Claims

1. A process for producing a semiconductor wafer of single-crystal silicon, comprising

growing a silicon single crystal by the Czochralski pulling process, wherein during the pulling the partial pressure of H_2 in the atmosphere in the pulling apparatus does not fall below 20 Pa;

separating a crystal piece from the ingot;

producing a test wafer from the crystal piece;

examining the test wafer for oxygen precipitates and interstitial oxygen, wherein the interstitial oxygen is determined to be not less than 4.5×10^{17} atoms/cm³ measured according to new ASTM and not more than 5.2×10^{17} atoms/cm³ measured according to new ASTM;

separating substrate wafers from the crystal piece with a diameter of not less than 300 mm;

an RTA treatment of the substrate wafer containing a first heat treatment of the substrate wafer at a first temperature in a temperature range of not less than 1200°C and not more than 1260°C for a period of not less than 5 s and not more than 30 s,

wherein a front side of the substrate wafer is exposed to an atmosphere containing argon,

a second heat treatment of the substrate wafer at a second temperature in a temperature range of not less than 1150°C and not more than 1190°C for a period of not less than 15 s and not more than 20 s, wherein a front side of the substrate wafer is exposed to an atmosphere containing argon and ammonia,

and a third heat treatment of the substrate wafer at a third temperature in a temperature range of not less than 1160°C and not more than 1190°C for a period

of not less than 20 s and not more than 30 s, wherein a front side of the substrate wafer is exposed to an inert atmosphere;

for the examination of the test wafer for oxygen precipitates, the test wafer is inserted into a furnace under a nitrogen atmosphere at a temperature between 880°C and 920°C and held there for at least 6 hours and at most 10 hours;

subsequently heated to at least 1080°C and at most 1120°C;

followed by wet oxidation with O_2/H_2 for a holding time between 1.5 and 2.5 hours;

then cooled under a pure O_2 atmosphere;

all heating and cooling rates are in the range between 5 K/min and 10 K/min;

the test wafer is then subjected to Secco etching with a removal of at least 5 µm and at most 10 µm;

defects occurring are detected using a radially scanning optical microscope and their density is determined;

and the examination has shown that the measured defect density in a circle on the front side of the test wafer, which shares its center with the front side of the test wafer and has a radius of not more than 50 mm, is greater than 50 defects/cm² and less than 75 defects/cm², and on the remainder of the test wafer less than 50 defects/cm², and over the entire front side of the test wafer less than 50 defects/cm².

2. The process as claimed in claim 1, wherein the time between the beginning of the first heat treatment and the end of the third heat treatment is not more than 320 s.

3. The process as claimed in claim 1 or claim 2, wherein

the minimum temperature of the substrate wafer

both between the first and the second heat treatment

and between the second and the third heat treatment

is not less than 600°C, preferably not less than 750°C.

4. The process as claimed in any of claims 1 to 3, wherein the atmosphere in the second heat treatment contains not less than 40% and not more than 60% NH_3.

5. The process as claimed in claim 1, wherein the testing of the test wafer for oxygen precipitates has shown that the measured defect density over the entire front side of the test wafer is less than 50 defects/cm².