Claims

1. A structure, comprising:

a substrate including a first porous region having a first porosity formed therein;

an active quantum well region epitaxially grown over the first porous region;

a second porous region having the first porosity over the active quantum well region,

wherein edges of the second porous region align with edges of the first porous region, and

wherein the substrate is a single base material.

2. The structure of claim 1, wherein the substrate is composed of germanium or gallium arsenide.

3. The structure of claim 1, wherein a stack of the first porous region, at least a first part of the active quantum well region that aligns with the first porous region, and the second porous region allows a first light wave at a first wavelength to pass through the stack.

4. The structure of claim 1, further comprising:

a first epitaxial distributed Bragg reflector multilayer grown over the substrate between the first porous region and the active quantum well region,

wherein the second porous region includes a second epitaxial distributed Bragg reflector multilayer over the active quantum well region, and

wherein a first reflectivity of the first epitaxial distributed Bragg reflector multilayer is different from a second reflectivity of the second epitaxial distributed Bragg reflector multilayer, thereby causing a stack of the first porous region, the first epitaxial distributed Bragg reflector multilayer, and the second epitaxial distributed Bragg reflector multilayer to allow a first light wave at a first wavelength to pass through the stack.

5. The structure of claim 1, wherein the first porous region and the second porous region align with a first region on the active quantum well region, and the substrate includes a third porous region formed therein, and

wherein the structure further comprises:

a fourth porous region having a second porosity over the active quantum well region,

wherein the second porous region and the fourth porous region are porous portions of a bulk layer grown over the active quantum well region, and

wherein the third porous region and the fourth porous region align with a second region on the active quantum well region.

6. The structure of claim 5, wherein:

the first porous region and the third porous region have different dimensions or different porosities, and

the second porous region and the fourth porous region have different dimensions or different porosities.

7. The structure of claim 5, wherein:

the first porous region, at least the first region of the active quantum well region, and the second porous region form a first VCSEL that allows a first light wave at a first wavelength to pass through, and

the third porous region, at least the second region of the active quantum well region and the fourth porous region form a second VCSEL that allows a second light wave at a second wavelength to pass through.

8. The structure of claim 5, further comprising:

a pseudomorphic high-electron-mobility transistor or a heterojunction bipolar transistor integrated into a bulk wafer at a space between the second porous region and the fourth porous region.

9. The structure of claim 5, wherein the second porous region and the fourth porous region have the first porosity and are connected to each other as a continuous porous multilayer in a bulk wafer.

10. The structure of claim 1, wherein the second porous region is a porous portion of a bulk layer grown over the active quantum well region, and

wherein the bulk layer has a plurality of spatially distributed porous multilayers, each porous multilayer from the plurality of spatially distributed porous multilayers having a porosity selected to yield a specific reflectivity of each porous multilayer to allow a light wave at a specific wavelength to pass through.

11. The structure of claim 1, further comprising:

one or more vertical porous portions perpendicular to and across the first porous region, the active quantum well region and the second porous region,

wherein the one or more vertical porous portions divides a stack of the first porous region, the active quantum well region, and the second porous region to form multiple VCSELs.

12. The structure of claim 11, wherein a thickness and a porosity of at least one vertical porous portion is selected to form a porous filter that allows a third light wave at a third wavelength to pass between two adjacent VCSELs from the multiple VCSELs.

13. The structure of claim 11, wherein a thickness and a porosity of at least one vertical porous portion is selected to form a porous isolation that allows no light wave passage between two adjacent VCSELs from the multiple VCSELs.

14. The structure of claim 1, wherein:

the first porous region comprises a first porous multilayer comprising alternating porous and substantially non-porous layers, and

the second porous region comprises a second porous multilayer comprising alternating porous and substantially non-porous layers.

15. A structure, comprising:

a substrate comprising:

a first porous region having a first porosity formed therein; and

a second porous region having a second porosity formed therein and spaced apart from the first porous region;

an active quantum well region epitaxially grown over the first and second porous regions;

a third porous region having the first porosity above the first porous region and over the active quantum well region; and

a fourth porous region having the second porosity above the second porous region, over the active quantum well region, and spaced apart from the third porous region,

wherein the substrate is a single base material.

16. The structure of claim 15, wherein the active quantum well region extends laterally between the first and second porous regions.

17. The structure of claim 15, wherein:

the first porous region comprises a first porous multilayer comprising alternating porous and substantially non-porous layers,

the second porous region comprises a second porous multilayer comprising alternating porous and substantially non-porous layers,

the third porous region comprises a third porous multilayer comprising alternating porous and substantially non-porous layers, and

the fourth porous region comprises a fourth porous multilayer comprising alternating porous and substantially non-porous layers.

18. A method comprising:

forming a first porous region having a first porosity within a substrate;

epitaxially growing an active quantum well region over the first porous region; and

forming a second porous region having the first porosity over the active quantum well region,

wherein the substrate is a single base material.

19. The method of claim 18, wherein forming the first porous region comprises etching a region of the substrate with an acid current.

20. The method of claim 19, wherein forming the first porous region comprises controlling one or more of a concentration of the acid current and a fluid velocity of the acid current.

21. The method of claim 18, wherein:

the first porous region comprises a first porous multilayer comprising alternating porous and substantially non-porous layers, and

the second porous region comprises a second porous multilayer comprising alternating porous and substantially non-porous layers.