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Process for the wet chemical treatment of semiconductor wafers

The invention relates to a process for the wet chemical treatment of semiconductor wafers, in which the semiconductor wafers are treated with treatment liquids, in particular a process for the cleaning of silicon semiconductor wafers.

A process of this generic type has been described, for example, by M. Meuris et al. in Solid State Technology, July 1995, p. 109.

The present invention provides a process by which metallic impurities and particles can be removed particularly effectively from semiconductor wafers.

The invention relates to a process for the wet chemical treatment of semiconductor wafers, in which the semiconductor wafers are treated with treatment liquids, wherein the semiconductor wafers are firstly treated with an aqueous HF solution, then with an aqueous O_3 solution and finally with water or an aqueous HCl solution, these treatments forming a treatment sequence.

It has been found that the object is achieved by this treatment sequence, which does not need to be interrupted by rinsing with water or another treatment liquid and is carried out exclusively at a pH which is lower than pH 7. The treatment according to the invention with the treatment liquids indicated is performed in treatment baths, it being preferable to circulate the treatment liquid, that is to say to take some of it from the corresponding treatment bath and put it back after having been filtered. This saves on outlay for the required chemicals and for deionized water. The addition of fresh water or other liquids to the treatment baths is to be avoided since, when valves are opened, pressure impulses are created and particles can be introduced into the baths. The treatment according to the invention is therefore different from a rinsing treatment, in which fresh treatment liquid is supplied continuously or at intervals.

The treatments, consisting in treating the

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semiconductor wafers firstly in a bath with an aqueous HF solution, then in a bath with an aqueous O_3 solution and finally in a bath with water or an aqueous HCl solution, form a treatment sequence B_2, which may be preceded by a treatment B_1 of the semiconductor wafers in a bath with an aqueous SC1 solution. An SC1 solution which contains NH_4OH and H_2O_2 or TMAH (= tetramethylammonium hydroxide) and H_2O_2 is preferred. The treatment sequence B_2 may also be followed by a treatment B_3 of drying the semiconductor wafers. The drying treatment is preferably carried out using the centrifugal, hot water, isopropanol or marangoni principle.

It is particularly preferable to arrange the sequencing of the treatment of the semiconductor wafers according to the term $m*(B_1 + B_2) + B_3$, m being a natural number and the treatment B_1 and the treatment sequence B_2 being carried out in succession, and this taking place m times, before the drying treatment B_3 is performed.

The aqueous HF solution used in the treatment sequence B_2 preferably contains HF in a concentration of from 0.001 to 2% by weight and optionally HCl in a concentration of up to 2% by weight and optionally a surfactant. A mixture of alkylbenzenesulfonate and fatty amine polyglycol ethers in a concentration of 0.001 to 2% by weight is particularly preferred as a surfactant additive. The aqueous O_3 solution used in the treatment sequence B_2 preferably contains O_3 in a concentration of from 1 to 30 ppm and optionally HF in a concentration of from 0.0001 to 2% by weight and is optionally exposed to megasonic waves. The liquid used last in the treatment sequence B_2 is water or an aqueous HCl solution, which preferably contains HCl in a concentration of from 0.001 to 10% by weight. The liquid may optionally contain O_3 and optionally be exposed to megasonic waves. The temperature of the bath is preferably at a temperature of from room temperature to 80°C.

The comparison below of an example with comparative examples shows the advantageous effect of the invention.

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The table contains the results (3 sigma values) of conventional counts of particles of specific size (LPD = light point defects), which were in each case carried out on 20 polished semiconductor wafers after a wet chemical treatment sequence and drying which was the same for all the semiconductor wafers.

The example (B) comprised the treatment sequence: HF bath, deionized water/ozone bath, HCl bath with megasonic exposure.

Comparative Example 1 (C1) comprised the treatment sequence: HF bath, deionized water/ozone bath, rinsing with deionized water outside the bath.

Comparative Example 2 (C2) comprised the treatment sequence: HF bath, deionized water/ozone bath with subsequent rinsing using deionized water in the bath and megasonic exposure.

LPD (μM)	>0.3	>0.2	>0.16	>0.12
	Number	Number	Number	Number
B	3	7	30	480
C1	4	13	50	550
C2	10	50	140	550

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Claims:

1. A process for the wet chemical treatment of semiconductor wafers, in which the semiconductor wafers are treated with treatment liquids, wherein the semiconductor wafers are firstly treated with an aqueous HF solution, then with an aqueous O_3 solution and finally with water or an aqueous HCl solution, these treatments forming a treatment sequence B_2.

2. The process as claimed in claim 1, wherein the treatment sequence B_2 is preceded by a treatment B_1 of the semiconductor wafers with an aqueous SC1 solution.

3. The process as claimed in claim 1 or claim 2, wherein the treatment sequence B_2 is followed by a treatment B_3 of drying the semiconductor wafers.

4. The process as claimed in claim 3, wherein the treatment of the semiconductor wafers is sequenced according to the term $m*(B_1 + B_2) + B_3$, m being a natural number and the treatment B_1 and the treatment sequence B_2 being carried out in succession, and this taking place m times, before the drying treatment B_3 is performed.

5. The process as claimed in one of claims 1 to 4, wherein the aqueous HF solution contains HF in a concentration of from 0.001 to 2% by weight and optionally HCl in a concentration of up to 2% by weight and optionally a surfactant.

6. The process as claimed in one of claims 1 to 5, wherein the aqueous O_3 solution contains O_3 in a concentration of from 1 to 30 ppm and is optionally exposed to megasonic waves.

7. The process as claimed in one of claims 1 to 6, wherein the treatment liquid used last in the treatment sequence B_2 contains ozone and is optionally exposed to megasonic waves.

8. The process as claimed in one of claims 3 to 7, wherein the drying treatment is carried out using the centrifugal, hot water, isopropanol or marangoni principle.

9. The process as claimed in one of claims 2 to 8, wherein the aqueous SC1 solution contains NH_4OH and H_2O_2

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or TMAH (= tetramethylammonium hydroxide) and H_2O_2.

10. The process as claimed in one of claims 1 to 9, wherein each treatment is carried out with a treatment liquid, ~~with one treatment liquid~~ in a bath.