resin was enclosed in a column made of PTFE (polytetrafluoroethylene) (having a length of about 50 cm and a diameter of about 10 cm). The column was then disposed at intermediate portion of the slurry supplying tube 30 between the slurry tank 18 and the slurry supplying opening 32. Thereafter, the above-mentioned polishing slurry intentionally contaminated with 100 ppb each of Ni^{2+} and Cu^{2+} was put into the slurry tank 18.

In the case (Comparative Example 1) using intentionally contaminated slurry, and in the other case (Example 1) using slurry prepared by purifying the intentionally contaminated slurry with the iminodiacetic

acid-type chelate resin, a silicon wafer was polished under the polishing condition specified above, respectively. After completion of the polishing, Ni^{2+} and Cu^{2+} concentrations on the respective silicon wafers were measured. The results of the measurements were shown in Fig. 2. As clearly seen from Fig. 2, Ni^{2+} and Cu^{2+} in the intentionally contaminated slurry were effectively eliminated by the chelate resin with a result that the concentrations of Ni^{2+} and Cu^{2+} were decreased, respectively.

[Example 2 and Comparative Example 2]

In the case (Example 2) with the iminodiacetic acid-type chelate resin column, and in the other case (Comparative Example 2) without the chelate resin column, a silicon wafer was polished under the same condition as in Example 1 by the circulation use of the polishing slurry intentionally contaminated with 20 ppb of Ni^{2+} , respectively. The changes of Ni^{2+} concentrations on the respective silicon wafers against time of the circulation use of the polishing slurry were measured. The results of the measurements were shown in Fig. 3. As clearly seen from Fig. 3, the Ni^{2+} concentration is gradually increased in the polishing apparatus without the chelate resin column, while the Ni^{2+} concentration is kept at a relatively low level in the polishing apparatus with the chelate resin column.

From the results of the above Examples and Comparative Examples, it is seen that the setting of the heavy metal ion eliminating means between the slurry tank and the turn table assembly or in the slurry supplying tube is effective for suppressing the heavy metal contamination of semiconductor wafers.

In the above Examples, Ni^{2+} and Cu^{2+} ions were employed as heavy metal ions and hence the iminodiacetic acid-type chelate resin was used to eliminate the ions. In case of eliminating ions other than Ni^{2+} and Cu^{2+} , if other metal ion capturing resins effective for eliminating the other ions are used, it is needless to say to achieve a similar result.

As stated above, according to the present invention, when polishing slurry is contaminated by dissolution of heavy metal ions from metallic portions of a polishing apparatus or an unexpected accident, heavy metal contamination on semiconductor wafers in a wafer polishing process can be suppressed by setting a heavy metal ion capturing means, for example, a column filled up with a high-molecular weight compound for eliminating heavy metal ions at a polishing slurry supplying member, for example, in close vicinity of a polishing slurry supplying opening of a polishing slurry supplying tube.

Obviously, various minor changes and modifications of the present invention are possible in the light of the above teaching. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

Claims

1. A polishing apparatus of semiconductor wafers including a turn table assembly having a rotatably fixed turn table and a polishing slurry tank for storing polishing slurry to be supplied onto the turn table through a polishing slurry supplying member, wherein said polishing slurry supplying member is provided with means for eliminating heavy metal ions from said polishing slurry.
2. A polishing apparatus according to claim 1, wherein said means for eliminating heavy metal ions from said polishing slurry is a column which is enclosed and filled up with a high-molecular weight compound for capturing heavy metal ions.
3. A polishing apparatus according to claim 2, wherein said high-molecular weight compound is an iminodiacetic acid-type chelate resin.
4. A polishing apparatus according to any one of claims 1 to 3, wherein said polishing slurry is returned to said polishing slurry tank after said polishing slurry is used in a polishing process so as to enable circulation use of said used polishing slurry in which said used polishing slurry is again used for polishing.
5. A polishing apparatus according to any one of claims 2 to 4, wherein said polishing slurry supplying member comprises a polishing slurry supplying tube, and said column is disposed in close vicinity to the polishing slurry supplying opening of said polishing slurry supplying tube.
6. A polishing method of semiconductor wafers, wherein semiconductor wafers are polished with polishing slurry from which heavy metal ions are eliminated using said polishing apparatus according to any one of claims 1 to 5.

FIG. 1

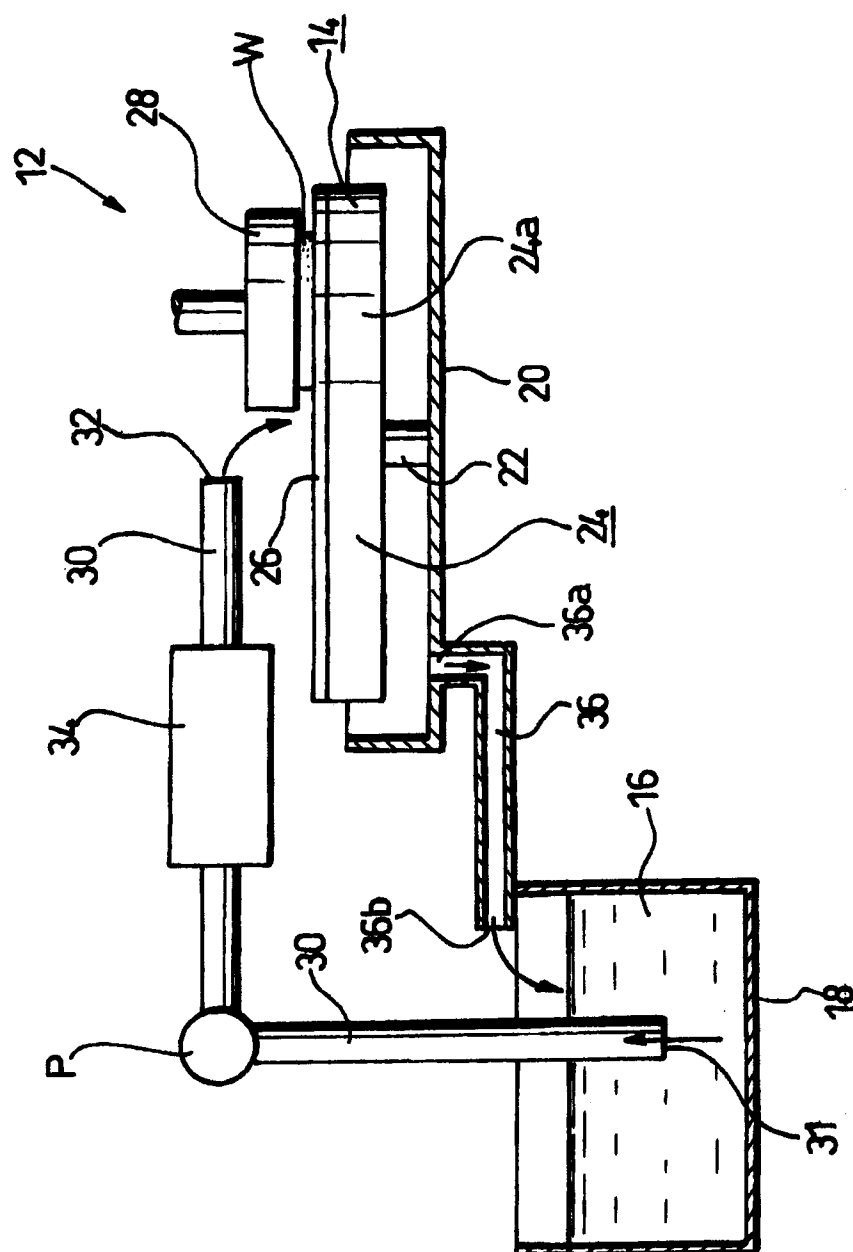


FIG. 2

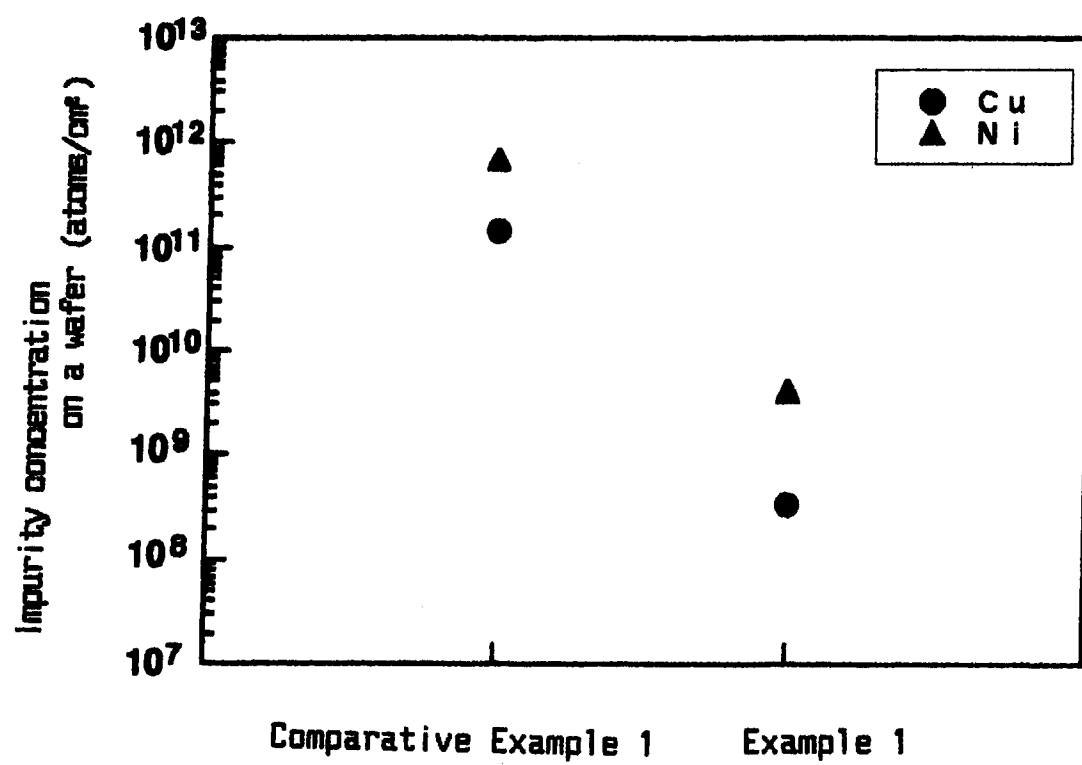


FIG. 3

