CLAIMS

What is claimed is:

1. An apparatus, comprising:

a first optical waveguide being supported on a surface of a substrate;

a second optical waveguide being supported over the surface;

an optical coupler being supported over the surface and optically coupling the first and second waveguides; and

a waveguide grating being supported over the surface and being adapted to transfer optical power between one or more waveguide modes of the second waveguide and an optical beam formed by or applied to the waveguide grating, wherein the second waveguide has an offset-transition region for which a core of the second waveguide has an offset distance that gradually changes from a first distance corresponding to the optical coupler to a different second distance.

2. The invention of claim 1, wherein:

a cladding of the second waveguide comprises a wedge-shaped portion located in the offset-transition region;

an index-of-refraction contrast of the second waveguide is greater than an index-of-refraction contrast of the first waveguide;

a core of the first waveguide comprises a ternary, quaternary, or quinary group III-V alloy;

a cladding of the first waveguide comprises a binary group III-V compound;

the core of the second waveguide comprises silicon; and

the cladding of the second waveguide comprises silicon oxide.

3. The invention of claim 1, wherein the optical coupler couples the first and second optical waveguides via evanescent fields.

4. The invention of claim 3, wherein the optical coupler has a length that causes optical energy to spatially beat one or more times between the first and second optical waveguides.

5. The invention of claim 1, wherein the core of the second optical waveguide comprises:

a first portion that is substantially parallel to a principal plane of the substrate;

a second portion located in the offset-transition region; and

a third portion that is substantially parallel to the principal plane, wherein:

the second portion is connected between the first and third portions; and

the waveguide grating is defined in the third portion.

6. The invention of claim 1, wherein the second offset distance is such that the apparatus produces constructive interference between (i) light diffracted by the waveguide grating toward an interface between a cladding of the first optical waveguide and a cladding of the second optical waveguide and then reflected back by the interface and (ii) light diffracted by the waveguide grating in a direction collinear with a propagation direction of the reflected light.

7. The invention of claim 1, wherein:

a core of first waveguide has a third offset distance with respect to the substrate; and

the third offset distance is outside the range between the first distance and the second distance.

8. The invention of claim 1, wherein:

a core of the first waveguide comprises a laterally tapered portion connected to the optical coupler;

the apparatus further comprises an optical signal-processing (OSP) circuit supported on the substrate, wherein the first waveguide is optically coupled to the OSP circuit;

the OSP circuit comprises at least one active optical element; and

the first and second waveguides, the waveguide grating, and the OSP circuit are parts of a photonic integrated circuit (PIC) formed on the substrate.

9. A photonic integrated circuit (PIC), comprising:

a substrate;

an optical signal-processing (OSP) circuit being supported on the substrate and having at least one active optical element;

a first optical waveguide being optically coupled to the active optical element;

a second optical waveguide having a waveguide grating adapted to transfer optical power between one or more waveguide modes of the second optical waveguide and an optical beam formed by or applied to the waveguide grating; and

an optical coupler that couples the first and second waveguides via evanescent fields, wherein the second optical waveguide has an offset transition region, within which a core of the second optical waveguide has an offset distance with respect to the substrate that gradually changes from a first distance to a different second distance.

10. A method of fabricating an optical device, comprising:

providing a substrate having a first optical waveguide thereon, the first optical waveguide having a cladding layer with a wedge-like portion;

forming a core of a second optical waveguide on the wedge-like portion; and

forming an array of cavities in the core of the second optical waveguide to define therein a waveguide grating, wherein the step of providing comprises:

forming a layer of cladding material over the first optical waveguide; and

subjecting the layer to a wet-etch process to form from the layer the wedge-like portion.

What is claimed is:

1. An apparatus, comprising:

a multilayered structure having a substrate layer, a first core layer, a first cladding layer, a second cladding layer, a second core layer, and a third cladding layer, wherein:

the first cladding layer comprises a first material; and

the second cladding layer has a wedge-like portion and comprises a second material different from the first material;

a first optical waveguide having a first core and a first cladding, wherein:

the first core comprises a portion of the first core layer; and

the first cladding comprises a portion of the substrate layer and a portion of the first cladding layer;

a second optical waveguide having a second core and a second cladding, wherein:

the second core comprises a portion of the second core layer; and

the second cladding comprises at least the wedge-like portion of the second cladding layer and a portion of the third cladding layer;

an optical coupler optically coupling the first and second waveguides, wherein the optical coupler comprises a portion of the first cladding layer; and

a waveguide grating being adapted to transfer optical power between one or more waveguide modes of the second waveguide and an optical beam formed by or applied to the waveguide grating, wherein the waveguide grating comprises a portion of the second core layer.

2. The apparatus of claim 1, wherein an index-of-refraction contrast of the second waveguide is greater than an index-of-refraction contrast of the first waveguide.

3. The apparatus of claim 1, wherein:

the substrate layer comprises the first material; and

the third cladding layer comprises the second material.

4. The apparatus of claim 3, wherein:

the first core layer comprises a ternary, quaternary, or quinary group III-V alloy;

the first material comprises a binary group III-V compound;

the second core layer comprises silicon; and

the second material comprises silicon oxide.

5. The apparatus of claim 1, wherein the optical coupler couples the first and second optical waveguides via evanescent fields.

6. The apparatus of claim 5, wherein the optical coupler has a length that causes optical energy to spatially beat one or more times between the first and second optical waveguides.

7. The apparatus of claim 1, wherein a portion of the second cladding layer adjacent to the waveguide grating has a thickness that causes the apparatus to produce constructive interference between (i) light diffracted by the waveguide grating toward an interface between the first cladding layer and the second cladding layer and then reflected back by the interface and (ii) light diffracted by the waveguide grating in a direction collinear with a propagation direction of the reflected light.

8. The apparatus of claim 1, wherein the first core comprises a laterally tapered portion connected to the optical coupler.

9. The apparatus of claim 1, further comprising an optical signal-processing (OSP) circuit supported on the substrate layer, wherein the first waveguide is optically coupled to the OSP circuit.

10. The apparatus of claim 9, wherein the OSP circuit comprises at least one active optical element.

11. The apparatus of claim 9, wherein the first and second waveguides, the waveguide grating, and the OSP circuit are parts of a photonic integrated circuit (PIC) formed on the substrate layer.

12. The apparatus of claim **1**, wherein:
the first core layer is directly connected to the substrate layer;
the first cladding layer is directly connected to the first core layer;
the second cladding layer is directly connected to the first cladding layer;
the second core layer is directly connected to the second cladding layer; and
the third cladding layer is directly connected to the second core layer.

13. The apparatus of claim **12**, wherein:
a portion of the second core layer is directly connected to the first cladding layer; and
a portion of the third cladding layer is directly connected to the first cladding layer.