According to an aspect of the present invention, there is provided ~~The problem is solved by~~ a layered semiconductor substrate comprising

- a wafer constituting a monocrystalline first layer 1 containing at least 80 % silicon and having a (111) crystal lattice orientation, a first thickness and a first lattice constant a_1, the first lattice constant a_1 being determined by a first dopant element and a first dopant concentration and
- a monocrystalline second layer 2 containing at least 80 % silicon and having a second thickness and a second lattice constant a_2, the second lattice constant a_2 being determined by a second dopant element and a second dopant concentration, the second layer 2 being in direct contact with the first layer, and
- a monocrystalline third layer 4 comprising a group III nitride, such that the second layer is located between the first layer and the third layer,

wherein the second lattice constant a_2 is larger than the first lattice constant a_1, wherein the crystal lattice of the first layer 1 and the second layer 2 are lattice-matched so that the second layer is stained and wherein the first thickness, the first lattice constant (a_1), the second thickness and the second lattice constant (a_2) are selected with regard to the monocrystalline third layer, such that ~~and wherein~~ the bow of the layered semiconductor substrate is in the range from -50 µm to 50 µm.

Contrary to the prior art, the present invention uses a completely silicon-based stack of layers to generate stress in order to compensate the stress exerted by the group III nitride layers which are to be deposited on the substrate.

According to the present invention, the composition of the second layer of the substrate is modified with regard to the first layer by adding at least one element to at least one of the layers that creates a lattice mismatch between the second and the first layer. The dopant elements and their concentrations are selected in a way that the lattice constant of the second layer is bigger than the lattice constant of the first layer. In this specification, the term "lattice constant" is understood to be the lattice constant of the material when

Claims

1. A layered semiconductor substrate comprising
- a monocrystalline first layer (1) containing at least 80 % silicon and having a first thickness and a first lattice constant (a_1), the first lattice constant (a_1) being determined by a first dopant element and a first dopant concentration and
- a monocrystalline second layer (2) containing at least 80 % silicon and having a second thickness and a second lattice constant (a_2), the second lattice constant (a_2) being determined by a second dopant element and a second dopant concentration, the second layer (2) being in direct contact with the first layer, and
- a monocrystalline third layer (4) consisting of a group III nitride, such that the second layer is located between the first layer and the third layer,

wherein the second lattice constant (a_2) is larger than the first lattice constant (a_1), wherein the crystal lattice of the first layer (1) and the second layer (2) are lattice-matched and wherein the bow of the layered semiconductor substrate is in the range from -50 µm to 50 µm.

2. The layered semiconductor substrate of claim 1, wherein the first and second dopant elements are identical.

3. The layered semiconductor substrate of claim 2, wherein the first and second dopant element is an element having a smaller covalent atomic radius than silicon and wherein the first dopant concentration is higher than the second dopant concentration.

4. The layered semiconductor substrate of claim 3, wherein the first and second dopant element is boron.

5. The layered semiconductor substrate of claim 3 or 4, wherein the second dopant concentration is zero.

6. The layered semiconductor substrate of claim 2, wherein the first and second dopant element is an element having a larger covalent atomic radius than silicon and wherein the second dopant concentration is higher than the first dopant concentration.

7. The layered semiconductor substrate of claim 6, wherein the first and second dopant element is germanium or antimony.

8. The layered semiconductor substrate of claim 6 or 7, wherein the first dopant concentration is zero.

9. The layered semiconductor substrate of claim 1, wherein the first dopant element has a smaller covalent atomic radius than silicon and wherein the second dopant element has a larger covalent atomic radius than silicon.

10. The layered semiconductor substrate of claim 9, wherein the first dopant element is boron and the second dopant element is germanium or antimony.

11. A method for manufacturing a layered semiconductor substrate according to claim 1, comprising the steps of

- growing a single crystal containing at least 80 % silicon and a first dopant element having the first dopant concentration, the single crystal having a first lattice constant,
- slicing at least one wafer from the single crystal,
- reducing the thickness of the wafer to the first thickness, the wafer constituting the first layer (1),
- epitaxially depositing the second layer (2) on one of the surfaces of the wafer, and

- epitaxially depositing the third layer (4) consisting of the group III nitride.

Claims

1. A layered semiconductor substrate comprising:
- a wafer constituting a monocrystalline first layer containing at least 80% silicon and having a (111) crystal lattice orientation, a first thickness and a first lattice constant (a_1), the first lattice constant (a_1) being determined by a first dopant element and a first dopant concentration and
- a monocrystalline second layer containing at least 80% silicon and having a second thickness and a second lattice constant (a_2), the second lattice constant (a_2) being determined by a second dopant element and a second dopant concentration, the second layer being in direct contact with the first layer, and
- a monocrystalline third layer consisting of a group III nitride, such that the second layer is located between the first layer and the third layer,
wherein the second lattice constant (a_2) in a relaxed state is larger than the first lattice constant (a_1), wherein the crystal lattice of the first layer and the second layer are lattice-matched so that the second layer is strained and wherein the first thickness, the first lattice constant (a_1), the second thickness and the second lattice constant (a_2) are selected with regard to the monocrystalline third layer, such that the bow of the layered semiconductor substrate is in the range from -50 µm to 50 µm.

2. The layered semiconductor substrate of claim 1, wherein the first and second dopant elements are identical.

3. The layered semiconductor substrate of claim 2, wherein the first and second dopant element is an element having a smaller covalent atomic radius than silicon and wherein the first dopant concentration is higher than the second dopant concentration.

4. The layered semiconductor substrate of claim 3, wherein the first and second dopant element is boron.

5. The layered semiconductor substrate of claim 3 or 4, wherein the second dopant concentration is zero.

6. The layered semiconductor substrate of claim 2, wherein the first and second dopant element is an element having a larger covalent atomic radius than silicon and wherein the second dopant concentration is higher than the first dopant concentration.

7. The layered semiconductor substrate of claim 6, wherein the first and second dopant element is germanium or antimony.

8. The layered semiconductor substrate of claim 6 or 7, wherein the first dopant concentration is zero.

9. The layered semiconductor substrate of claim 1, wherein the first dopant element has a smaller covalent atomic radius than silicon and wherein the second dopant element has a larger covalent atomic radius than silicon.

10. The layered semiconductor substrate of claim 9, wherein the first dopant element is boron and the second dopant element is germanium or antimony.

11. A method for manufacturing a layered semiconductor substrate according to claim 1, comprising the steps of

- growing a single crystal containing at least 80% silicon and a first dopant element having the first dopant concentration, the single crystal having a first lattice constant,
- slicing at least one wafer from the single crystal,
- reducing the thickness of the wafer to the first thickness, the wafer constituting the first layer,
- epitaxially depositing the second layer on one of the surfaces of the wafer, and
- epitaxially depositing the third layer consisting of the group III nitride.