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ZHAO et al.

(54) **OPTICAL MODULE FOR TRANSMITTING OPTICAL SIGNAL**

(75) Inventors: **JIM ZHAO**, Irvine, CA (US); **YUAN CHIEH LIN**, Lake Forest, CA (US); **JIA-HAU LIU**, New Taipei (TW)

(73) Assignee: **HON HAI PRECISION INDUSTRY CO., LTD.**, New Taipei (TW)

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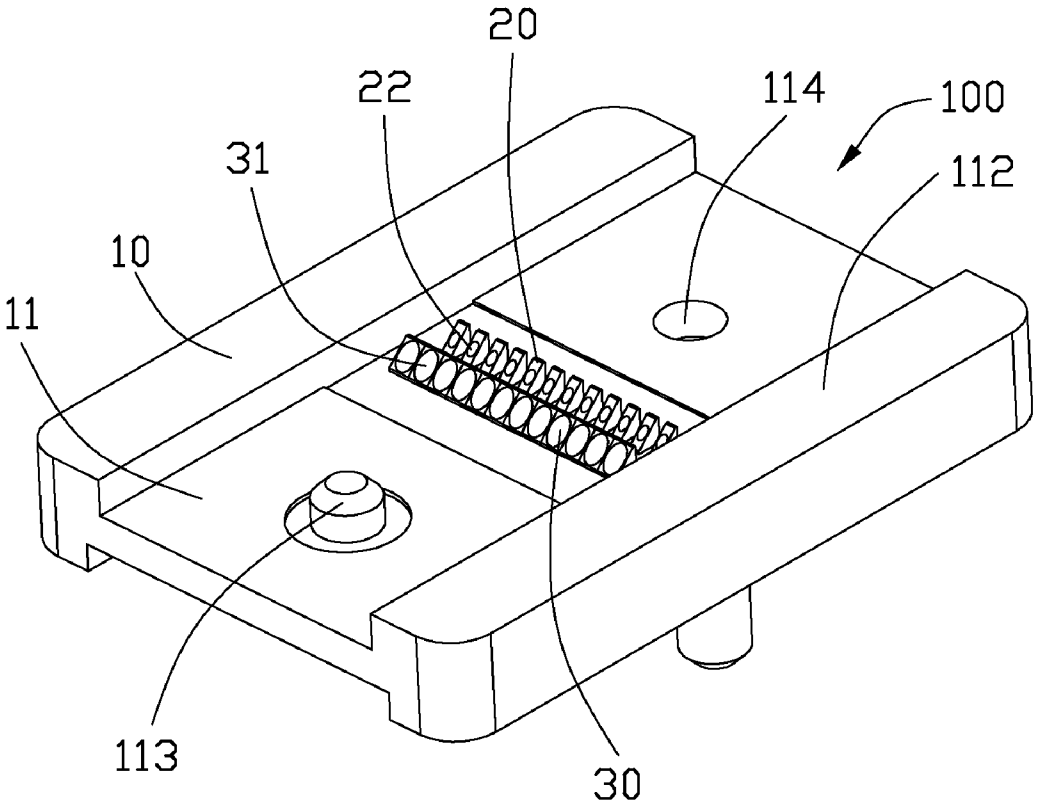
(57) **ABSTRACT**

An optical module comprises: a housing; a first incident surface mounted on the housing for receiving an optical signal converted from an electrical signal; a first output surface mounted on the housing for exporting the optical signal from the first incident surface; a second incident surface mounted on the housing for receiving another optical signal to be converted to another electrical signal; and a second output surface mounted on the housing for exporting the another optical signal from the second incident surface. An aperture of the first incident surface is smaller than an aperture of the second incident surface.



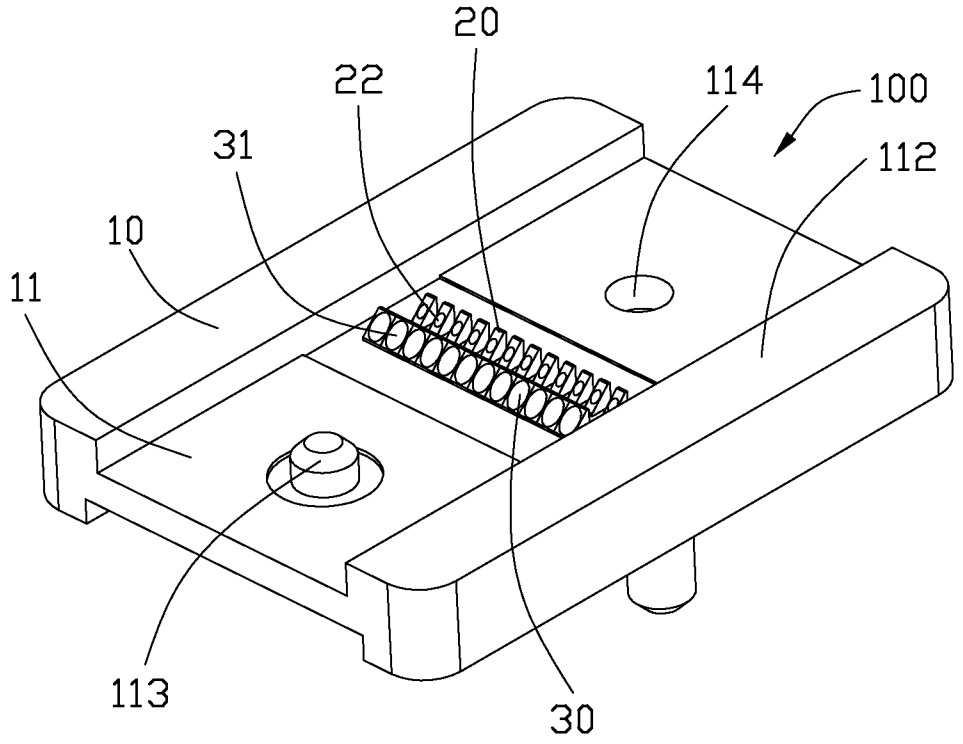


FIG. 1

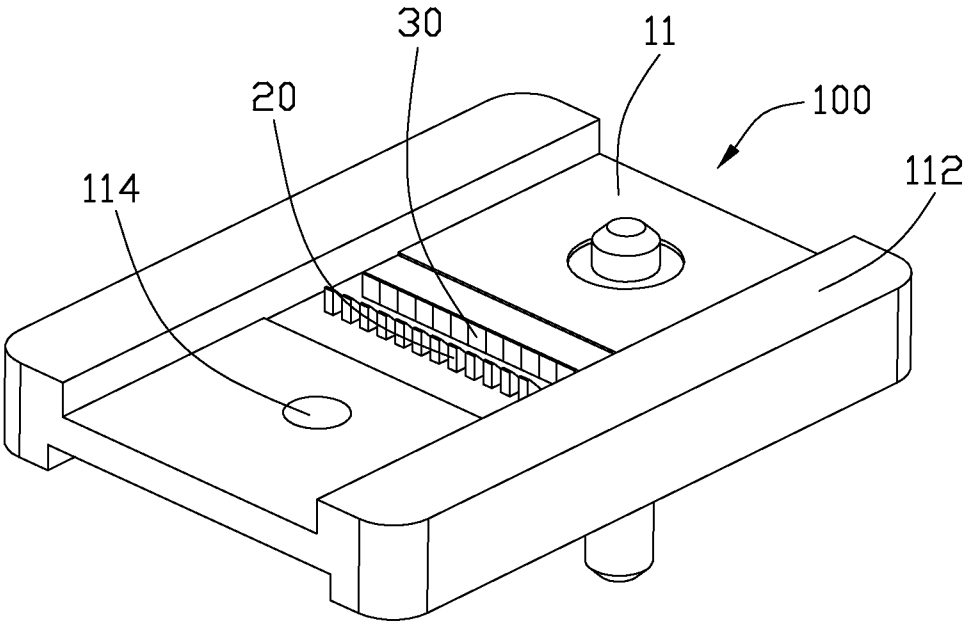


FIG. 2

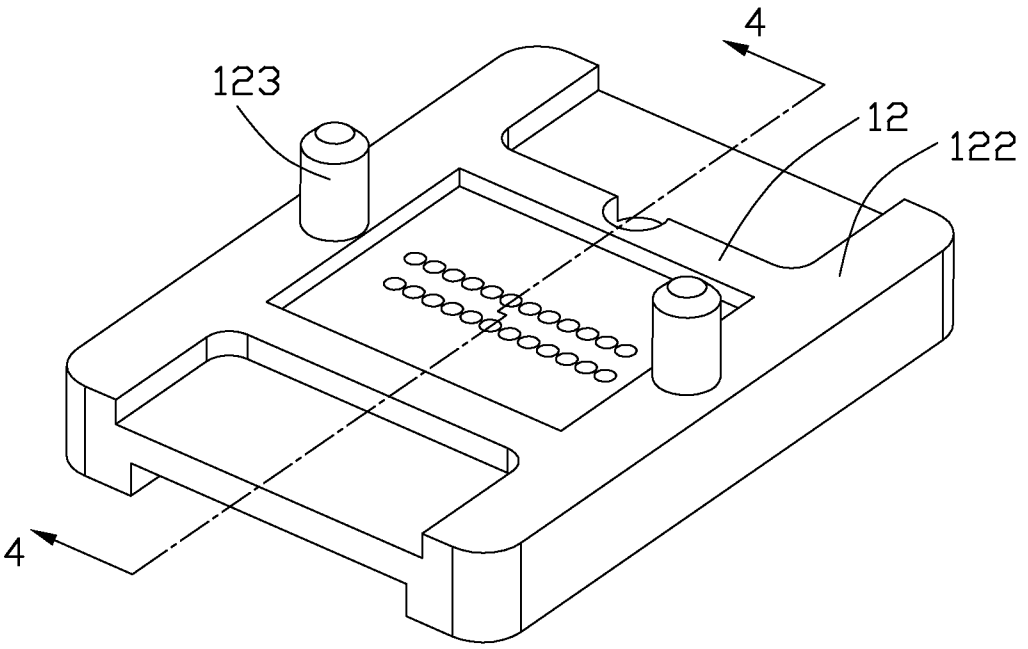


FIG. 3

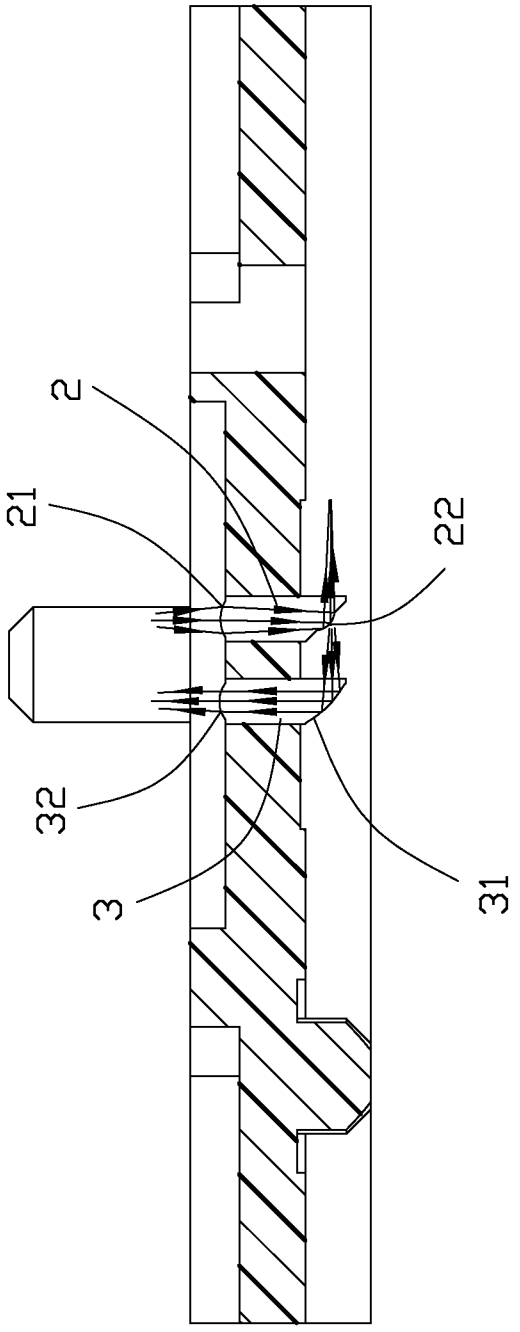


FIG. 4

OPTICAL MODULE FOR TRANSMITTING OPTICAL SIGNAL

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an optical module, and more particularly to an optical module for improving optical signal transmission.

[0003] 2. Description of Related Arts

[0004] An optical transceiver is used in optical networking for conversion between an optical signal and an electrical signal.

[0005] Generally, an optical transceiver comprises an optical module having a TOSA (Transmitter Optical Subassembly) for receiving an optical signal converted from an electrical signal by a VCSEL and transmitting the optical signal to a waveguide, and a ROSA (Receiver Optical Subassembly) for receiving an optical signal from another waveguide and transmitting the optical signal to a photodiode which converts the optical signal to an electrical signal. Between the optical signal from the VCSEL to the waveguide and the optical signal from the another waveguide to the photodiode are needed two lenses for handling the optical signals.

[0006] U.S. Pat. No. 8,195,017 discloses a consumer input/output (CIO) optical transceiver module for use in an active optical cable. The transceiver module includes two singlet laser diodes and two singlet photodiodes in a row, instead of costly parallel arrays of laser diodes and parallel arrays of photodiodes that are used in known active optical cables, for providing two high-speed transmit channels and two high-speed receive channels, respectively. Correspondingly arranged is an optics system module having lenses formed therein for coupling light between optical fibers and the laser diodes and the photodiodes.

[0007] U.S. Pat. No. 7,212,698, issued to Bapst et al. on May 1, 2007, discloses a method of processing a circuit board having one or more associated optical waveguides, comprising providing and using one or more etch stop layers in proximate to the one or more waveguides to provide one or more cavities having a defined positioning and depth for alignment of one or more optical components. The optical component is selected from the group consisting of opto-electronic modules, lenses, turning mirrors and/or their combination. Also disclosed is staggering of turning mirrors and lenses to increase waveguide density.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide an improved optical module. To achieve the this object, an optical module comprises: a housing; a first incident surface mounted on the housing for receiving an optical signal converted from an electrical signal; a first output surface mounted on the housing for exporting the optical signal from the first incident surface; a second incident surface mounted on the housing for receiving another optical signal to be converted to another electrical signal; and a second output surface mounted on the housing for exporting the another optical signal from the second incident surface. An aperture of the first incident surface is smaller than an aperture of the second incident surface.

[0009] Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0010] FIG. **1** is a perspective view of an optical module in accordance with the present invention;

[0011] FIG. **2** is a view similar to FIG. **1**, but from another aspect;

[0012] FIG. **3** is a view similar to FIG. **1**, but from the third aspect; and

[0013] FIG. **4** is a cross section view of the optical module of FIG. **3** taken along line **4-4**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] Reference will now be made in detail to a preferred embodiment of the present invention.

[0015] Referring to FIGS. **1** to **4**, an optical module **100** for being used for an optical transmitter or transceiver in accordance with the present invention comprises a housing **10**, a first lens array **20** as a route which an optical signal converted to an electrical signal and a second lens array **30** as a route which an electrical signal converted to an optical signal.

[0016] Referring to FIGS. **1** to **4**, the housing **10** comprises a main portion **11** for mounting to the first and second lens arrays **20**, **30**. The main portion **11** is a rectangular and has a first surface **11** and a second surface **12** opposite to the first surface **11**. Two pairs of flanges **112**, **122** extend outwardly from two lateral sides of the first surface **11** and second surface **12**, respectively. A first column **113** is defined between two flanges **112** on the first surface **11** and extends outwardly from the first surface **11**. A pair of second columns **123** are defined between two flanges **122** on the second surface **12** and extends outwardly from the second surface **12** for positioning the housing **10**. A through hole **114** is run through the first and second surfaces **11**, **12**.

[0017] The first lens array **20** and the second lens array **30** parallel to the second lens array **20** are mounted on the housing **10**. The first lens array **20** and the second lens array **30** are vertical to two pairs of flanges **112**. The first lens array **20** has a number of first lenses **2** arranged in a row. The second lens array **30** has a number of second lenses **3** arranged in a row. The housing **1** is molded on the periphery of the first lens array **20** and the second lens array **30**. From a view of a vertical direction of the first and second lens arrays **20**, **30**, the first lenses **20** and the second lenses **30** are staggered each other. Each first lens **2** has a first incident surface **21** for receiving the optical signal transmitting into the lens **2** and a first output surface **22** for exporting the optical signal transmission from the lens **2**. The first incident surface **21** and the first output surface **22** are mounted or constituted on the housing **1**. The first incident surface **21** and the first output surface **22** are respectively a curved surface which belong to an elliptical or circle structure and bulged outwardly. The curved surface may be a convex lens. The mid portions of the first incident and output surface **21**, **22** are bulged highest. Each second lens **3** has a second incident surface **31** for receiving an optical signal transmitting into the second lens **3** and a second output surface **32** for exporting the optical signal transmission from the second lens **3**. The second incident surface **31** and the second output surface **32** are mounted or constituted on the housing **1**, too. The second incident surface **31** and the second output surface **32** are respectively similar to the structures of the first incident and output surface **21**, **22**, that is an curved surface of the second incident or output surface **31**, **32** which belong to an elliptical or round structure

and bulged outwardly. The curved surface can be another convex lens. The mid portions of the second incident and output surface **31**, **32** are bulged highest. In other embodiments, the first incident and output surface **21**, **22** may be not formed on a lens **2**, the first incident and output surface **21**, **22** are formed on two different lenses. The second incident or output surface **31**, **32** are formed on two different lenses. The first incident and output surface **21**, **22** and the second incident or output surface **31**, **32** are exposed from the first and second surface **11**, **12** of the housing **1**, respectively.

[0018] The first incident surface **21** of the first lens **2** and the second output surface **32** of the second lens **3** are located on a first surface **11** of the housing. The first output surface **22** of the first lens **2** and the second incident surface **31** of the second lens **3** are located on a second surface **12** of the housing **1**. An approximately 45 degrees angle is formed between the first incident surface **21** and first output surface **22** of the first lens **2**, and an approximately 45 degrees angle is formed between the second incident surface **31** and second output surface **32** of the second lens **3**.

[0019] When the optical module **100** is used for the optical transmitter or transceiver, and the optical transmitter or transceiver is needed to an optical signal be converted from an electrical signal, the optical signal be converted from the electrical signal by a vertical cavity surface emitting laser (VCSEL) firstly, the first incident surface **21** receives the optical signal from VCSEL mounted on the first surface **11** of the housing **1**, and the optical signal goes through the first lens **2** and exports the first output surface **22** toward a waveguide, secondly. When the optical transmitter or transceiver is needed to an optical signal be converted to an electrical signal, the optical signal which comes from electrical signal is converted to by another waveguide is sent toward a photodiode, the second incident surface **31** receives the optical signal from the waveguide mounted on the second surface **12** of the housing **1**, and the optical signal goes through the second lens **3** and exports the second output surface **32** toward the photodiode.

[0020] The term "aperture" refers to the size of receiving an optical signal or handling the optical signal. If the incident or output surface of first or second lens **2**, **3** is circle, the aperture is as the diameter of the incident or output surface; and if the incident or output surface is elliptical, the aperture is as the area of the incident or output surface. After divergence optical signal is received by the aperture of the first or second incident surface **21**, **31**, the optical signal can be parallel to each other or gather inwardly. After the divergence optical signal is received by the area of the outside of the aperture of the first or second incident surface **21**, **31**, the divergence optical signal is still divergence outwardly, and of which angle is increased. Due to the VCSEL providing a small hole to emit the optical signal, and the divergence angle of the optical signal from the VCSEL is small. So, the small aperture of the first incident surface **21** is provided to receive the small divergence angle optical signal. After the parallel or gathering the optical signal in the lens **2** being exported by the first output surface **22**, the optical signal can gather inwardly again or focus on a point and transit toward the waveguide. The hole of the VCSEL is vertical to the first and second surface of housing **1**, and the hole of the waveguide is extending along the first and second surface of housing **1**. Through the optical signal is sent by the first lens **2** and the second lens **3**, the route of optical signal before the first or second lens **2**, **3** is vertical roughly to the route the route of the optical signal which is exported from the first or second lens **2**, **3**.

[0021] Due to the waveguide providing a bigger hole than the VCSEL to emit an optical signal, the divergence angle of the optical signal from the waveguide is bigger. So, the aperture of the second incident surface **31** bigger than the first incident surface's **21** is provided to receive the bigger divergence angle optical signal. After the parallel or gathering the optical signal in the second lens **3** being exported by the second output surface **32**, the optical signal can gather inwardly again or focus on a point and transit toward the photodiode. As the divergence angle or area of the optical signal sent by the first lens **2** is smaller than second lens **3**, as the aperture of the first output surface **22** of the first lens **2** is smaller an aperture of the second output surface **32** of the second lens **3**.

[0022] According to the divergence angle that the optical signal arrival at the first or second incident **21**, **31** of the lenses **2**, **3**, the optical module **100** is confirmed that the aperture area of the first lens **2** or second lens **3**. The optical module **100** has a big aperture for receiving the big divergence angle of the optical signal, and has a small aperture for receiving the small divergence angle of the optical signal.

[0023] It is to be understood, however, that even though numerous characteristics of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. An optical module comprising:

a housing;

a first incident surface mounted on the housing for receiving an optical signal converted from an electrical signal;

a first output surface mounted on the housing for exporting the optical signal from the first incident surface;

a second incident surface mounted on the housing for receiving another optical signal to be converted to another electrical signal; and

a second output surface mounted on the housing for exporting the another optical signal from the second incident surface; wherein

an aperture of the first incident surface is smaller than an aperture of the second incident surface.

2. The optical module as recited in claim **1**, wherein an approximately 45 degrees angle is formed between the first incident surface and the first output surface, and an approximately 45 degrees angle is formed between the second incident surface and the second output surface.

3. The optical module as recited in claim **1**, wherein the first incident surface and the first output surface constitute a first lens, and the second incident surface and the second output surface constitute a second lens.

4. The optical module as recited in claim **3**, wherein a plurality of first lenses are provided to form a first lens array arranged in a row, and a plurality of second lenses are provided to form a second lens array arranged in a row.

5. The optical module as recited in claim **4**, wherein the first incident surface of the first lens and the second output surface of the second lens are located on a first surface of the housing.

6. The optical module as recited in claim **5**, wherein the first output surface of the first lens and the second incident surface of the second lens are located on an opposite second surface of the housing.

7. The optical module as recited in claim **1**, wherein the first incident surface of the first lens collimate the optical signals.

8. The optical module as recited in claim **1**, wherein the second incident surface of the second lens collimate the optical signals.

9. The optical module as recited in claim **8**, wherein the first and second lenses are staggered.

10. The optical module as recited in claim **1**, wherein an aperture of the first output surface is smaller than an aperture of the second output surface.

11. An optical module comprising:

a housing defining a lengthwise direction and a transverse direction perpendicular to each other and both perpendicular to a vertical direction along which opposite first and second faces are opposite to each other;

a first lens array including a plurality of first lenses thereof and a second lens array including a plurality of second lenses thereof, both of which are associated with the housing and space from each other in said lengthwise direction while each arranged in said transverse direction;

the first lens defining a first light transmission path with a first incident surface around the second face for receiving a first optical signal which is converted from an electrical signal, and with a first output surface around the first face for transmitting the first optical signal to a corresponding waveguide around the first face; and

the second lens defining a second light transmission path with a second incident surface around the first face for receiving a second optical signal from a corresponding waveguide around the first face, and with a second output surface around the second face for transmitting the second optical signal toward a photodiode for converting the second optical signal to an electrical signal; wherein

the first lens is configured to be different from the second lens.

12. The optical module as claimed in claim **11**, wherein the first lens defines a first reflection curved area around the first output surface and the second lens defines a second reflection curved area around the second incident surface under condition that the first reflection curved area and the second reflection curved area are sized different from each other.

13. The optical module as claimed in claim **12**, wherein said first reflection curved area is smaller than the second reflection curved area.

14. The optical module as claimed in claim **11**, wherein the first lens is smaller than the second lens.

15. The optical module as claimed in claim **14**, wherein the first lens is configured to be a converging type while the second lens is configured to be a parallel type.

16. The optical module as claimed in claim **11**, wherein the first lens defines a first curved area around the first incident surface and the second lens defines a second curved area around the second incident surface under condition that the first reflection curved area and the second reflection curved area are sized different from each other.

17. The optical module as claimed in claim **16**, wherein the first curved area is smaller than the second curved area.

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