

VEHICLE, DISPLAY DEVICE AND MANUFACTURING METHOD FOR A SEMICONDUCTOR DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a semiconductor device having a circuit composed of thin film transistors (hereinafter referred to as TFTs) transferred by bonding a layer to be peeled off to a base member. More particularly, the present invention relates to an electro-optical device which is represented by a liquid crystal module, a light emitting device which is represented by an EL module, and electronic equipment on which such a device is mounted as a part. Further, the present invention relates to a manufacturing method of all these devices and apparatuses mentioned above.

[0003] Note that a semiconductor device in this specification indicates general devices functioning by utilizing semiconductor characteristics, and an electro-optical device, a light emitting device, a semiconductor circuit, and electronic equipment are all semiconductor devices.

[0004] 2. Description of the Related Art

[0005] In recent years, a technique of constructing a thin film transistor (TFT) using a semiconductor thin film (about several to several hundred nm in thickness) formed on a substrate having an insulating surface has been noted. The thin film transistor is widely applied to an electronic device such as an IC or an electro-optical device. In particular, the development of the thin film transistor as a switching element of an image display device is urgently necessary.

[0006] Further, concern over mounting, for example, a navigation system display device, an audio operation screen display device and a measuring display device into various display devices of vehicles such as an automobile and aircraft has been attempted.

[0007] Various applications utilizing such an image display device are expected, and particularly its utilization in a portable device is noted. Currently, a glass substrate or a quartz substrate is used for forming the TFT in many cases. However, there is a defect that the above substrate is easy to crack and heavy. In addition, in the case of mass production, it is difficult and thus not suitable to use a large size glass substrate and a large size quartz substrate. Thus, it is attempted to form a TFT element on a flexible substrate, typically, a flexible plastic film.

[0008] However, the plastic film has a low heat resistance, so that it is necessary to reduce a maximum temperature of a process. As a result, under the current circumstances, a TFT having a preferable electrical characteristic cannot be formed on the plastic film as compared with the case where the glass substrate is used. Therefore, a liquid crystal display device and a light emitting element for which the plastic film is used and which each have a high performance are not realized.

[0009] If a light emitting device in which an organic light emitting element (OLED: organic light emitting device) is formed or a liquid crystal display device can be manufactured on a flexible substrate such as a plastic film, such a device can be used for a display having a curved surface, a

show window and the like in addition to being thin and light weight. Thus, its use is not limited to only a mobile device and the scope of application is very wide.

[0010] Further, if a display having a curved surface becomes available, in the case where an imaging or measuring display is to be furnished in a limited space such as at the driver's seat in an automobile or aircraft or other such vehicle, the display can be mounted to various locations that have curved surfaces (such as the window, the ceiling, the door, the dashboard, etc.), thereby reducing the space occupied by the display. Since the display has been a flat one up to now, space in vehicles has been narrowed, or, complicated operations for embodying a flat display, such as operations for cutting off the walls, attaching and the like have been required.

SUMMARY OF THE INVENTION

[0011] An object of the present invention is to provide a semiconductor device in which a layer to be peeled off is bonded to a base member having a curved surface and a manufacturing method thereof. More particularly, an object of the present invention is to provide a display having a curved surface, specifically, a light emitting device having a light emitting element in which a layer containing an organic compound serves as a light emitting layer is bonded to the base member having a curved surface, or a liquid crystal display device in which a layer to be peeled off is bonded to the base member having the curved surface.

[0012] Also, another object of the present invention is to provide a semiconductor device in which various elements (a thin film diode, a photoelectric conversion element which is made of silicon and has a PIN junction, and a silicon resistor element) represented by a TFT are bonded to a flexible film (bendable film) and a manufacturing method thereof.

[0013] According to the present invention, when forming a layer to be peeled off containing an element onto a substrate, the channel length directions of the regions functioning as channels for the element are all arranged in the same direction, and irradiation of laser light that scans in the same direction as the channel lengths is performed, whereby the element is completed. After that, the element is applied to a base having a curved surface curving in a different direction than the above-mentioned channel length direction, that is, curving along the direction of the channel width, and thus a display having a curved surface is realized. Note that, in the case where the peeled layer is applied to the base with the curved surface, the peeled layer will also be curved along the curved surface of the base. In the present invention, all the channel length directions of the elements are arranged going in the same direction, while the channel length directions and the direction that the base is curved are different. Therefore, even if the peeled layer containing the elements is curved, any influence on the characteristics of the elements can be kept at a minimum. In other words, it is also possible to provide a semiconductor device that is sturdy with respect to deformation along a certain direction (here meaning the direction along which the base is curved).

[0014] The construction of the invention with respect to a manufacturing method disclosed in the present specification is as follows: