

CLAIMS

1. A method for forming a semiconductor structure comprising a silicon-on-insulator layer structure with
5 crystalline silicon oxide SiO_x as the insulator material, the method comprising:

providing a crystalline silicon substrate having a substantially clean deposition surface in a vacuum chamber;

10 heating the crystalline silicon substrate to an oxidation temperature T_0 in the range of 550 to 1200 °C; and

supplying, while keeping the crystalline silicon substrate in the oxidation temperature, with an
15 oxidation 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 (L);

whereby at least part of the molecular oxygen
20 supplied into the vacuum chamber is adsorbed onto the deposition surface and diffuses into the crystalline silicon substrate, and a crystalline silicon oxide layer with a thickness of at least two molecular layers is formed within the crystalline silicon substrate, between
25 a crystalline silicon base layer and a crystalline silicon top layer.

2. A method as defined in claim 1, wherein the oxidation temperature T_0 lies in the range of 550 to 750 °C, the
30 oxidation pressure P_0 lies in the range of $1 \cdot 10^{-7}$ to

$1 \cdot 10^{-4}$ mbar, and the oxygen dose D_o lies in the range of 5 to 300 L.

3. A method 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):

- 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;
- 10 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;
- 15 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;
- 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.

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4. A method as defined in claim 1, wherein the molecular oxygen is supplied into the vacuum chamber for an oxidation period of at least 0.5 s.

25 5. A method as defined in claim 1, further comprising cleaning the deposition surface by removing possible native oxide and/or impurities on the deposition surface of the crystalline silicon substrate therefrom before supplying the molecular oxygen into the vacuum chamber.

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6. A method as specified in claim 1, wherein the deposition surface is a silicon {100}, silicon {111}, or silicon {110} surface.

5 7. A method as specified in claim 1, further comprising annealing the crystalline 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 to remove possible excess oxygen not
10 contained in the crystalline silicon oxide layer.

8. A method as defined in claim 1, further comprising depositing a cap layer on the crystalline silicon top layer, the cap layer comprising, silicon dioxide SiO_2 ,
15 aluminum oxide Al_2O_3 , hafnium oxide HfO_2 , or titanium oxide TiO_2 .

9. A method as defined in claim 8, wherein the cap layer is deposited so as to have a thickness of 1 to 500 nm.

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

25 a crystalline silicon base layer;
a crystalline silicon oxide layer, with a thickness of at least two molecular layers, on the crystalline silicon base layer; and
a crystalline silicon top layer on the crystalline silicon oxide layer, wherein the semiconductor structure
30 is formed by:

providing a crystalline silicon substrate have a substantially clean deposition surface in a vacuum chamber;

5 heating the crystalline silicon substrate to an oxidation temperature T_0 in the range of 550 to 1200 °C; and

supplying, while keeping the crystalline silicon substrate in the oxidation temperature, with an oxidation 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 molecular oxygen supplied into the vacuum chamber is adsorbed onto the deposition surface and diffuses into the crystalline silicon substrate, and the crystalline silicon oxide layer is formed within the crystalline silicon substrate, between the crystalline silicon base layer and the crystalline silicon top layer.

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11. A semiconductor structure as defined in claim 10, wherein the deposition surface is silicon {100}, silicon {111}, or silicon {110}.

25 12. A method as defined in claim 1, wherein the deposition surface is planar.

13. A method as defined in claim 1, wherein the oxidation temperature T_0 is in the range of 550 to 850 °C.