~~Listing of~~ Claims

~~What is claimed is:~~

~~1.~~ 1. A ~~layered~~ structure, comprising:

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

an active quantum well ~~capping layer~~region epitaxially grown over the first porous ~~multilayer;~~ region;

a second porous ~~multilayer~~region having the first porosity over the active quantum well ~~capping layer,~~ region,

wherein edges of the second porous ~~multilayer aligns~~region align with edges of the first porous ~~multilayer.~~region, and

wherein the substrate is a single base material.

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

~~3.~~ 3. The ~~layered~~ structure of claim 1, wherein ~~the second porous multilayer has the first porosity, and~~

a stack of the first porous ~~multilayer~~region, at least a first part of the active quantum well ~~capping layer~~region that aligns with the first porous ~~multilayer~~region, and the second porous ~~multilayer~~region allows a first light wave at a first wavelength to pass through the stack.

~~4.~~ 4. The ~~layered~~ structure of claim 1, further comprising:

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

wherein the second porous ~~multilayer~~region includes a second epitaxial distributed Bragg reflector multilayer over the active quantum well ~~capping layer~~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 ~~multilayer~~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.~~ 5. The ~~layered~~ structure of claim 1, wherein the first porous ~~multilayer~~region and the second porous ~~multilayer aligns~~region align with a first region on the active quantum well ~~capping layer~~region, and the substrate includes a third porous ~~multilayer~~region formed therein, and

wherein the ~~layered~~ structure further comprises:

a fourth porous ~~multilayer~~region having ~~the~~a second porosity over the active quantum well ~~capping layer,~~region,

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

wherein the third porous ~~multilayer~~region and the fourth porous ~~multilayer aligns~~region align with a second region on the active quantum well ~~capping layer~~region.

6. The ~~layered~~ structure of claim 5, wherein~~-~~:

~~6.~~ the first porous ~~multilayer~~region and the third porous ~~multilayer~~region have different dimensions or different porosities, and

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

7. The ~~layered~~ structure of claim 5, wherein~~-~~:

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

~~7.~~ the third porous ~~multilayer~~region, at least the second region of the active quantum well ~~capping layer~~region and the fourth porous ~~multilayer~~region form a second VCSEL that allows a second light wave at a second wavelength to pass through.

~~8. The layered structure of claim 1, wherein the second porous multilayer is a porous portion of a bulk layer grown over the active quantum well capping layer, and~~

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

~~9. The layered~~8. The structure of claim 5, further comprising:

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

~~10.~~ 9. The ~~layered~~ structure of claim 5, wherein the second porous ~~multilayer~~region and the fourth porous ~~multilayer~~region have ~~a same~~the first porosity and are connected to each other as a continuous porous multilayer in ~~the~~a bulk wafer.

~~11.~~ 10. The ~~layered structure of claim 9, further comprising:~~

~~a pin diode integrated into the substrate at a space between the first porous multilayer and the third porous multilayer.~~

~~12. The layered structure of claim 10, wherein the continuous porous multilayer includes a fifth porous multilayer aligning with the pin diode, and the fifth porous multilayer has a third porosity that allows the fifth porous multilayer to reflect the first light wave at the first wavelength emitted from the active quantum well capping layer to a direction of the pin diode.~~

~~13. The layered structure of claim 11, wherein the substrate includes a sixth porous multilayer in proximity to the pin diode, and the sixth porous multilayer is configured to allow the first light wave at the first wavelength to pass through to reach the pin diode.~~

~~14. The layered~~ structure of claim 1, ~~further comprising:~~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 ~~multilayers~~portions perpendicular to and across the first porous ~~multilayer~~region, the active quantum well ~~capping layer~~region and the second porous ~~multilayer~~region,

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

~~15.~~ 12. The ~~layered~~ structure of claim ~~13~~11, wherein a thickness and a porosity of at least one vertical porous ~~multilayer~~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.

~~16.~~ 13. The ~~layered~~ structure of claim ~~13~~11, wherein a thickness and a porosity of at least one vertical porous ~~multilayer~~portion is selected to form a porous isolation that allows no light wave passage between two adjacent VCSELs from the multiple VCSELs.

~~A layered~~14. The structure~~,~~ of claim 1, wherein:

~~17.~~ 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 ~~epitaxial distributed Bragg reflector multilayer grown over~~porous region having a first porosity formed therein; and

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

an active quantum well ~~capping layer~~region epitaxially grown over the first ~~epitaxial distributed Bragg reflector multilayer; and~~and second porous regions;

~~a~~ 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 ~~composed of a same material with the substrate, the~~comprising alternating porous and substantially non-porous layers,

the second porous region comprises a second porous multilayer ~~over the active quantum well capping layer.~~comprising alternating porous and substantially non-porous layers,

~~18. The layered structure of claim 16, further comprising:~~

~~a second epitaxial distributed Bragg reflector~~the third porous region comprises a third porous multilayer ~~grown over the active quantum well and between the active quantum well and the~~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.

~~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 porous multilayer, 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.~~

~~19.~~ 18. A ~~circular layered structure,~~method comprising:

~~a circular substrate;~~

~~a first radial porous distributed Bragg reflector multilayer radially beneath the circular substrate;~~

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

epitaxially growing an active quantum well ~~capping layer radially beneath~~region over the first ~~radial~~porous region; and

forming a second porous ~~distributed Bragg reflector multilayer; and~~

~~a second radial porous distributed Bragg reflector multilayer radially beneath the circular~~ region having the first porosity over the active quantum well ~~capping layer.~~region,

~~20. The circular layered structure of claim 18, wherein the first radial porous distributed Bragg reflector multilayer has a same radial porosity with the second radial porous distributed Bragg reflector multilayer.~~

~~The circular layered structure~~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 ~~radial porous distributed Bragg reflector multilayer, the circular active quantum well capping layer~~porous region comprises controlling one or more of a concentration of the acid current and ~~the second radial porous distributed Bragg reflector multilayer form a focused VSCEL that allows a~~ a fluid velocity of the acid current.

21. The method of claim 18, wherein:

~~21.~~ the first ~~light wave at~~porous region comprises a first ~~wavelength to pass through.~~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.