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(54) PLANAR TYPE LIGHT EMITTING AND RECEIVING COMPONENT HAVING HIGH LIGHT GATHERING EFFICIENCY

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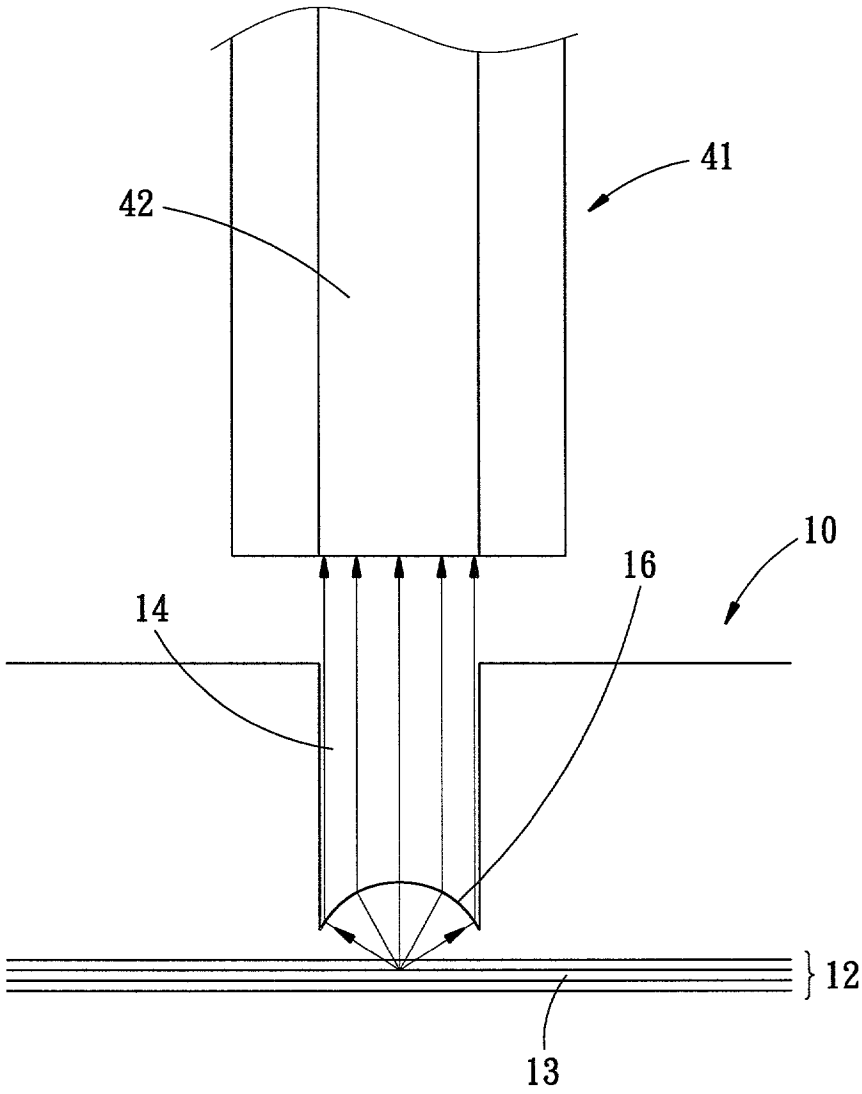
(57) **ABSTRACT**

The present invention is to provide a planar type light emitting and receiving component having a high light gathering efficiency, and including a substrate provided with a epitaxy growth layer and formed with a cavity, an active region provided in the epitaxy growth layer for emitting light, and a light gathering lens formed in the cavity and located close to the active region of the epitaxy growth layer. Thus, the distance between the active region and the light gathering face may be shortened, thereby efficiently gathering the light.



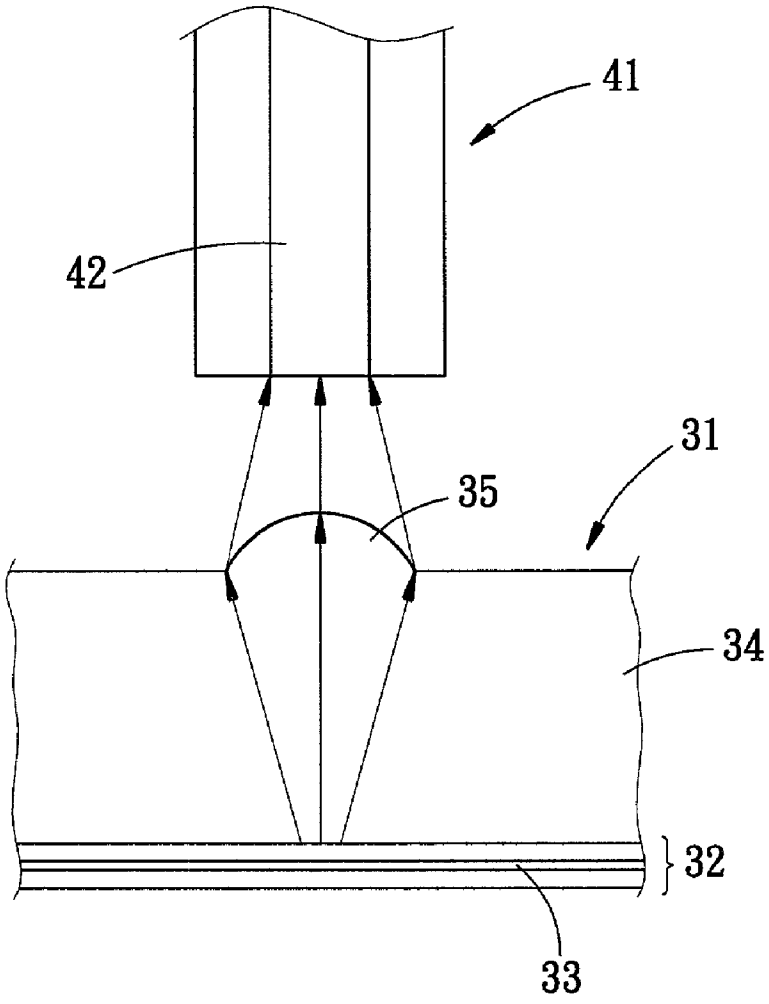


FIG. 1
PRIOR ART

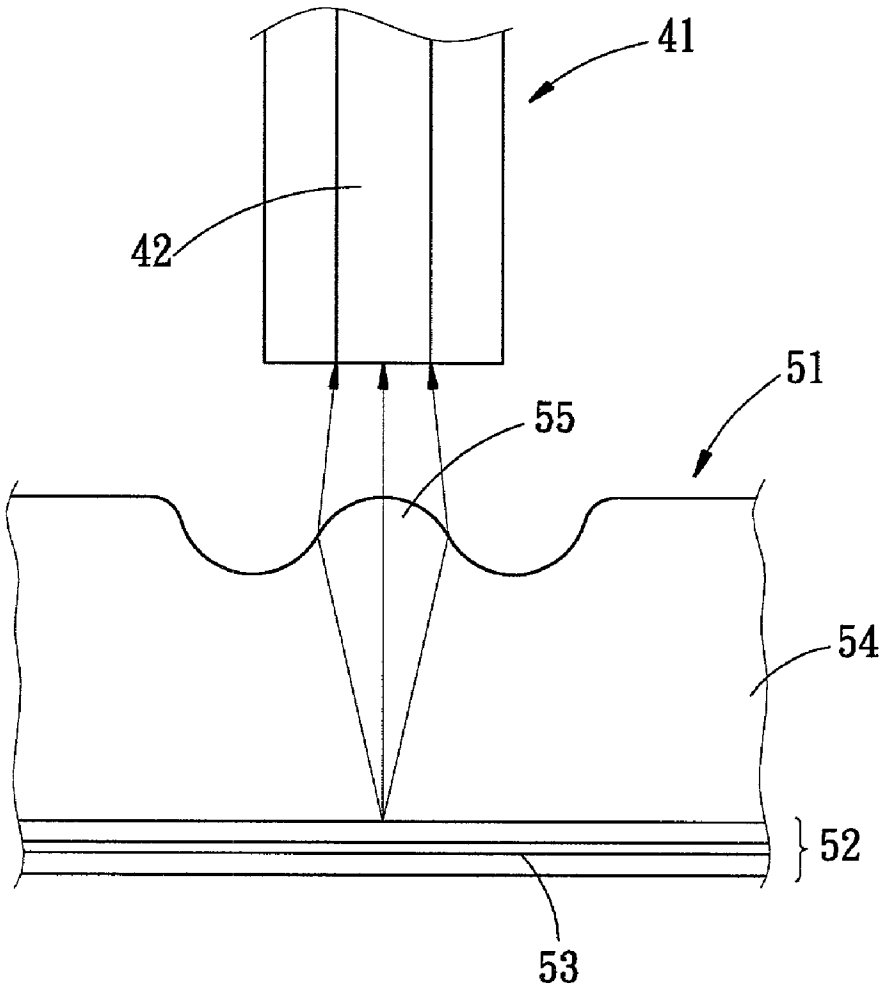


FIG. 2
PRIOR ART

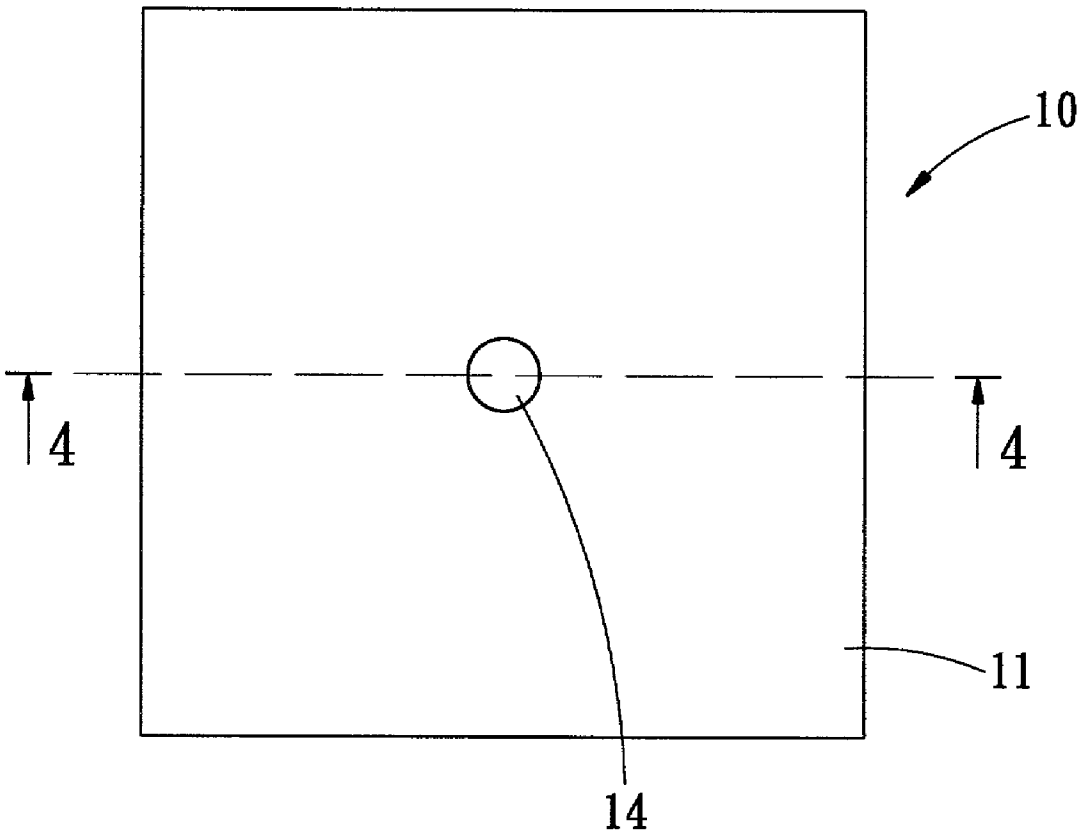
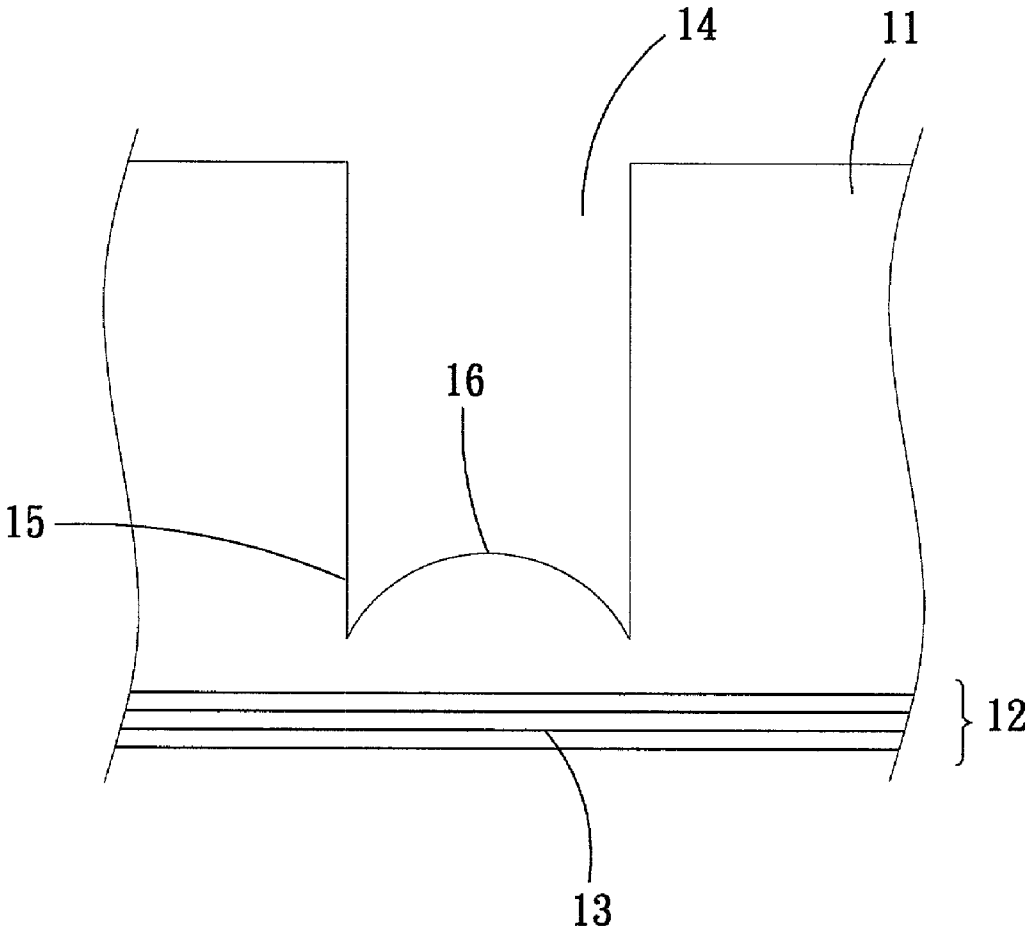


FIG. 3



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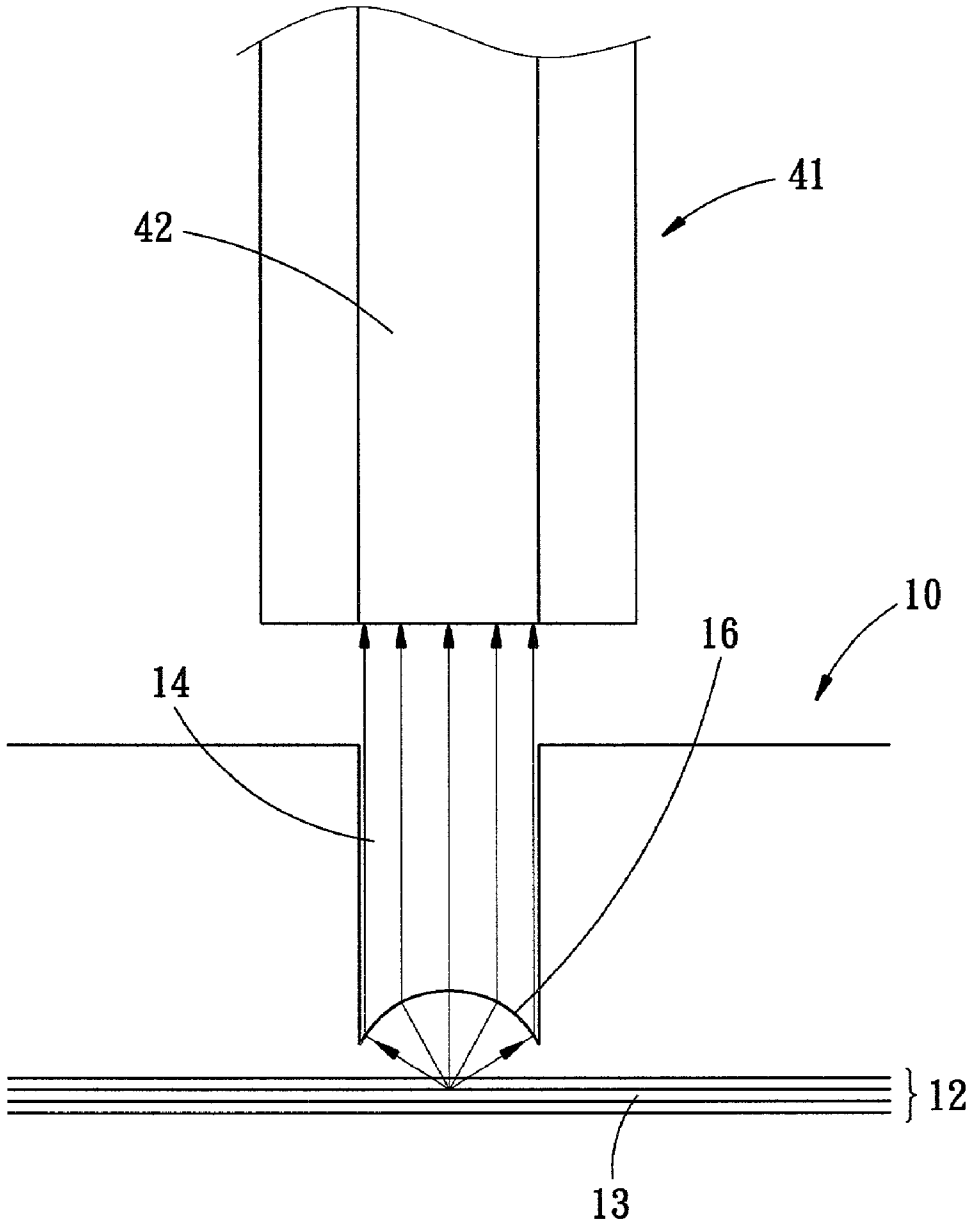

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PLANAR TYPE LIGHT EMITTING AND RECEIVING COMPONENT HAVING HIGH LIGHT GATHERING EFFICIENCY

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a planar type light emitting and receiving component having a high light gathering efficiency, that may be coupled with an optical fiber.

[0003] 2. Description of the Related Art

[0004] A conventional light emitting and receiving component **31** shown in **FIG. 1** is coupled with an optical fiber **41**. The light emitting and receiving component **31** includes an active region **33** that is provided in a epitaxy growth layer **32** of a few micrometers (μm) for emitting light. A substrate **34** is connected with the epitaxy growth layer **32**, and a light gathering face **35** is protruded outward from a side of the substrate **34**, and is far spaced from the epitaxy growth layer **32**. The light gathering face **35** that is directly made on the substrate **34** may be mass produced during a batch process, and may facilitate the control of the component feature, and control of the evenness of the entire wafer, thereby efficiently decreasing the cost.

[0005] The thickness of the substrate **34** is about hundreds of μm, and the thickness of the epitaxy growth layer **32** is about a few μm, so that the thickness of the substrate **34** is mush greater than that of the epitaxy growth layer **32**. Further, the light gathering face **35** is protruded outward from the substrate **34**, so that the light gathering face **35** is far spaced from the active region **33**.

[0006] Thus, when in use, the light (as indicated by arrows) of the active region **33** may be reflected and focused through the light gathering face **35** to enter the core **42** of the optical fiber **41**. However, the light gathering face **35** is far spaced from the active region **33**, so that many beams of light scatter, thereby greatly decreasing the light gathering effect.

[0007] Another conventional light emitting and receiving component **51** in accordance with the prior art shown in **FIG. 2** is coupled with an optical fiber **41**. The light emitting and receiving component **51** includes a epitaxy growth layer **52** having an active region **53** for emitting the light. A substrate **54** is connected with the epitaxy growth layer **52**, and a convex-shaped light gathering face **55** is etched on the surface of the substrate **54**, and is far spaced from the epitaxy growth layer **52**.

[0008] In comparison, the light gathering face **55** as shown in **FIG. 2** is slightly closer to the active region than the light gathering face **35** as shown in **FIG. 1**. However, the top of the light gathering face **55** is flush with the surface of the substrate **54**. That is, the light gathering face **55** is far spaced from the active region **53**, thereby greatly decreasing the light gathering effect.

[0009] The substrate **34** or **54** may be made to have a thin-shape, so that the light gathering face **35** or **55** is closer to the active region **33** or **53**. However, after the wafer is made, the light emitting and receiving component **31** or **51** needs to be cut into crystal particles. Thus, if the substrate **34** or **54** is made to have a thin-shape, the wafer is easily broken in the following manufacturing process. In addition, during the cutting process, the wafer is easily broken due to the stress effect, thereby decreasing the quality of the product. Therefore, reduction of thickness of the substrate **34** or **54** may enhance the feature of the component, but cannot satisfy the practical requirements of the manufacturing process.

SUMMARY OF THE INVENTION

[0010] The primary objective of the present invention is to provide a planar type light emitting and receiving component having a high light gathering efficiency, comprising: a substrate provided with a epitaxy growth layer and formed with a cavity, an active region provided in the epitaxy growth layer for emitting light, a convex-shaped light gathering face formed in the cavity and located close to the active region of the epitaxy growth layer. Thus, the distance between the active region and the light gathering face may be greatly shortened, thereby efficiently gathering the light. Thus, the light emitted from the active region may be focused by the light gathering face immediately, thereby increasing the light gathering effect. In addition, the thickness of the substrate needs not to be changed, thereby maintaining the completeness of the crystal particles, and thereby increasing the quality of the manufacturing process.

[0011] Further benefits and advantages of the present invention will become apparent after a careful reading of the detailed description with appropriate reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a schematic view of a conventional light emitting and receiving component coupled with an optical fiber in accordance with the prior art;

[0013] **FIG. 2** is a schematic view of another conventional light emitting and receiving component coupled with an optical fiber in accordance with the prior art;

[0014] **FIG. 3** is top plan view of a planar type light emitting and receiving component having a high light gathering efficiency in accordance with the present invention;

[0015] **FIG. 4** is a cross-sectional view of the planar type light emitting and receiving component having a high light gathering efficiency taken along line **4-4** as shown in **FIG. 3**; and

[0016] **FIG. 5** is a schematic view of the planar type light emitting and receiving component having a high light gathering efficiency coupled with an optical fiber.

DETAILED DESCRIPTION OF THE INVENTION

[0017] Referring to the drawings and initially to **FIGS. 3 and 4**, a planar type light emitting and receiving component **10** having a high light gathering efficiency in accordance with a preferred embodiment of the present invention comprises a substrate **11** having a surface provided with a epitaxy growth layer **12** that is made of a compound semiconductor. An active region **13** is provided in the epitaxy growth layer **12** for emitting light. The light emitted from the active region **13** may penetrate through the substrate **11**.

[0018] A cavity **14** is etched in the substrate **11**, and has an area much smaller than that of the substrate **11** as shown in

FIG. 3. The bottom **15** of the cavity **14** is integrally formed with a lens face during the etching process. The lens face may be a light gathering face **16** having a convex shape. The light gathering face **16** may be very close to the epitaxy growth layer **12**, so that the distance between the light gathering face **16** and the active region **13** is much shorter.

[**0019**] As shown in **FIGS. 4 and 5**, the light gathering face **16** in the cavity **14** is close to the epitaxy growth layer **12**. Thus, when the planar type light emitting and receiving component **10** is coupled with the optical fiber **41**, and the active region **13** emits light, the light may reach the light gathering face **16** in a very short optical path. Thus, the light gathering face **16** may gather and focus the light emitted from the active region **13** before the light scatters largely, so that the light may be highly gathered, and the penetrating light may exactly enter the core **42** of the optical fiber **41**.

[**0020**] The thickness of the substrate **11** may exceed 350 μm. Traditionally, the etching velocity is about 2 to 3 μm. Thus, it is necessary to take a long time to etch a cavity **14** having a depth of 300 μm in the substrate **11**, so that the distance between the light gathering face **16** and the epitaxy growth layer **12** is about 50 μm. Recently, a more rapid etching technology, such as the high density plasma reactive ion etching (HDP-RIE) technology, may provide an etching speed greater than 10 μm/min. Thus, it only needs to take about thirty minutes to etch a cavity **14** having a depth of 300 μm in the substrate **11**, so that the etching time is apparently shortened largely, thereby fully satisfying the practical requirements of the manufacturing process.

[**0021**] Of course, the substrate **11** may be made to have a thin-shape under the condition that it may withstand the cutting force, thereby shortening the etching time so that the distance between the light gathering face **16** and the epitaxy growth layer **12** is about 50 μm, thereby fully satisfying the practical requirements of the manufacturing process.

[**0022**] In comparison, the light gathering face **16** as shown in **FIG. 5** is much closer to the active region **13** than the light gathering face **35** as shown in **FIG. 1** and the light gathering face **55** as shown in **FIG. 2**, such that the present invention may provide a shorter optical path for the active region **13**, thereby enhancing the light gathering effect.

[**0023**] In addition, during the process of cutting the crystal particles, the area of the cavity **14** (i.e., the active region) is very small without affecting the strength of the substrate **11**, thereby increasing the quality of cutting the crystal particles, so as to satisfy the requirements of the manufacturing process.

[**0024**] In addition, during the process of etching the cavity **14**, the bottom **15** of the cavity **14** is integrally formed with the light gathering face **16**, thereby satisfying the requirements of production and fabrication without needing an additional manufacturing process.

[**0025**] When the optical fiber **41** is used, it is necessary to provide a light emitting component on one side of the optical fiber **41**, and to provide a light receiving component on the other side of the optical fiber **41**. Thus, the light signal emitted from the light emitting component is transmitted through the optical fiber **41**, and is received by the light receiving component. In the above embodiment, the light emitting and receiving component **10** may emit the light toward one side of the optical fiber **41**. At this time, the light emitting and receiving component **10** functions as a light emitting component. Similarly, the light emitting and receiving component **10** may be provided on the other side of the optical fiber **41**, such that the light signal transmitted through the optical fiber **41** may be received by the light emitting and receiving component **10**. At this time, the light emitting and receiving component **10** functions as a light receiving component. The light emitting and receiving component **10** may co-operate with the light gathering face **16** so as to enhance the effect of receiving the light signal.

[**0026**] The lens face disclosed in the above embodiment is a light gathering face **16** having the effect of a convex lens, and the light gathering face **16** is close to the active region **13**, so that the light of the active region **13** may further enhance the focusing effect. In such a manner, the light emitting and receiving component may be formed with a cavity which my be formed with a lens face (such as a concave lens) that may diverge the light. Thus, the active region **13** may attenuate the energy of the light through the concave lens, and then the light signal may be transmitted toward the optical fiber.

[**0027**] While the preferred embodiment of the present invention has been shown and described, it will be apparent to those skilled in the art that various modifications may be made in the embodiment without departing from the spirit of the present invention. Such modifications are all within the scope of the present invention.

What is claimed is:

1. A planar type light emitting and receiving component having a high light gathering efficiency, comprising: a substrate provided with a epitaxy growth layer and formed with a cavity, an active region provided in the epitaxy growth layer for emitting light, a lens face formed in the cavity and located close to the active region of the epitaxy growth layer.

2. The planar type light emitting and receiving component having a high light gathering efficiency in accordance with claim 1, wherein the lens face is a light gathering face having a convex shape.

3. The planar type light emitting and receiving component having a high light gathering efficiency in accordance with claim 1, wherein the lens face is formed on a bottom of the cavity.

4. The planar type light emitting and receiving component having a high light gathering efficiency in accordance with claim 1, wherein the lens face is integrally formed when the cavity is etched on the substrate.

5. The planar type light emitting and receiving component having a high light gathering efficiency in accordance with claim 1, wherein the lens face is a light diverging face having a concave shape.

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