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(54) ORGANIC ELECTROLUMINESCENT DISPLAY AND MANUFACTURING METHOD THEREOF, ELECTRO-OPTIC DEVICE AND MANUFACTURING METHOD THEREOF, AND ELECTRONIC DEVICE

(76) Inventors: **Tatsuya Shimoda**, Nagano-ken (JP); **Satoru Miyashita**, Chino-shi (JP); **Satoshi Inoue**, Nagano (JP)

Correspondence Address:
HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 828
BLOOMFIELD HILLS, MI 48303 (US)

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(57) ABSTRACT

An object is to efficiently manufacture an organic EL display. A circuit substrate **10** in which is set microstructures **12** and which is formed with wiring **14**, and a transparent substrate **20** formed with a transparent electrode **21**, an emissive layer **25** and a cathode layer **26**, are stuck together with the side formed with the wiring **14** and the side formed with the cathode layer **26** facing the inside, to thereby manufacture an organic EL display **30**. In the sticking together of the circuit substrate **10** and the transparent substrate **20**, an anisotropic conductive paste or an anisotropic conductive film can be used.

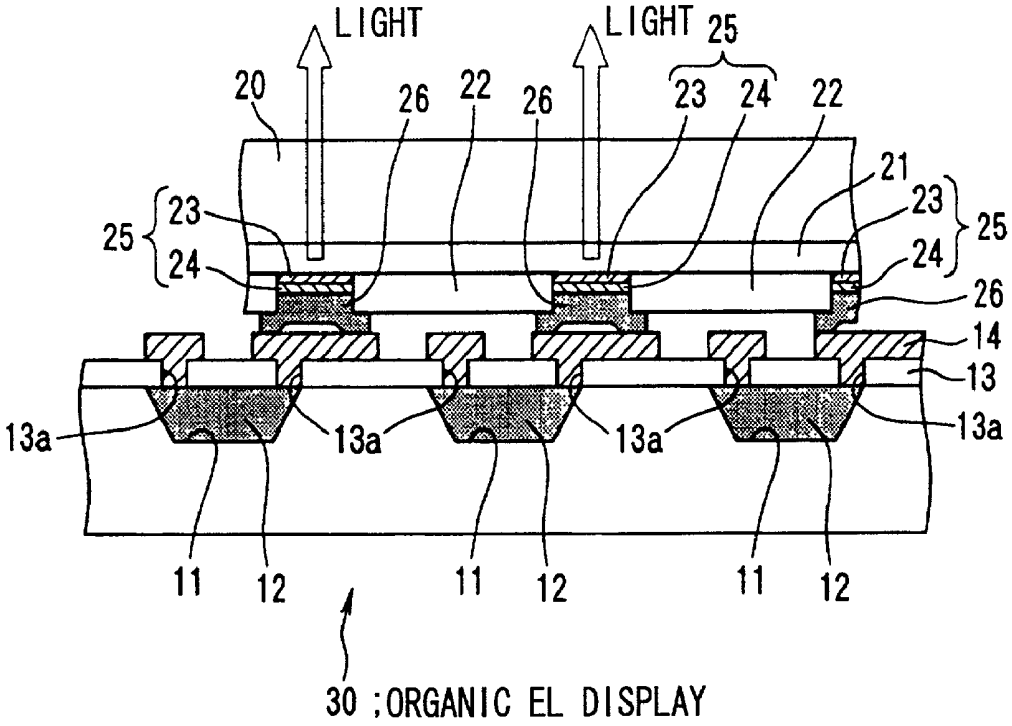


FIG. 1

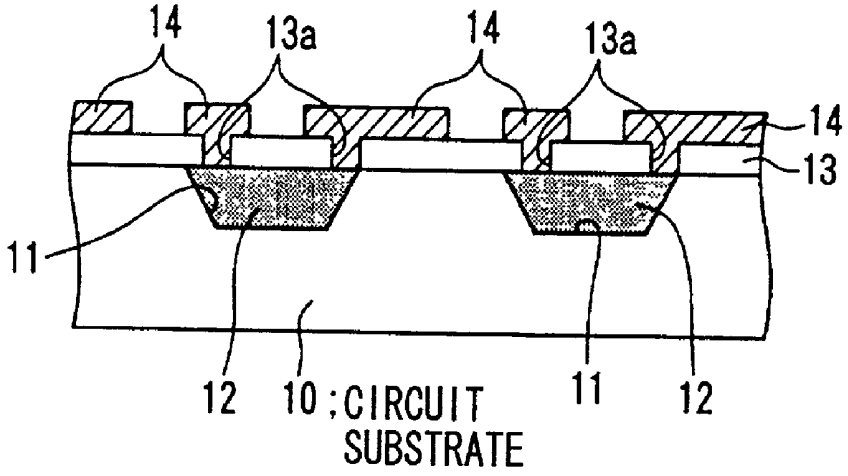

14
13a
14
13a
14
13
11
12
10 ; CIRCUIT SUBSTRATE
11
12

FIG. 2

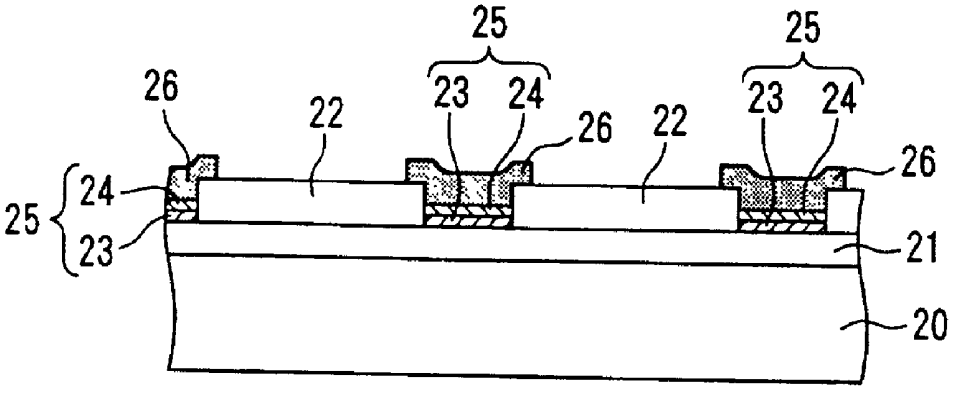

25
25
26
22
23
24
26
22
23
24
26
25
24
23
21
20

FIG. 3

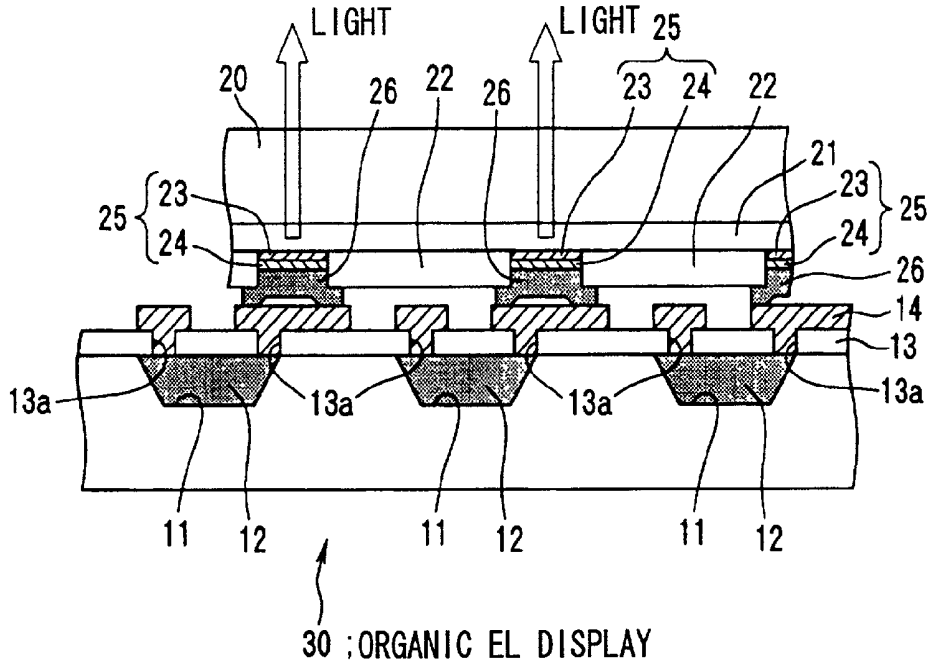

LIGHT
LIGHT
25
20
26
22
26
23
24
22
21
23
25
25
23
24
24
26
14
13
13a
13a
13a
13a
11
12
11
12
11
12
30 ;ORGANIC EL DISPLAY

FIG. 4

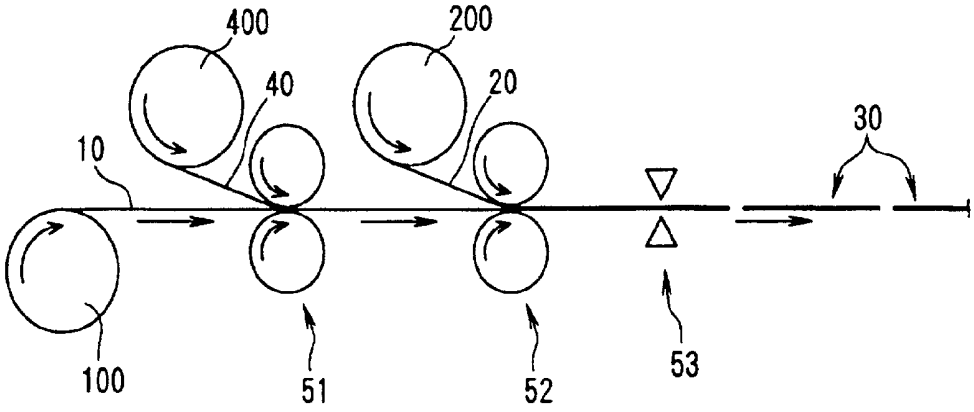

400
200
40
20
30
10
100
51
52
53

FIG. 5

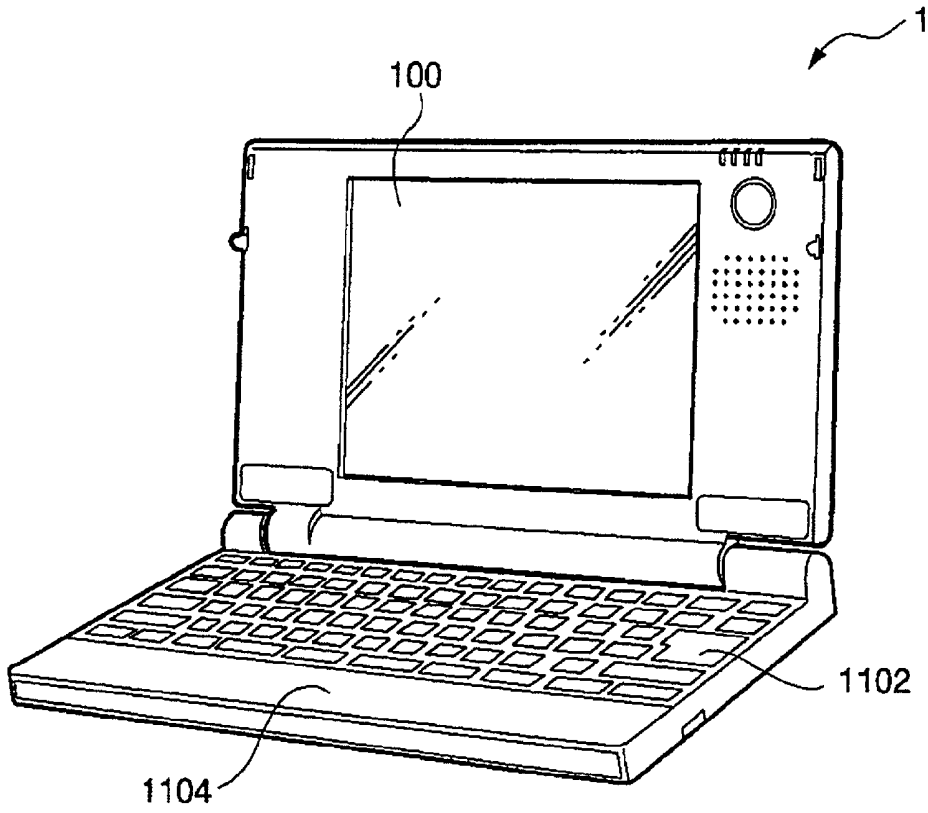


FIG. 6

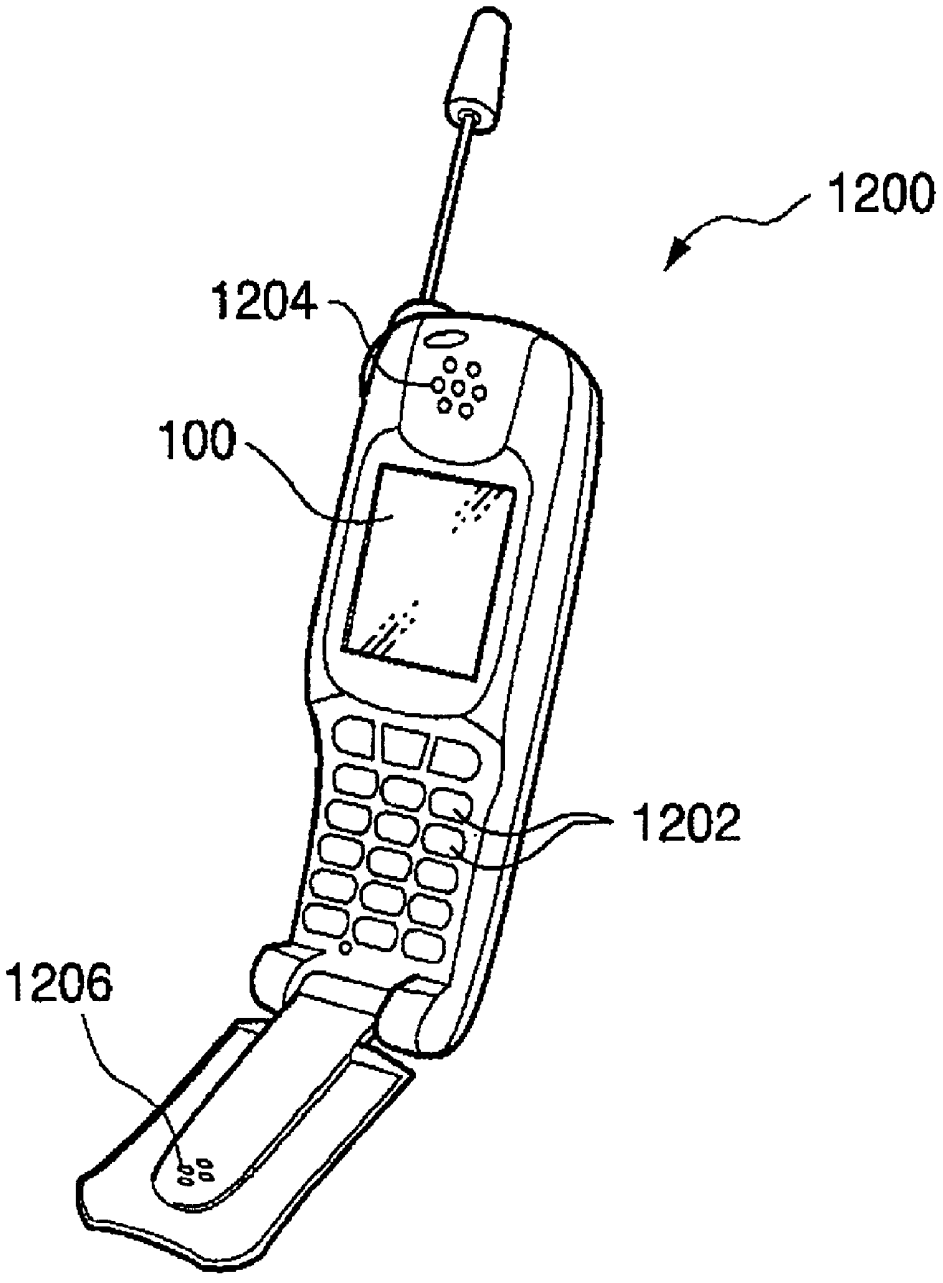
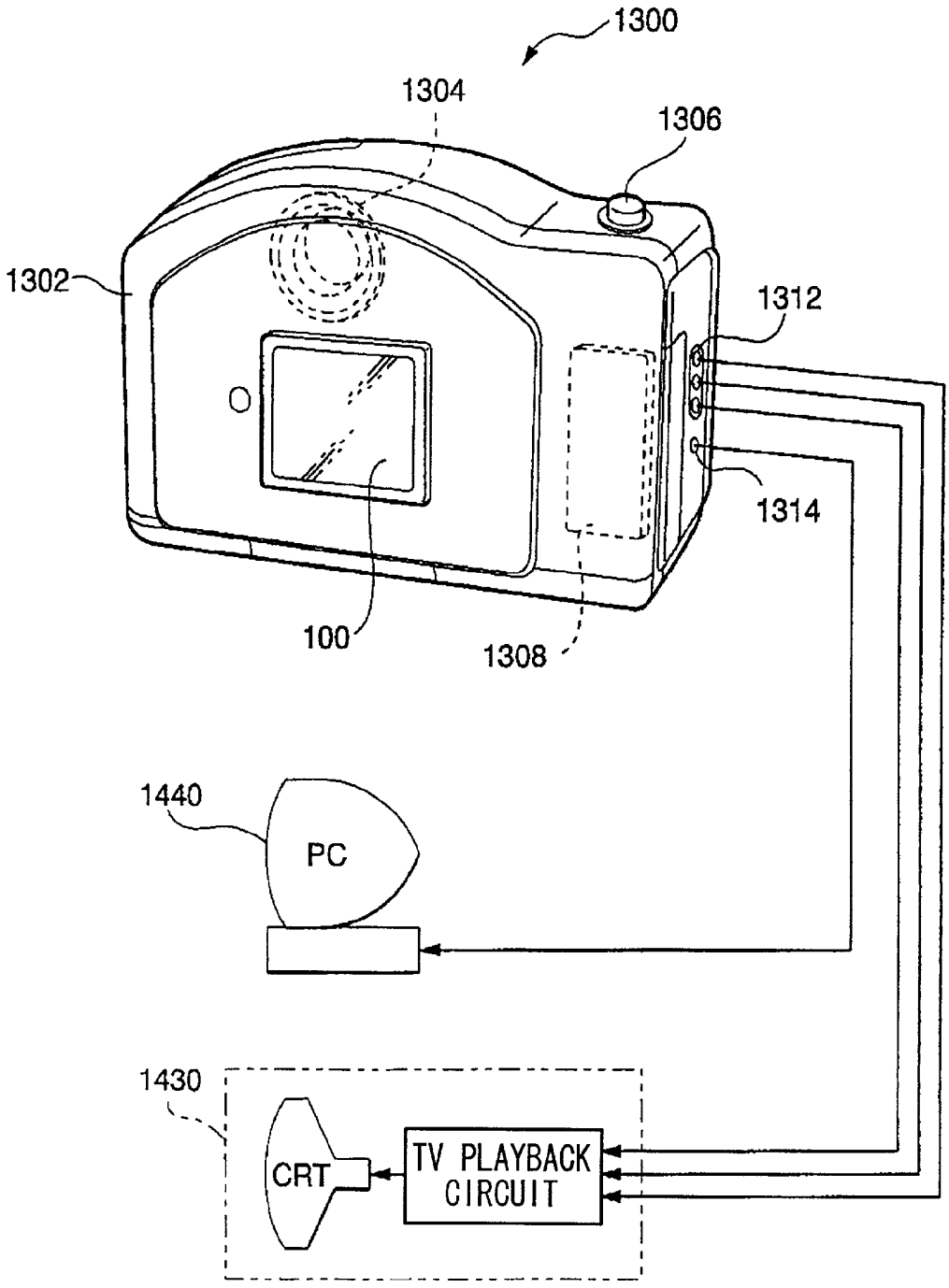


FIG. 7


1300
1304
1306
1302
1312
1314
100
1308
1440
PC
1430
CRT
TV PLAYBACK CIRCUIT

ORGANIC ELECTROLUMINESCENT DISPLAY AND MANUFACTURING METHOD THEREOF, ELECTRO-OPTIC DEVICE AND MANUFACTURING METHOD THEREOF, AND ELECTRONIC DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to the construction of an organic electroluminescent (hereunder EL for short) display and a manufacturing method thereof, to an electro-optic device and a manufacturing method thereof, and to an electronic device. In particular the invention is one where, in a manufacturing method for a display incorporating microstructures made with drive circuits for organic EL elements, the organic EL display can be manufactured extremely efficiently.

[0003] 2. Description of Related Art

[0004] Heretofore, there is a method of manufacturing an electronic device using microstructures made with electronic circuit elements (refer for example to U.S. Pat. Nos. 5,904,545, 5,824,186, 5,783,856, and 5,545,291).

[0005] That is, there is a manufacturing method which uses microstructures, and which enjoys for example the advantage that even with a configuration where a plurality of electronic circuits are scattered over a substrate of an electronic device, the semiconductor material need not be wasted.

[0006] Therefore, the present inventors and others, as a result of earnest research, as a means of utilizing microstructures in an organic EL display and a manufacturing method thereof, have completed a manufacturing method for obtaining an organic EL display involving firstly, making a drive circuit for an organic EL element within a microstructure and arranging this on a transparent substrate, and then performing in sequence; a wiring forming step a transparent electrode forming step, an emissive layer forming step and a cathode forming step. However while undoubtedly it has been shown that the organic EL display can be manufactured while enjoying the advantages from such a microstructure, in practice in order to mass produce the organic EL display with a profit base, further improvement is desired. Furthermore, this type of problem is also a common problem for electro-optic devices other than organic EL displays.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention has resulted due to such requirements, with the object of providing a method and an organic EL display construction whereby an organic EL display can be manufactured extremely efficiently, or a method and an electro-optic device construction whereby an electro-optic device can be manufactured extremely efficiently.

[0008] In order to achieve the above object, a first aspect of the present invention is a manufacturing method for a display which uses an organic EL element in a display portion, involving respectively preparing a circuit substrate with microstructures made with drive circuits for the organic EL element set at positions corresponding to pixels, and with wiring formed on the surface, and a transparent substrate with a transparent electrode layer common with the pixels laminated on the surface, and an emissive layer containing the organic EL layer and a cathode layer laminated on the upper surface of the transparent electrode layer at a position corresponding to the pixels, and then sticking together the circuit substrate and the transparent substrate with the side on which the wiring of the circuit substrate is formed and the side on which the cathode layer of the transparent substrate is formed facing towards the inside.

[0009] A second aspect of the present invention is that in the manufacturing method for an organic EL display being the first aspect, the sticking together of the circuit substrate and the transparent substrate being performed by inserting an anisotropic conductive paste or an anisotropic conductive film therebetween.

[0010] The anisotropic conductive paste and anisotropic conductive film are already known products, being a paste and film which can be used as an adhesive. In the case where this is thinly interposed between the two members as an adhesive, this exhibits a low electrical resistance in the film thickness direction, and exhibits a high electrical resistance in the direction along the surface of the film.

[0011] A third aspect of the present invention is that in the manufacturing method for an organic EL display being the first aspect, this involves respectively preparing a roll of the circuit substrate, and a roll of the transparent substrate, and then unrolling the circuit substrate and the transparent substrate from these rolls while inserting an anisotropic conductive film therebetween, and pressing with a pressing roll from front and rear surfaces to thereby stick together the circuit substrate and the transparent substrate.

[0012] A fourth aspect of the present invention is that in the manufacturing method for an organic EL display being the third aspect, after sticking together the circuit substrate and the transparent substrate, the stuck together product being cut to an optional length.

[0013] In order to achieve the above object, a fifth aspect of the present invention is a display which uses an organic EL element in a display portion, microstructures made with drive circuits for the organic EL element being set at positions corresponding to pixels of a first substrate, and an emissive layer containing an organic EL layer being formed on at least one of the first substrate and a second substrate, and these first substrate and second substrate being stuck together. That is, the emissive layer containing the organic EL layer may be formed on either one of the first substrate and the second substrate, or may be formed on both substrates, and the first substrate and the second substrate are stuck together so as to face each other through the emissive layer containing the organic EL layer.

[0014] Moreover, a sixth aspect of the present invention is a display which uses an organic EL element in a display portion, a circuit substrate with microstructures made with drive circuits for the organic EL element set at positions corresponding to pixels, and with wiring formed on the surface, and a transparent substrate with a transparent electrode layer common with the pixels laminated on the surface, and an emissive layer containing the organic EL layer and a cathode layer laminated on the upper surface of the transparent electrode layer at a position corresponding to the pixels, being stuck together with the side on which the

wiring of the circuit substrate is formed and the side on which the cathode layer of the transparent substrate is formed facing towards the inside.

[0015] A seventh aspect of the present invention is that in the organic EL display being the sixth aspect, the circuit substrate and the transparent substrate being stuck together by inserting an anisotropic conductive paste or an anisotropic conductive film therebetween.

[0016] In order to achieve the above object, an eighth aspect of the present invention is a manufacturing method for an electro-optic device which uses electro-optic elements in a display portion, involving respectively preparing a first substrate with microstructures formed with drive circuits for the electro-optic elements set at positions corresponding to pixels, and a second substrate with the electro-optic elements formed at positions corresponding to the pixels, and then sticking together the first substrate and the second substrate with the side of the first substrate on which the drive circuits are formed and the side of the second substrate on which the electro-optic elements are formed facing towards the inside. Here "electro-optic element" is an element such as for example the abovementioned organic EL element, or a liquid crystal element.

[0017] A ninth aspect of the present invention is an electro-optic device which uses electro-optic elements in a display portion, microstructures made with drive circuits for the electro-optic elements being set at positions corresponding to pixels of a first substrate, and an electro-optic layer being formed on at least one of the first substrate and a second substrate, and the first substrate and second substrate being stuck together. Here "electro-optic layer" may be a layer such as for example the abovementioned emissive layer containing the organic EL layer, or a film liquid crystal.

[0018] Furthermore, a ninth aspect of the present invention is characterized in that the electro-optic device of the abovementioned ninth aspect is provided.

[0019] According to the present invention, since an organic EL display is manufactured by sticking together a circuit substrate in which microstructures are set, and an emissive substrate formed with an emissive layer and the like, there is the effect that the organic EL display can be manufactured extremely efficiently.

[0020] In particular, according to the third and fourth aspects, since the organic EL display can be continuously manufactured, a reduction in manufacturing cost can also be achieved.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0021] **FIG. 1** is a cross-sectional view showing the construction of a circuit substrate.

[0022] **FIG. 2** is a cross-sectional view showing the construction of a transparent substrate.

[0023] **FIG. 3** is a cross-sectional view showing the construction of an organic EL display.

[0024] **FIG. 4** is a diagram illustrating a manufacturing process using rolls.

[0025] **FIG. 5** is a perspective view illustrating a construction of a personal computer being an example of an electronic device of the present invention.

[0026] **FIG. 6** is a perspective view illustrating a construction of a portable telephone being an example of an electronic device.

[0027] **FIG. 7** is a perspective view illustrating a construction of a rear face side of a digital still camera being an example of an electronic device.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Hereunder is a description of embodiments of the present invention based on the drawings.

[0029] **FIG. 1** through **FIG. 3** are diagrams illustrating a first embodiment of the present invention, **FIG. 1** being cross-sectional view showing the construction of a circuit substrate **10** before being stuck, **FIG. 2** being a cross-sectional view showing the construction of a transparent substrate **20** before being stuck, and **FIG. 3** being a cross-sectional view showing the construction of an organic EL display **30** manufactured by sticking both members together.

[0030] That is, as shown in **FIG. 1**, on the surface of the circuit substrate **10** comprising an insulating material, there is formed a plurality of concavities **11** corresponding to the position of pixels of the organic EL display **30** which is made later, and inside these concavities **11** are inlayed microstructures **12**. Then, the surface of the circuit substrate **10**, in a condition with the microstructures inlayed therein, is covered by a protective film **13** made of an insulating material.

[0031] In the protective film **13** is formed through holes **13***a* for exposing electrode pads (not shown in the figure) formed on the surface of the microstructures **12**, and wiring **14** such as scanning lines or signal lines is formed so as to conduct with the electrode pads through the through holes **13***a*.

[0032] As a manufacturing method for the microstructures **13**, and a method of setting these in the concavities **11**, the methods disclosed for example in U.S. Pat. Nos. 5,904,545, 5,824,186, 5,783,856 and 5,545,291 may be applied. Furthermore, for the depositing method for the protective film **13**, the method of opening the through holes **13***a*, and the patterning method for the wiring **14**, known depositing methods and photolithography processes may be adopted.

[0033] On the other hand, as shown in **FIG. 2, a** transparent electrode layer **21** is deposited over the entire surface of the transparent substrate **20** made from a transparent synthetic resin or glass. Then, on the upper face of the transparent electrode layer **21** in the pixel forming regions which are mutually separated by banks **22** made of insulating material, is laminated from the transparent electrode layer **21** side, a hole injection layer **23**, an organic EL layer **24** and a cathode layer **26**, to thereby manufacture the emissive layer **25** with the hole injection layer **23** and the organic EL layer **24**. For the materials for forming the transparent electrode layer **21**, the hole injection layer **23**, the organic EL layer **24** and the cathode layer **26**, materials the same as known materials used in organic EL displays may be applied. Also, for the method of forming these, known manufacturing methods may be applied.

[0034] Then, the circuit substrate **10** shown in **FIG. 1** and the transparent substrate **20** shown in **FIG. 2** are stuck

together as shown in **FIG. 3** with the side formed with the wiring **14** and the side formed with the cathode layer **26** facing the inside, to thereby manufacture the organic EL display **30**. Consequently, it is necessary to perform alignment of the circuit substrate **10** and the transparent substrate **20** and sticking together so that the portions of the wiring **14** to be connected to the cathode layer **26**, and the cathode layer **26** are electrically connected. Furthermore, in the sticking together of the circuit substrate **10** and the transparent substrate **20**, since a known anisotropic conductive paste or an anisotropic conductive film is used, then unanticipated short circuits and the like can be avoided.

[**0035**] In this manner, according to the present embodiment, the circuit substrate **10** in which is set the microstructures **12**, and the transparent substrate **20** formed with the emissive layer **25** and the cathode layer **26** are manufactured separately. In order to manufacture the organic EL display **30** with these two stuck together, then with regards to the circuit substrate **10**, since the necessary processes are only a few after inlaying the microstructures **12** in the concavities **11**, the possibility of the microstructures **12** made with electronic circuit elements such as transistors, capacitors and the like, being damaged by the manufacturing process can be greatly reduced.

[**0036**] Furthermore, since the circuit substrate **10** and the transparent substrate **20** are manufactured in separate processes, there is also the effect of an increase in yield. Depending on the situation, a manufacturing method is also possible where the circuit substrate **10** and the transparent substrate **20** are respectively manufactured at separate factories, or by different enterprises, and then finally the two are stuck together. Therefore this is also extremely effective in reducing manufacturing costs.

[**0037**] Furthermore, as also shown in **FIG. 3**, the light generated from the emissive layer **25** shines to the outside through the transparent electrode layer **21** and the transparent substrate **20**. That is, the entire rear face side of the transparent substrate **20** becomes the screen of the organic EL display **30**. However since wiring and the like which blocks light is not made on the transparent substrate **20**, the aperture ratio of the organic EL display **30** can be made extremely high.

[**0038**] Moreover, the pitch of each pixel of the organic EL display **30** is determined by the pitch of the emissive layer **25** made on the transparent substrate **20**, and the positioning accuracy at the time of sticking together the circuit substrate **10** and the transparent substrate **20** does not have any effect on the pitch of the pixels. Therefore, even if a manufacturing method involving sticking together as with the present embodiment is adopted, there is no drop in the accuracy of the pixel pitch of the organic EL display **30**.

[**0039**] In this manner, according to the manufacturing method of the present embodiment, the organic EL display **30** can be extremely efficiently manufactured.

[**0040**] **FIG. 4** is a diagram showing a second embodiment of the present invention, being a scheme for a sticking together process for the circuit substrate **10** shown in **FIG. 1** and the transparent substrate **20** shown in **FIG. 2**.

[**0041**] That is, in this embodiment, on the surface of a long length circuit substrate **10** is formed the wiring **14** and the like as shown in **FIG. 1**, and a roll **100** is then prepared with the long length circuit substrate **10** rolled so that the wiring **14** side is on the outer surface side. Moreover, on the surface of a long length transparent substrate **20** of the same width as the circuit substrate **10** is formed an emissive layer **25** and the like as shown in **FIG. 2**, and a roll **200** is then prepared with the long length transparent substrate **20** rolled so that the cathode layer **26** side is on the outer surface side. Furthermore, a roll **400** made by rolling an anisotropic conductive film **40** of the same width as the circuit substrate **10** is also prepared.

[**0042**] Next, a pair of upper and lower pressing rollers **51** and **52** are positioned one in front of the other, the roll **100** and the roll **400** are arranged at the insertion side of the upstream pressing rollers **51**, the roll **200** is arranged at the insertion side of the downstream pressing rollers **52**, and a cutting device **53** is arranged further on the downstream side of the downstream pressing rollers **52**.

[**0043**] Then, the long length circuit substrate **10** unwound from the roll **100** is inserted into the pressing rolls **51** with the wiring **14** side facing upwards, the anisotropic conductive film **40** unwound from the roll **400** is inserted into the same rollers **51** so as to lie on the upper face of the circuit substrate **10**, and the two are made into one by the pressing force of the pressing rollers **51**.

[**0044**] The circuit substrate **10** and the anisotropic conductive film **40** which have passed through the pressing rolls **51** are then continuously inserted into the pressing rollers **52**, and the long length transparent substrate **20** which is unwound from the roll **200** is also inserted into the pressing rollers **52** in a condition with the cathode layer **26** facing downward and so as to lie on the circuit substrate **10** and while performing alignment of the two as described for the first embodiment. By so doing, due to the pressing force of the pressing rollers **52** and the adhesive strength of the anisotropic conductive film **40**, the circuit substrate **10** and the transparent substrate **20** are stuck together in the condition as shown in **FIG. 3**.

[**0045**] Furthermore, the stuck together product of the circuit substrate **10** and transparent substrate **20** which has passed through the pressing rollers **52** is cut into predetermined lengths in the cutting device **53**, to thereby give the organic EL display **30**.

[**0046**] In this manner, according to the present embodiment, by using the previously prepared rolls **100**, **200** and **400**, the organic EL display **30** can be continuously manufactured. Therefore the manufacturing cost thereof can be further reduced.

[**0047**] In the above embodiment, the description has been given for an organic EL display as one example of an electro-optic device. However the present invention where microstructures formed with drive circuits are positioned in concavities on one substrate, and electro-optic elements are formed on an other substrate and these substrates are then stuck together, may, other than the organic EL substrate, be applied to electro-optic devices of the self luminescent type such as plasma displays and electro-optic devices such as liquid crystal displays which use film liquid crystals.

[**0048**] Electronic Devices

[**0049**] Next is a description of examples of electronic devices incorporating the abovementioned EL element drive circuits and EL display panels which are driven by these drive circuits.

FIRST EXAMPLE

Mobile Type Computer

[0050] At first is a description of an example for where an organic EL display panel according to the embodiments is applied to a mobile type personal computer. **FIG. 5** is a perspective view illustrating the construction of this personal computer. In the figure, a personal computer **1100** comprises a main frame **1104** incorporating a key board **1102**, and a display unit **1106**. The display unit **1106** has an organic EL display panel **100**.

SECOND EXAMPLE

Portable Telephone

[0051] Next is a description of an example for where an organic EL display panel is applied to a display portion of a mobile telephone. **FIG. 6** is a perspective view illustrating the construction of this mobile telephone. In the figure, a mobile telephone **1200** incorporates a plurality of operating buttons **1202** as well as, an earpiece **1204**, a mouth piece **1206** and the abovementioned organic EL display panel **100**.

THIRD EXAMPLE

Digital Still Camera

[0052] Next is a description of a digital still camera which uses an organic EL display panel in a finder. **FIG. 7** is perspective view illustrating the construction of this digital still camera, with connections for external equipment also shown simplified.

[0053] In contrast to a normal camera where the film is exposed by an optical image of a photographic subject, with the digital still camera **1300**, the optical image of the photographic subject is photoelectrically converted by an imaging element such as a CCD (charged coupled device) to thereby produce an image signal. Here, the construction is such that the abovementioned organic EL display panel **100** is provided on a back face of a case **1302** of the digital still camera **1300**, and display is performed based on the image signal from the CCD. Therefore the organic EL display panel **100** functions as a finder for displaying the photographic subject. Furthermore, on the viewing side (the rear face side in the figure) of the case **1302** there is provided a light receiving unit **1304** which includes an optical lens and a CCD or the like.

[0054] Here, when the photographer has confirmed the subject image displayed on the organic EL display panel **100** and pushes a shutter button **1306**, the image signal from the CCD at that time is sent to a memory of a circuit substrate **1308** and stored therein. Furthermore, in this digital still camera **1300**, on the side face of the case **1302** there is provided a video signal output terminal **1312** and an input-output terminal **1314** for data communication. Moreover, as shown in the figure, as required, a television monitor **1430** is connected to the former video signal output terminal **1312**, or a personal computer **1430** is connected to the later data communication input-output terminal **1314**. Furthermore, the construction is such that by a predetermined operation, the imaging signal stored in the memory of the circuit substrate **1308** is output to the television monitor **1430** or the personal computer **1440**.

[0055] For the electronic device, in addition to the personal computer of **FIG. 5**, the mobile telephone of **FIG. 6**, or the digital still camera of **FIG. 7**, there can be given devices such as a liquid crystal television, a view finder type or direct view monitor type video recorder, a car navigation unit, a pager, an electronic notebook, an electronic calculator, a word processor, a work station, a video phone, a POS terminal, a device furnished with a touch panel and so on. Moreover, needless to say for the display portion of these various electronic devices, the abovementioned display device can be applied.

What is claimed is:

1. A manufacturing method for a display which uses an organic EL element in a display portion, involving respectively preparing a circuit substrate with microstructures made with drive circuits for said organic EL element set at positions corresponding to pixels, and with wiring formed on the surface, and a transparent substrate with a transparent electrode layer common with the pixels laminated on the surface, and an emissive layer containing the organic EL layer and a cathode layer laminated on the upper surface of the transparent electrode layer at a position corresponding to said pixels, and then sticking together said circuit substrate and said transparent substrate with the side on which said wiring of said circuit substrate is formed and the side on which said cathode layer of said transparent substrate is formed facing towards the inside.

2. The manufacturing method for an organic EL display according to claim 1, the sticking together of said circuit substrate and said transparent substrate being performed by inserting an anisotropic conductive paste or an anisotropic conductive film therebetween.

3. The manufacturing method for an organic EL display according to claim 1, involving respectively preparing a roll of said circuit substrate, and a roll of said transparent substrate, and the n unrolling said circuit substrate and said transparent substrate from these rolls while inserting an anisotropic conductive film therebetween, and pressing with a pressing roller from front and rear surfaces to thereby stick together said circuit substrate and said transparent substrate.

4. The manufacturing method for an organic EL display according to claim 3, after sticking together said circuit substrate and said transparent substrate, the stuck together product being cut to an optional length.

5. An organic EL display which uses an organic EL element in a display portion, microstructures made with drive circuits for said organic EL element being set at positions corresponding to pixels of a first substrate, and an emissive layer containing an organic EL layer being formed on at least one of the first substrate and a second substrate, and these first substrate and second substrate being stuck together.

6. An organic EL display which uses an organic EL element in a display portion, a circuit substrate with microstructures made with drive circuits for the organic EL element set at positions corresponding to pixels, and with wiring formed on the surface, and a transparent substrate with a transparent electrode layer common with the pixels laminated on the surface, and an emissive layer containing the organic EL layer and a cathode layer laminated on the upper surface of said transparent electrode layer at a position corresponding to said pixels, being stuck together with the side on which said wiring of said circuit substrate is formed

and the side on which said cathode layer of said transparent substrate is formed facing towards the inside.

7. The organic EL display according to claim 6, said circuit substrate and said transparent substrate being stuck together by inserting an anisotropic conductive paste or an anisotropic conductive film therebetween.

8. A manufacturing method for an electro-optic device which uses electro-optic elements in a display portion, involving respectively preparing a first substrate with microstructures formed with drive circuits for said electro-optic elements set at positions corresponding to pixels, and a second substrate with said electro-optic elements formed at positions corresponding to said pixels, and then sticking together said first substrate and said second substrate with the side of said first substrate on which said drive circuits are formed and the side of said second substrate on which said electro-optic elements are formed facing towards the inside.

9. An electro-optic device which uses electro-optic elements in a display portion, microstructures made with drive circuits for said electro-optic elements being set at positions corresponding to pixels of a first substrate, and an electro-optic layer being formed on at least one of said first substrate and a second substrate, and said first substrate and second substrate being stuck together.

10. An electronic device provided with the electro-optic device according to claim **9**.

* * * * *

专利名称(译)	有机电致发光显示器及其制造方法，电光器件及其制造方法，以及电子器件		
公开(公告)号	US20020158577A1	公开(公告)日	2002-10-31
申请号	US09/900738	申请日	2001-07-06
[标]申请(专利权)人(译)	下田TATSUYA MIYASHITA悟 井上聪		
申请(专利权)人(译)	下田TATSUYA MIYASHITA悟 井上聪		
当前申请(专利权)人(译)	下田TATSUYA MIYASHITA悟 井上聪		
[标]发明人	SHIMODA TATSUYA MIYASHITA SATORU INOUE SATOSHI		
发明人	SHIMODA, TATSUYA MIYASHITA, SATORU INOUE, SATOSHI		
IPC分类号	H05B33/10 G09F9/00 G09F9/30 H01L27/32 H01L51/50 H01L51/52 H01L51/56 H05B33/22 H05B33/00		
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优先权	2000207390 2000-07-07 JP 2001201712 2001-07-03 JP		
其他公开文献	US6919680		
外部链接	Espacenet USPTO		

摘要(译)

一个目的是有效地制造有机EL显示器。其中设置有微结构12并且由布线14形成的电路基板10，以及形成有透明电极21，发光层25和阴极层26的透明基板20与形成有布线的一侧粘在一起在图14中所示的侧面和阴极层26面向内部形成的一侧，从而制造有机EL显示器30.在电路基板10和透明基板20粘合在一起时，可以使用各向异性导电膏或各向异性导电膜。

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