[40] As used herein in the specification and in the claims, the phrase "at least one," in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase "at least one" refers, whether related or unrelated to those elements specifically identified.

[41] The terms "approximately" and "about" may be used to mean within ±20% of a target value in some embodiments, within ±10% of a target value in some embodiments, within ±5% of a target value in some embodiments, and yet within ±2% of a target value in some embodiments. The terms "approximately" and "about" may include the target value.

[42] In the claims, as well as in the specification above, all transitional phrases such as "comprising," "including," "carrying," "having," "containing," "involving," "holding," "composed of," and the like are to be understood to be open-ended, *i.e.*, to mean including but not limited to. The transitional phrases "consisting of" and "consisting essentially of" shall be closed or semi-closed transitional phrases, respectively.

CLAIMS

1. A method of forming a waveguide comprising:

forming a trench in a silicon substrate, wherein the trench has a first surface;

filling the trench with a dielectric material; and

patterning the waveguide on the dielectric material over the trench such that the waveguide is disposed at a distance L from the first surface,

wherein a first end of the waveguide terminating over the trench has a first size and a second end of the waveguide distal the first end has a second size different than the first size, and

wherein a material of the waveguide and the first size define a mode size of the waveguide smaller than 2L.

2. The method of claim 1, wherein a lateral dimension of the waveguide substantially parallel to the first surface of the trench is smaller at the first end than at the second end.

3. The method of claim 1, wherein the waveguide is a first waveguide, and wherein the method further comprises forming a second waveguide over the silicon substrate, wherein at least a portion of the second waveguide overlaps with at least the second end of the first waveguide.

4. The method of claim 3, wherein the second waveguide is positioned between the first waveguide and the silicon substrate.

5. The method of claim 3, wherein the second waveguide comprises a third end overlapping the first waveguide and a fourth end distal the third end, and wherein the second waveguide has a lateral dimension substantially parallel to the first surface that increases along a direction from the third end to the fourth end.

6. The method of claim 1, wherein the waveguide includes one or more of silicon, Si_3N_4, and SiON.

7. The method of claim 1, further comprising dicing the silicon substrate at the trench.

8. The method of claim 1, wherein the material of the waveguide and the first size define a vertical mode size of the waveguide smaller than 2L.

9. An apparatus comprising:

a silicon substrate having a trench formed therein proximate a facet of the silicon substrate, wherein the trench has a first surface;

a dielectric material filling the trench;

a waveguide formed on the dielectric material and disposed at a distance L from the first surface,

wherein a first end of the waveguide proximate the facet of the semiconductor chip has a first size and a second end of the waveguide distal the first end has a second size different than the first size, and wherein a material of the waveguide and the first size define a mode size of the waveguide smaller than 2L.

10. The apparatus of claim 9, wherein a lateral dimension of the waveguide substantially parallel to the first surface of the trench is smaller at the first end than at the second end.

11. The apparatus of claim 9, wherein the waveguide is a first waveguide, and wherein the apparatus further comprises a second waveguide over the silicon substrate, wherein at least a portion of the second waveguide overlaps with the second end of the first waveguide.

12. The apparatus of claim 11, wherein the second waveguide is positioned between the first waveguide and the silicon substrate.

13. The apparatus of claim 12, wherein the second waveguide and the first waveguide are separated by a layer of dielectric material.

14. The apparatus of claim 11, wherein the second waveguide comprises a third end overlapping the first waveguide and a fourth end distal the third end, and wherein the second waveguide has a lateral dimension substantially parallel to the first surface that increases along a direction from the third end to the fourth end.

15. The apparatus of claim 9, wherein the waveguide includes one or more of silicon, Si_3N_4, and SiON.