CLAIMS

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A method of preparing an optical fiber for coupling, comprising:

activating an end surface of the optical fiber in a plasma to generate dangling bonds on the end surface of the optical fiber, whereby the dangling bonds facilitate coupling with a surface of a chip.

2. The method of claim 1, wherein the plasma is generated from a gas specie containing oxygen, hydrogen, nitrogen, ammonia or argon.

3. The method of claim 2, wherein the activating step is performed using reactive ion etching plasma or microwave radicals generated from the gas specie.

4. The method of claim 1, further comprising chamfering a portion of the end surface of the optical fiber.

5. The method of claim 4, further comprising activating the chamfered portion of the end surface of the optical fiber.

6. The method of claim 5, wherein the chamfering step is performed before the activating the chamfered portion of the end surface step.

7. An optical device manufacturing process, comprising:

pre-activating an end surface of at least one optical fiber in a plasma to generate dangling bonds on the end surface of the optical fiber; and

connecting the pre-activated end surface of the at least one optical fiber to a surface of a chip.

8. The process of claim 7, wherein the plasma is generated from a gas specie containing oxygen, hydrogen or argon.

9. The process of claim 7, further comprising the step of annealing the chip at a temperature of at least 200 degrees Celsius, wherein the annealing step is performed after the connecting step.

10. The process of claim 7, further comprising chamfering a portion of the end surface of the at least one optical fiber, wherein the chamfering step is performed before the pre-activating step.

11. The process of claim 10, further comprising chamfering the surface of the chip such that the chamfered surface of the chip aligns with the chamfered end surface of the at least one optical fiber.

12. The process of claim 7, wherein the pre-activating step is performed on a plurality of optical fibers, and the connecting step occurs within two hours of the pre-activating step.

13. An optical device, comprising:

a photonic-integrated chip on which an optical waveguide is formed; and

an optical fiber assembly comprising an optical fiber having an end surface that is pre-activated in a plasma to create dangling bonds which facilitate coupling with the optical waveguide, the end surface of the optical fiber providing a hermetically sealed optical connection to the optical waveguide formed in the photonic-integrated chip.

14. The optical device of claim 13, wherein the optical fiber is connected to the optical waveguide using an inverted taper.

15. The optical device of claim 13, wherein a portion of the end surface of the optical fiber is chamfered and the chamfered end surface of the optical fiber aligns with a corresponding chamfered side of the photonic-integrated chip.

16. The optical device of claim 15, wherein the corresponding chamfered side of the photonic-integrated chip is pre-activated in the plasma.

CLAIMS

1. A method of coupling an optical fiber to a chip, comprising:

chamfering a portion of an end surface of the optical fiber which will contact with a surface of the chip;

activating the end surface of the optical fiber, including the chamfered portion, in a plasma to generate dangling bonds on the end surface of the optical fiber, whereby the dangling bonds facilitate coupling with a surface of the chip;

directly contacting the end surface of the optical fiber to the surface of the chip; and

applying a pressure between the chamfered portion of the optical fiber and the surface of the chip to ensure no gaps are formed between the optical fiber and the chip.

2. The method of claim 1, wherein the plasma is generated from a gas specie containing oxygen, hydrogen, nitrogen, ammonia or argon.

3. The method of claim 2, wherein the activating step is performed using reactive ion etching plasma or microwave radicals generated from the gas specie.

4. The method of claim 1, wherein the chamfered portion of the end surface of the optical fiber and the surface of the chip are complementary surfaces that match and align with each other.

5. The method of claim 1, wherein the activated end surface of the optical fiber forms a hermetic seal with the surface of the chip.

6. The method of claim 1, wherein the chip comprises an optical waveguide and the optical fiber forms at least one covalent bond directly with the optical waveguide.

7. An optical device manufacturing process, comprising:

pre-activating an end surface of at least one optical fiber in a plasma to generate dangling bonds on the end surface of the optical fiber;

connecting the pre-activated end surface of the at least one optical fiber to a surface of a chip,

wherein the end surface of the at least one optical fiber directly contacts the surface of the chip,

wherein a portion of the end surface of the at least one optical fiber is chamfered and the surface of the chip is chamfered such that the chamfered surface of the chip matches and aligns with the chamfered end surface of the at least one optical fiber; and

applying a pressure between the end surface of the optical fiber and the surface of the chip to ensure no gaps are formed between the optical fiber and the surface of the chip.

8. The process of claim 7, wherein the plasma is generated from a gas specie containing oxygen, hydrogen or argon.

9. The process of claim 7, further comprising the step of annealing the chip at a temperature of at least 200 degrees Celsius, wherein the annealing step is performed after the connecting step.

10. The process of claim 7, wherein the chamfering of the optical fiber is performed before the pre-activating step.

11. The process of claim 7, wherein the the connecting step occurs within two hours of the pre-activating step.

12. An optical device, comprising:

a photonic-integrated chip on which an optical waveguide is formed; and

an optical fiber assembly comprising an optical fiber having a chamfered end surface that is pre-activated in a plasma to create dangling bonds which facilitate coupling with the optical waveguide, the optical waveguide having a chamfered surface that matches and aligns with the chamfered end surface of the optical fiber, and the chamfered end surface of the optical fiber providing a hermetically sealed optical connection to the optical waveguide formed in the photonic-integrated

chip, wherein the end surface of the optical fiber directly contacts the chamfered surface of the optical waveguide.

13. The optical device of claim 12, wherein chamfered end surface of the optical fiber is an inverted taper.

14. The optical device of claim 13, wherein the chamfered surface of the optical waveguide is pre-activated in the plasma.