~~What is Claimed is:~~

Claims

1. A layered structure comprising:

a silicon-based substrate having a crystallographic orientation;

a buffer layer formed over the silicon-based substrate~~; and~~, wherein the buffer layer comprises:

a Ge-based layer formed over the silicon-based substrate;

a III-As layer formed over the Ge-based layer; and

an epitaxial Sb-containing layer formed over the III-As layer; and

an epitaxial Sb-based optoelectronic device formed over the buffer layer, ~~wherein:~~

~~the optoelectronic device is a metamorphic-epitaxy-formed, Sb-based optoelectronic device; and~~

wherein the buffer layer ~~provides~~has a ~~transition in~~ lattice constant that transition between ~~the~~ a lattice constant of the silicon-based substrate and a lattice constant of the epitaxial Sb-based optoelectronic device.

2. The layered structure of claim 1, wherein the buffer layer is an ~~epitaxially formed~~ epitaxial buffer layer formed directly over the silicon-based substrate.

3. The layered structure of claim 1, wherein the buffer layer comprises more than one layer.

4. The layered structure of claim 3, wherein each of the more than one layer is an ~~epitaxially grown layer.~~

~~5. The layered structure of claim 3, wherein the buffer layer comprises:~~

~~a Ge-based layer formed over the substrate, wherein the substrate comprises a silicon-based substrate;~~

epitaxial layer~~a III-As layer formed over the Ge-based layer; and~~

~~a III-Sb layer metamorphic epitaxy formed over the III-As layer~~.

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5. The layered structure of claim ~~5~~1, wherein the buffer layer comprises:

the Ge-based layer formed directly over the ~~substrate, wherein the substrate comprises a~~ silicon-based substrate;

the III-As layer formed directly over the Ge-based layer; and

the ~~III-~~epitaxial Sb-containing layer formed directly over the III-As layer.

6. The layered structure of claim 1, wherein the crystallographic orientation is a <100> surface miscut towards a <111> orientation.

7. The layered structure of claim 1, wherein the ~~substrate comprises a silicon wafer having a crystallographic orientation.~~

~~8. The layered structure of claim 7, wherein the crystallographic orientation is a (100) surface miscut towards the <111> orientation.~~

~~9. The layered structure of claim 1, wherein the~~silicon-based substrate comprises a complementary-metal-oxide-semiconductor (CMOS) compatible circuit, and wherein the epitaxial Sb-based optoelectronic device comprises an infrared photodetector electrically coupled to the CMOS compatible circuit.

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8. The layered structure of claim 1, wherein the epitaxial Sb-based optoelectronic device comprises an alloy comprising a group-V element and a group-III element.

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9. The layered structure of claim 1, wherein the epitaxial Sb-based optoelectronic device comprises a material ~~of~~selected from the group consisting of $InAs_zSb_{1-z}$, $AlAs_zSb_{1-z}$, and $GaAs_zSb_{1-z}$, wherein z is a real number in the range of 0 to 1.

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10. The layered structure of claim 1, wherein the epitaxial Sb-based optoelectronic device comprises a material of the group consisting of $In_xAl_yGa_{1-x-y}As_zSb_{1-z}$ wherein x, y, x+y, and z are real numbers in the range of 0 to 1.

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11. The layered structure of claim 1, wherein the epitaxial Sb-based optoelectronic device comprises an infrared photodetector, and wherein the buffer layer provides the transition in lattice constant between the silicon-based substrate and an Sb-based absorber layer of the infrared photodetector.

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12. A method for making a layered structure, the method comprising:

forming a buffer layer formed over a silicon-based substrate~~; and~~

~~forming, by metamorphic epitaxy, an optoelectronic device over the buffer layer, wherein:~~

~~the optoelectronic device is an Sb-based optoelectronic device; and~~

~~the buffer layer provides a transition in lattice constant between the substrate and the optoelectronic device.~~

~~15. The method of claim 14~~, wherein forming the buffer layer comprises:

forming a Ge-based layer over the ~~substrate, wherein the substrate comprises a~~ silicon-based substrate~~;~~,

forming a III-As layer over the Ge-based layer; and

forming a ~~III-~~Sb-containing layer over the III-As layer~~.~~; and

~~16~~forming, by epitaxy an Sb-based optoelectronic device over the buffer layer, wherein:

the buffer layer provides a transition in lattice constant between the silicon-based substrate and the Sb-based optoelectronic device.

13. The method of claim ~~15~~12, wherein forming the Ge-based layer comprises using chemical vapor deposition (CVD).

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14. The method of claim ~~15~~12, wherein forming the III-As layer comprises using molecular beam epitaxy (MBE).

15. ~~18~~The method of claim 12, wherein forming the Sb-containing layer comprises using molecular beam epitaxy (MBE).

16. The method of claim ~~15~~12, wherein forming the ~~III-~~Sb~~ layer comprises using MBE.~~

~~19. The method of claim 15, wherein forming the~~-based optoelectronic device comprises using molecular beam epitaxy (MBE~~.~~).

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17. The method of claim ~~15~~12, wherein forming the Ge-based layer over the silicon-based substrate comprises forming a Ge~~-~~—Si substrate in a first reaction process, and wherein forming a III-As layer over the Ge-based layer comprises forming the III-As layer over the Ge~~-~~—Si substrate in a second reaction process.