METHOD FOR FABRICATING SEMICONDUCTOR DEVICE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method for fabricating a semiconductor device having a circuit configured of a thin film transistor (hereafter, it is called a TFT) in which a peeled layer that has been peeled is bonded and transferred to a base material, particularly to a method for transferring a circuit configured of a TFT to a support with curvature.

[0002] In recent years, a technique has been receiving attention in which a semiconductor thin film (a thickness of about a few to a few hundreds nanometers) formed over a substrate having an insulated surface is used to configure TFTs. The TFT is widely used for electronic devices such as ICs and electro-optic devices, which has been urged to develop as a switching device for image display devices.

[0003] In addition, an attempt has been made to install various display devices on vehicles such as automobiles and aircrafts, including display devices for navigation systems, operation screen display devices for audio systems, and display devices for meters.

[0004] Various applications utilizing such the image display devices are expected, however, attention is being given to the use for portable devices in particular. At present, glass and silica are mainly used for substrates, but the display devices with glass and silica substrates have disadvantages of being thick, heavy-weight and easy to crack, which particularly have disadvantages for portable devices that are highly required to be low-profile, light-weight and hard to crack. Furthermore, glass and silica are generally difficult to be formed into large-sized products, having disadvantages for mass production in particular. On this account, an attempt has been made to form TFT devices on a substrate having bendability, flexibility or elasticity, typically a flexible plastic film or sheet.

[0005] However, plastics have low heat resistance, inevitably dropping the maximum temperature in the device fabrication processes. On this account, the electric characteristics of the TFTs formed on a plastic are essentially inferior to the TFTs formed on a glass substrate. Therefore, high-performance light emitting diodes and liquid crystal display devices using plastics have not been realized yet.

SUMMARY OF THE INVENTION

[0006] When light emitting devices and liquid crystal display devices can be fabricated, which have an organic light emitting diode formed on a substrate with bendability, flexibility or elasticity, typically a plastic film or sheet, they can be used for displays and show windows having a curved surface, in addition to the characteristics of being low-profile, light-weight and hard to crack. Thus, the use is not limited only to portable devices, having the wide application range.

[0007] Furthermore, in the case where displays for images and meters are installed in limited spaces, such as the driver seat of vehicles including automobiles and aircrafts, when display devices are formed to match the curvatures with various curved surfaces of windows, ceilings, doors and dashboards beforehand, allowing installing them not only on the flat surfaces but also on the curved surfaces as they are. Traditionally, the displays have had flat surfaces, causing spaces inside the vehicles to narrow or the installation work to be complex that a wall is cut out to fit and install a flat display.

[0008] The object of the invention is to provide a method for fabricating a semiconductor device having a peeled layer bonded to a base material with curvature. Particularly, the object is to provide a method for fabricating a display with curvature, more specifically, a light emitting device having an organic light emitting diode bonded to a base material with curvature, or a liquid crystal display device bonded to a base material with curvature.

[0009] The configuration of the invention relating to the fabrication method disclosed in the specification is a method for fabricating a semiconductor device including:

[0010] a first step of forming a support and a transfer object (body) with curvature;

[0011] a second step of forming a peeled layer containing a device over a substrate having rigidity higher than that of the support;

[0012] a third step of bonding the support with curvature to the peeled layer containing the device and the substrate with an external force applied so as to match the surface topology of the peeled layer containing the device and the substrate;

[0013] a fourth step of peeling the peeled layer containing the device bonded with the support from the substrate by a physical unit; and

[0014] a fifth step of bonding the transfer object to the peeled layer containing the device to sandwich the device between the support and the transfer object,

[0015] wherein the support bonded with the peeled layer containing the device fully or partially returns into the shape after the first step has been finished at the time of finishing the fourth step.

[0016] In addition, in the invention, the support is for bonding to the peeled layer in peeling by the physical unit, which is not defined particularly when it has a desired curvature and elasticity, that is, the property to exert a restoring force to return to the original shape when an external force is applied. The base materials are fine to have any composition, including plastics, glass, metals and ceramics. Furthermore, in the specification, the transfer object is for bonding to the peeled layer after peeled, which is not defined in particular when it has a desired curvature. The base materials are fine to have any composition, including plastics, glass, metals and ceramics. Particularly, when the top priority is weight saving, a film plastic substrate is preferable, such as polyethylene terephthalate (PET), polyether sulfone (PES), polyethylene naphthalate (PEN), polycarbonate (PC), nylon, polyether ether ketone (PEEK), polysulfone (PSF), polyetherimide (PEI), polyallylate (PAR), and polybutylene terephthalate (PBT).

[0017] Moreover, the configuration is characterized by $R_i R_f \leqq R_m$, where the curvature radius of the support after the first step is finished is R_i, the curvature radius after the third step is finished is R_m, and the curvature radius after the fourth step is finished is R_f.