

CLAIMS

1. A method (100) for forming a semiconductor structure (200) comprising a silicon-on-insulator layer structure with crystalline silicon oxide SiO_x as the insulator material, the method comprising:
5 providing (120) a crystalline silicon substrate (201) having a substantially clean deposition surface (202) in a vacuum chamber;
10 heating (130) the silicon substrate to an oxidation temperature T_0 in the range of 550 to 1200, 550 to 1000, or 550 to 850 °C;
supplying (140), while keeping the silicon substrate in the oxidation temperature, with an oxidation
15 pressure P_0 in the range of $1 \cdot 10^{-8}$ to $1 \cdot 10^{-4}$ mbar in the vacuum chamber, molecular oxygen O_2 into the vacuum chamber with an oxygen dose D_0 in the range of 0.1 to 1000 Langmuir ;
whereby at least part of the oxygen supplied into the
20 vacuum chamber is adsorbed onto the deposition surface and diffuses into the silicon substrate, and a crystalline silicon oxide layer (204) with a thickness of at least two molecular layers is formed within the silicon substrate, between a crystalline silicon base
25 layer (203) and a crystalline silicon top layer (205).
2. A method (100) as defined in claim 1, wherein the oxidation temperature T_0 lies in the range of 550 to 750 °C, the oxidation pressure P_0 lies in the range of
30 $1 \cdot 10^{-7}$ to $1 \cdot 10^{-4}$ mbar, and the oxygen dose D_0 lies in the range of 5 to 300 L.

3. A method (100) as defined in claim 2, wherein the oxidation temperature, the oxidation pressure, and the oxygen dose lie within one of the following parameter spaces a) to f):

5 a) $T_o = 550$ to 700 °C, $P_o = 1 \cdot 10^{-7}$ to $1 \cdot 10^{-4}$ mbar, $D_o = 10$ to 50 L;

 b) $T_o = 650$ to 700 °C, $P_o = 1 \cdot 10^{-7}$ to $1 \cdot 10^{-6}$ mbar, $D_o = 50$ to 100 L;

 c) $T_o = 650$ to 750 °C, $P_o = 1 \cdot 10^{-7}$ to $5 \cdot 10^{-7}$ mbar, $D_o = 50$ to 300 L;

 d) $T_o = 700$ to 750 °C, $P_o = 1 \cdot 10^{-5}$ to $5 \cdot 10^{-5}$ mbar, $D_o = 5$ to 50 L;

 e) $T_o = 550$ to 600 °C, $P_o = 1 \cdot 10^{-7}$ to $5 \cdot 10^{-7}$ mbar, $D_o = 5$ to 75 L;

15 f) $T_o = 700$ to 750 °C, $P_o = 5 \cdot 10^{-6}$ to $1 \cdot 10^{-5}$ mbar, $D_o = 10$ to 100 L.

4. A method (100) as defined in any of claims 1 to 3, wherein the molecular oxygen is supplied into the vacuum chamber for an oxidation period of at least 0.5 s.

5. A method (100) as defined in any of claims 1 to 4, further comprising cleaning (110) the deposition surface (202) by removing possible native oxide and/or other impurities therefrom before supplying the molecular oxygen into the vacuum chamber.

6. A method (100) as specified in any of claims 1 to 5, wherein the deposition surface (202) is a silicon {100}, silicon {111}, or silicon {110} surface.

7. A method (300) as specified in any of claims 1 to 6, further comprising annealing (350) the silicon substrate, after supplying the molecular oxygen, at a post heating temperature in the range of 650 to 750 °C for 30 seconds to 60 minutes, for example, for 5 to 20 minutes, to remove possible excess oxygen not contained in the crystalline silicon oxide layer.

8. A method (500) as defined in any of claims 1 to 7, further comprising depositing (560) a cap layer (606) on the crystalline silicon top layer (605), the cap layer comprising, for example, silicon dioxide SiO_2 , aluminum oxide Al_2O_3 , hafnium oxide HfO_2 , or titanium oxide TiO_2 .

9. A method (500) as defined in claim 8, wherein the cap layer (606) is deposited so as to have a thickness of 1 to 500 nm or 1 to 400 nm, for example, 3 to 300 nm.

10. A semiconductor structure (200) comprising a silicon-on-insulator layer structure with crystalline silicon oxide SiO_x as the insulator material, comprising:

- a crystalline silicon base layer (203);
- a crystalline silicon oxide layer (204),

with a thickness of at least two molecular layers, on the silicon base layer; and

- a crystalline silicon top layer (205) on the crystalline silicon oxide layer.

11. A semiconductor structure (600) as defined in claim 10, further comprising a cap layer (606) on the crystalline silicon top layer (605), the cap layer comprising, for example, silicon dioxide SiO_2 , aluminum oxide Al_2O_3 , hafnium oxide HfO_2 , or titanium oxide TiO_2 .

12. A semiconductor structure (600) as defined in claim 11, wherein the cap layer (606) has a thickness of 1 to 500 nm or 1 to 400 nm, for example, 3 to 300 nm.

13. A semiconductor structure (200, 600) as defined in any of claims 10 to 12, formed using a method in accordance with any of claims 1 to 9.

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