CLAIMS

What is claimed is:

1. A photonics structure comprising:

a substrate;

a dielectric stack disposed on the substrate;

one or more photonics device integrated in the dielectric stack; and

a laser light source having a laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are integrated in the dielectric stack, wherein the laser stack includes an active region configured to emit light in response to the application of electrical energy to the laser stack, wherein the laser light source includes a buffer material formation having a bottom elevation below a top elevation of the substrate.

2. The photonics structure of claim 1, wherein the laser light source includes a buffer material formation, a cladding layer, an aluminum tuning layer and an active region.

3. The photonics structure of claim 1, wherein the dielectric stack is defined by an insulator layer of a silicon on insulator (SOI) wafer, and wherein a photonics device of the one or more photonics device is defined by a silicon layer of the SOI wafer.

4. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a waveguide, wherein the active region has an elevation in common with waveguide, and wherein the active region is configured to emit light into the waveguide.

5. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a monocrystalline silicon waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide is aligned with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the monocrystalline silicon waveguide.

6. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a nitride waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide is aligned with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the nitride waveguide.

7. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a nitride waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide is aligned with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the nitride waveguide, wherein the dielectric stack is defined by an insulator layer of a silicon on insulator (SOI) wafer, and wherein a photonics device of the one or more photonics device is monocrystalline waveguide defined by a silicon layer of the SOI wafer, wherein the photonics structure includes a plurality of waveguides arranged in an overlapping stepwise pattern configured to evanescently couple light emitted from the active region into the monocrystalline waveguide defined by a silicon layer of the SOI wafer.

8. The photonics structure of claim 1, wherein the laser light source includes a buffer material formation, a contact layer, an aluminum tuning layer and an active layer.

9. The photonics structure of claim 1, wherein the one or more photonics device disposed within the dielectric stack includes a monocrystalline silicon waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide coincides with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the monocrystalline silicon waveguide.

10. The photonics structure of claim 1, wherein the substrate is a substrate of a silicon on insulator (SOI) wafer having a silicon layer formed on an insulator which is formed on the substrate, wherein the one or more photonics device includes a waveguide defined by the silicon layer, the waveguide being being aligned with the active region.

11. The photonics structure of claim 1, wherein the one or more photonics device includes each of a photodetector integrated in the dielectric stack, a modulator integrated in the dielectric stack and, and a waveguide integrated in the dielectric stack.

12. The photonics structure of claim 1, wherein the photonics structure includes a second laser light source having a second laser stack, wherein the laser stack and the second laser stack each include a bottom contact layer interfaced to a contact, wherein the bottom contact layer of the second laser stack is at a higher elevation than a bottom contact layer of the laser stack.

13. The photonics structure of claim 1, wherein the dielectric stack is defined by an insulator layer of an SOI wafer, and wherein the laser stack extends entirely through elevations of the insulator layer.

14. A method comprising:

patterning a waveguide in a silicon layer of a silicon on insulator (SOI) wafer of a photonics structure having a dielectric stack defined by an insulator of the SOI wafer;

forming in the photonics structure a trench extending through dielectric layers of the dielectric stack; and

epitaxially growing a laser stack within the trench, the laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are disposed within the dielectric stack and include an active region configured to emit light in response to the application of electrical energy to the laser stack, wherein the forming in the photonics structure a trench extending through dielectric layers of the dielectric stack includes forming in the photonics structure a trench extending through dielectric layers of the dielectric stack so that the trench has a bottom elevation lower than a top elevation of a substrate of the SOI wafer.

15. The method of claim 14, wherein the active region is aligned with the waveguide.

16. The method of claim 14, wherein the waveguide is horizontally extending and disposed at an elevation in common with an elevation of the active region which is aligned with the waveguide and wherein the active region emits light horizontally so that light emitted by the active region is coupled into the waveguide.

17. The method of claim 14, wherein the patterning the waveguide in the silicon layer includes using a first process temperature range, and wherein the epitaxially growing includes epitaxially growing a buffer material formation defining the laser stack using a second process temperature

range, wherein a highest temperature of the second process temperature range is lower than a highest temperature of the first process temperature range.

18. The method of claim 14, wherein the epitaxially growing the laser stack includes epitaxially growing a buffer material formation, epitaxially growing a contact layer on the buffer material formation, epitaxially growing a first aluminum tuning layer the buffer material formation, epitaxially growing a second cladding layer on the first aluminum tuning layer, epitaxially growing a second aluminum tuning layer on the first cladding layer, epitaxially growing a spacer layer on the second aluminum tuning layer and epitaxially growing the active region on the spacer layer.

19. The method of claim 14, wherein the active region comprises quantum dots.

20. The method of claim 14, wherein the epitaxially growing a laser stack within the trench includes epitaxially growing a buffer material formation on a silicon surface defined by the substrate, wherein the method includes removing the substrate and material of the buffer material formation to reveal a bottom side surface of the dielectric stack, and fabricating an extended dielectric stack region on the bottom side surface of the dielectric stack, wherein the method includes fabricating in the extended dielectric stack region an integrated electrical contact that contacts a contact layer of the laser stack, and fabricating a termination in electrical communication with the electrical contact.

21. The photonics structure of claim 1, wherein the laser stack includes a first tuning layer for confining light within the activation region at an elevation lower than the active region, and a second tuning layer for confining light within the activation region at an elevation higher than the active region.

22. The photonics structure of claim 1, wherein the laser stack includes a patterned layer pattern integrated in the dielectric stack for selection of a wavelength at which the active region operates.

23. A photonics structure comprising:

a substrate;

a dielectric stack disposed on the substrate;

one or more photonics device integrated in the dielectric stack; and

a laser light source having a laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are integrated in the dielectric stack, wherein the laser stack includes an active region configured to emit light in response to the application of electrical energy to the laser stack, wherein the dielectric stack is defined by an insulator layer of a silicon on insulator (SOI) wafer, and wherein a photonics device of the one or more photonics device is monocrystalline waveguide defined by a silicon layer of the SOI wafer, wherein the photonics structure includes a plurality of waveguides arranged in an overlapping stepwise pattern configured to evanescently couple light emitted from the active region into the monocrystalline waveguide defined by a silicon layer of the SOI wafer.

24. A photonics structure comprising:

a substrate;

a dielectric stack disposed on the substrate;

one or more photonics device integrated in the dielectric stack; and

a laser light source having a laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are integrated in the dielectric stack, wherein the laser stack includes an active region configured to emit light in response to the application of electrical energy to the laser stack, wherein the photonics structure includes a second laser light source having a second laser stack, wherein the laser stack and the second laser stack each include a bottom contact layer interfaced to a contact, wherein a bottom contact layer of second laser stack is at a higher elevation than a bottom contact layer of the laser stack.

25. A photonics structure comprising:

a substrate;

a dielectric stack disposed on the substrate;

one or more photonics device integrated in the dielectric stack; and

a laser light source having a laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are integrated in the dielectric stack, wherein the laser stack includes an active region configured to emit light in response to the application of electrical energy to the laser stack, wherein the dielectric stack is defined by an insulator layer of an SOI wafer, and wherein the laser stack extends entirely through elevations of the insulator layer.

26. A photonics structure comprising:

a substrate;

a dielectric stack disposed on the substrate;

one or more photonics device integrated in the dielectric stack; and

a laser light source having a laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are integrated in the dielectric stack, wherein the laser stack includes an active region configured to emit light in response to the application of electrical energy to the laser stack, wherein the dielectric stack is defined by an insulator layer of an SOI wafer, wherein a bottom elevation of the laser stack is defined by a bottom elevation of a buffer material formation, the buffer material formation having a bottom elevation within an elevation of the insulator layer.

27. The photonics structure of claim 25, wherein the laser light source include a buffer material formation having a bottom elevation below a top elevation of the substrate.

28. The photonics structure of claim 24, wherein the bottom contact layer of the second laser stack is epitaxially grown on an aluminum tuning layer of the second laser stack, wherein the bottom contact layer of the laser stack is epitaxially grown on a buffer material formation of the laser light source.

CLAIMS

What is claimed is:

1. A photonics structure comprising:

a substrate;

a dielectric stack disposed on the substrate;

one or more photonics device integrated in the dielectric stack; and

a laser light source having a laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are integrated in the dielectric stack, wherein the laser stack includes an active region configured to emit light in response to the application of electrical energy to the laser stack.

2. The photonics structure of claim 1, wherein the laser light source includes a buffer material formation, a cladding layer, an aluminum tuning layer and an active region.

3. The photonics structure of claim 1, wherein the dielectric stack is defined by an insulator layer of a silicon on insulator (SOI) wafer, and wherein a photonics device of the one or more photonics device is defined by a silicon layer of the SOI wafer.

4. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a waveguide, wherein the active region has an elevation in common with waveguide, and wherein the active region is configured to emit light into the waveguide.

5. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a monocrystalline silicon waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide is aligned with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the monocrystalline silicon waveguide.

6. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a nitride waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide is aligned with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the nitride waveguide.

7. The photonics structure of claim 1, wherein the one or more photonics device integrally formed within the dielectric stack includes a nitride waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide is aligned with a horizontally extending longitudinal axis of the active region, and wherein the active region

is configured to emit light into the nitride waveguide, wherein the dielectric stack is defined by an insulator layer of a silicon on insulator (SOI) wafer, and wherein a photonics device of the one or more photonics device is monocrystalline waveguide defined by a silicon layer of the SOI wafer, wherein the photonics structure includes a plurality of waveguides arranged in an overlapping stepwise pattern configured to evanescently couple light emitted from the active region into the monocrystalline waveguide defined by a silicon layer of the SOI wafer.

8. The photonics structure of claim 1, wherein the laser light source includes a buffer material formation, a contact layer, an aluminum tuning layer and an active layer.

9. The photonics structure of claim 1, wherein the laser light source include a buffer material formation having a bottom elevation below a top elevation of the substrate.

10. The photonics structure of claim 1, wherein the laser light source include a buffer material formation having a bottom elevation below a top elevation of the substrate, wherein the one or more photonics device disposed within the dielectric stack includes a monocrystalline silicon waveguide having a horizontally extending longitudinal axis, wherein the horizontally extending longitudinal axis of the waveguide coincides with a horizontally extending longitudinal axis of the active region, and wherein the active region is configured to emit light into the monocrystalline silicon waveguide.

11. The photonics structure of claim 1, wherein the substrate is a substrate of a silicon on insulator (SOI) wafer having a silicon layer formed on an insulator which is formed on the substrate, wherein the one or more photonics device includes a waveguide defined by the silicon layer, the waveguide being defined by the active region.

12. The photonics structure of claim 1, wherein the substrate includes silicon.

13. The photonics structure of claim 1, wherein the one or more photonics device includes each of a photodetector integrated in the dielectric stack, a modulator integrated in the dielectric stack and, and a waveguide integrated in the dielectric stack.

14. The photonics structure of claim 1, wherein the photonics structure includes a second laser light source having a second laser stack, wherein the laser stack and the second laser stack each include a bottom contact layer interfaced to a contact, wherein the bottom contact layer of second laser stack is at a higher elevation than a bottom contact layer of the laser stack.

15. The photonics structure of claim 1, wherein the photonics structure includes a second laser light source having a second laser stack, wherein the laser stack and the second laser stack each include a bottom contact layer interfaced to a contact, wherein the bottom contact layer of second laser stack is at a higher elevation than a lower contact layer of the laser stack, wherein the bottom contact layer of the second laser stack is epitaxially grown on an aluminum tuning layer of the second laser stack, wherein the bottom contact layer of the laser stack is epitaxially grown on a buffer material formation of the first laser light source.

16. The photonics structure of claim 1, wherein the dielectric stack is defined by an insulator layer of an SOI wafer, and wherein the laser stack extends entirely through elevations of the insulator layer.

17. The photonics structure of claim 1, wherein the dielectric stack is defined by an insulator layer of an SOI wafer, wherein a bottom elevation of the laser stack is defined by a bottom elevation of a buffer material formation, the buffer material formation having a bottom elevation within an elevation of the insulator layer.

18. A method comprising:

patterning a waveguide in a silicon layer of a silicon on insulator (SOI) wafer of a photonics structure having a dielectric stack defined by an insulator of the SOI wafer;

forming in the photonics structure a trench extending through dielectric layers of the dielectric stack; and

epitaxially growing a laser stack within the trench, the laser stack including a plurality of structures arranged in a stack, wherein structures of the plurality of structures are disposed within the dielectric stack and include an active region configured to emit light in response to the application of electrical energy to the laser stack.

19. The method of claim 18, wherein the active region is aligned with the waveguide.

20. The method of claim 18, wherein the waveguide is horizontally extending and disposed at an elevation in common with an elevation of the active region which is aligned with the waveguide and wherein the active region emits light horizontally so that light emitted by the active region is coupled into the waveguide.

21. The method of claim 18, wherein the forming in the photonics structure a trench extending through dielectric layers of the dielectric stack includes forming in the photonics structure a trench extending through dielectric layers of the dielectric stack so that the trench has a bottom elevation lower than a top elevation of a substrate of the SOI wafer.

22. The method of claim 18, wherein the method includes integrally fabricating within the dielectric stack a photodetector and a modulator.

23. The method of claim 18, wherein the patterning the waveguide in the silicon layer includes using a first process temperature range, and wherein the epitaxially growing includes epitaxially growing a buffer material formation defining the laser stack using a second process temperature range, wherein a highest temperature of the second process temperature range is lower that a highest temperature of the second process temperature range.

~~24. The method of claim 18, wherein the epitaxially growing the laser stack includes epitaxially growing a buffer material formation, epitaxially growing a contact layer on the buffer material formation, epitaxially growing a first aluminum tuning layer the buffer material formation, epitaxially growing a second cladding layer on the first aluminum tuning layer, epitaxially growing a second aluminum tuning layer on the first cladding layer, epitaxially growing a spacer layer on the second aluminum tuning layer and epitaxially growing the active region on the spacer layer.~~

~~25. The method of claim 18, wherein the active region comprises quantum dots.~~

~~26. The method of claim 18, wherein the epitaxially growing a laser stack within the trench includes epitaxially growing a buffer material formation on a silicon surface defined by the substrate, wherein the method includes removing the substrate and material of the buffer material formation to reveal the bottom side surface of the dielectric stack, and fabricating an extended dielectric stack region on the bottom side surface of the dielectric stack, wherein the method includes fabricating in the extended dielectric stack region an integrated electrical contact that contacts a contact layer of the laser stack, and fabricating a termination in electrical communication with the electrical contact.~~