CLAIMS

What is claimed is:

1. An optoelectrical system, comprising:

a first photonics structure having a first photonics dielectric stack;

a second photonics structure having a second photonics dielectric stack;

a bond layer that fusion bonds the first photonics structure to the second photonics structure;

one or more metallization layer integrally formed in the first photonics dielectric stack;

at least one metallization layer integrally formed in the second photonics dielectric stack;

one or more photonics device integrally formed in the first photonics dielectric stack;

at least one photonics device integrally formed in the second photonics dielectric stack;

one or more laser stack structure active region integrally formed in the second photonics dielectric stack, each laser stack structure active region including a laser stack structure associated therewith, the laser stack structure having a bottom contact structure thereof; and

an extended dielectric stack region of the second photonics dielectric stack including a contact extending therethrough to contact at least one bottom contact structure of a laser stack structure, and the extended dielectric stack region further including a termination in electrical communication with the contact.

2. The optoelectrical system of claim 1, wherein the one or more photonics device includes at least one waveguide, and wherein the at least one photonics device includes at least one waveguide.

3. The optoelectrical system of claim 1, wherein the bond layer fusion bonds the first photonics dielectric stack to the second photonics dielectric stack.

4. The optoelectrical system of claim 1, further including a waveguide integrally formed in the second photonics dielectric stack, the waveguide being edge coupled to a laser stack structure active region of the one or more laser stack structure active region integrally formed in the second photonics dielectric stack.

5. The optoelectrical system of claim 1, further including a waveguide integrally formed in the second photonics dielectric stack, the waveguide being edge coupled to a laser stack structure active region of the one or more laser stack structure active region integrally formed in the second photonics dielectric stack, the waveguide having a longitudinal axis configured to coincide with a longitudinal axis of the laser stack structure active region of the one or more laser stack structure active region integrally formed in the second photonics dielectric stack.

6. The optoelectrical system of claim 1, wherein the one or more photonics device includes a photodetector.

7. The optoelectrical system of claim 1, wherein the at least one photonics device includes a first waveguide formed at a first elevation, a second waveguide formed at a second elevation.

8. The optoelectrical system of claim 1, further including:

an interposer base structure, the interposer base structure including a metallization layer, a redistribution layer, and through silicon vias electrically connected to the redistribution layer;

a bond layer that fusion bonds the first photonics dielectric stack to the interposer base structure;

a through via that connects a metallization layer of a third photonics structure to a metallization layer of the second photonics structure, the through via extending entirely through the bond layer that fusion bonds the interposer base structure to the first photonics structure; and

a second through via that connects a metallization layer of the second photonics structure to a metallization layer of the first photonics structure, the second through via extending entirely through the bond layer that fusion bonds the first photonics structure to the first photonics structure.

9. An optoelectrical system, comprising:

a first photonics structure having a first photonics dielectric stack;

a second photonics structure having a second photonics dielectric stack;

a bond layer that fusion bonds the first photonics structure to the second photonics structure;

one or more metallization layer integrally formed in the first photonics dielectric stack;

at least one metallization layer integrally formed in the second photonics dielectric stack;

one or more photonics device integrally formed in the first photonics dielectric stack;

at least one photonics device integrally formed in the second photonics dielectric stack;

one or more laser stack structure active region integrally formed in the second photonics dielectric stack, each laser stack structure active region including a laser stack structure associated therewith, the laser stack structure having a bottom contact structure thereof;

an extended dielectric stack region of the second photonics dielectric stack including a contact extending therethrough to contact at least one bottom contact structure of a laser stack structure, and the extended dielectric stack region further including a termination in electrical communication with the contact;

a first waveguide integrally formed in the second photonics dielectric stack, the waveguide being edge coupled to a laser stack structure of the one or more laser stack structure active region integrally formed in the second photonics dielectric stack;

a monocrystalline waveguide integrally fabricated within the first photonics dielectric stack; and

a plurality of intermediary waveguides configured to evanescently couple light from the first waveguide, through the bond layer, to the monocrystalline waveguide.

10. The optoelectrical system of claim 9,

wherein the monocrystalline waveguide is defined by a monocrystalline layer of an SOI wafer, wherein a dielectric layer of the first photonics structure dielectric stack is defined by an insulator layer of the SOI wafer.

11. The optoelectrical system of claim 9, wherein the first waveguide is formed of a first material and each of the plurality of intermediary waveguides formed of a second material.

12. The optoelectrical system of claim 9, wherein the optoelectrical system further includes:

an interposer base structure, the interposer base structure including a redistribution layer, and through silicon vias electrically connected to the redistribution layer; and

a bond layer that fusion bonds the first photonics dielectric stack to the interposer base structure.

13. The optoelectrical system of claim 9, wherein the optoelectrical system further includes:

an interposer base structure, the interposer base structure including a metallization layer, a redistribution layer, and through silicon vias electrically connected to the redistribution layer;

a bond layer that fusion bonds the first photonics dielectric stack to the interposer base structure; and

a through via that connects a metallization layer of the first photonics structure to the metallization layer of the interposer base structure.

14. The optoelectrical system of claim 9, wherein the optoelectrical system further includes:

an interposer base structure, the interposer base structure including a metallization layer, a redistribution layer, and through silicon vias electrically connected to the redistribution layer;

a bond layer that fusion bonds the first photonics dielectric stack to the interposer base structure; and

a through via that connects a metallization layer of the second photonics structure to a metallization layer of the first photonics structure.

15. An optoelectrical system, comprising:

a first photonics structure having a first photonics dielectric stack;

a second photonics structure having a second photonics dielectric stack;

a bond layer that fusion bonds the first photonics structure to the second photonics structure;

one or more metallization layer integrally formed in the first photonics dielectric stack;

at least one metallization layer integrally formed in the second photonics dielectric stack;

one or more photonics device integrally formed in the first photonics dielectric stack;

at least one photonics device integrally formed in the second photonics dielectric stack;

one or more laser stack structure active region integrally formed in the second photonics dielectric stack, each laser stack structure active region including a laser stack structure associated therewith, the laser stack structure having a bottom contact structure thereof;

an extended dielectric stack region of the second photonics dielectric stack including a contact extending therethrough to contact at least one bottom contact structure of a laser stack structure, and the extended dielectric stack region further including a termination in electrical communication with the contact;

a first waveguide formed in the second photonics dielectric stack, at least a portion of the first waveguide horizontally aligned with at least one of the one or more laser stack structure active region of the second photonics dielectric stack; and

a ridge waveguide formed in the first photonics dielectric stack, at least a portion of the ridge waveguide vertically aligned with the first waveguide, wherein the first waveguide formed in the second photonics dielectric stack is evanescently coupled to the ridge waveguide formed in the first photonics dielectric stack.

16. The optoelectrical system of claim 15, further including at least one intermediary waveguide formed in the first photonics dielectric stack, the at least one intermediary waveguide position

vertically between the first waveguide and the ridge waveguide, wherein at least a portion of the at least one intermediary waveguide is vertically aligned with at least one of the first waveguide or the ridge waveguide.

17. The optoelectrical system of claim 16, wherein the at least one intermediary waveguide includes:

a first intermediary waveguide formed in the first photonics dielectric stack adjacent the bond layer, at least a portion of the first intermediary waveguide vertically aligned with the first waveguide, wherein the first intermediary waveguide is evanescently coupled to the first waveguide;

a second intermediary waveguide formed in the first photonics dielectric stack, between the first intermediary waveguide and the ridge waveguide, at least a portion of the second intermediary waveguide vertically aligned with the first intermediary waveguide, wherein the second intermediary waveguide is evanescently coupled to the first intermediary waveguide; and

a third intermediary waveguide formed in the first photonics dielectric stack, between the second intermediary waveguide and the ridge waveguide, at least a portion of the second intermediary waveguide vertically aligned with:

the first intermediary waveguide, and

the ridge waveguide,

wherein the third intermediary waveguide is evanescently coupled to the second intermediary waveguide and the ridge waveguide.

18. The optoelectrical system of claim 17, further including a photodetector formed in the first photonics dielectric stack, wherein the second intermediary waveguide and the third intermediary waveguide are positioned adjacent to and at least partially horizontally aligned with the photodetector.

19. The optoelectrical system of claim 15, wherein the ridge waveguide is formed adjacent to and at least partially horizontally aligned with a waveguiding material formation.

20. The optoelectrical system of claim 15, wherein the one or more photonics device includes a photodetector.