

“ASSEMBLY COMPRISING AT LEAST ONE SUPPORT WITH DEPOSIT OF
GETTER MATERIAL FOR USE IN ELECTROLUMINESCENT ORGANIC
SCREENS”

5 The present invention relates to an assembly comprising at least one support with a deposit of getter material for the use in electroluminescent organic screens.

Electroluminescent organic screens are characterized by a very reduced thickness and they are under development for the use in stereo apparatus (in particular of cars) or cellular phones, and their use as television screens is also
10 under study. These screens are better known in the field with the definition "OLED" (from "Organic Light Emitting Diode"), which will be used in the rest of the description.

Very briefly, an OLED is formed of a first transparent, essentially planar support, generally made of glass or of a plastic polymer; a first row of transparent
15 electrodes (generally made of ITO, a mixed tin- and indium-oxide), linear and parallel to each other deposited on the first support; a double layer of different electroluminescent organic materials, of which the first is conductor of electrons and the second of electron vacancies, deposited on the first series of electrodes; a second series of electrodes (made generally of alloys Al-Li or Al-Mg or with
20 composite double layers such as for example Al-LiF or Al-Li₂O), linear and parallel to each other and with orthogonal orientation with respect to those of the first row, contacting the upper part of the double layer of organic materials, so that this is comprised between the two rows of electrodes; and a second, not necessarily transparent support, which can be made of glass, metal or plastics,
25 essentially planar and parallel to the first support. The two supports are fixed to each other along their perimeter, generally by gluing, so that the active part of the structure (electrodes and electroluminescent organic materials) is in a closed space. The first transparent support is the portion wherein the image is visualized, whereas the second support has generally only the function of closure and backing
30 of the device, in order to provide it a sufficient mechanical resistance.

The main problem noticed with these devices consists in that they rapidly

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lose their light-emission features following to humidity sorption. The life of these devices is reduced from thousands or tens of thousands of hours in the absence of humidity, as experimentally verified in suitable chambers, to a few hours when exposed to the atmosphere. Even if the mechanisms of the OLED functional decay
5 have not been completely clarified, it is probable that the phenomenon can be attributed on one hand to addition reactions of the water molecule to the unsaturated bonds of the organic component, and on the other hand to the reaction of water with the electrodes, in particular the metal cathodes. The main route for entrance of water into the OLEDs is the perimetral sealing of the two supports,
10 which is generally carried out by gluing with water-permeable epoxy resins, used by nearly all manufacturers; water can additionally permeate through the same supports, in the case these are made of polymeric materials (always water-permeable, even if there are permeability differences among the various materials) or it can be released from the same organic materials of the electroluminescent
15 double layer.

The solution of the problem caused by the entrance of water into an OLED is the subject-matter of various patent publications which propose different solutions.

Patents USA 5,693,956 and 5,874,804 describe OLEDs for whose
20 manufacture are employed inorganic materials impermeable to water, such as quartz or metals. Anyway, these systems do not solve the problem of the release of water by the materials which form the OLED.

The international publication WO99/03122 describes introducing into the OLED inner space gases such as silanes, trimethylaluminum or triethylaluminum
25 which react quickly with the water molecules by generating reaction products harmless for the device functioning. This system has however moderate applicability in the industry.

Patents USA 5,804,917 and 5,882,761 and the international publication WO99/35681 describe the use of humidity sorbing systems, but extremely
30 vaguely, by simply indicating the use of a getter applied to the OLED second support without either specifying the nature of the getter material or providing

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useful indications about the constructing method of an OLED containing said getter material. The international publication WO98/59356 adds to the preceding documents the teaching on the kind of getter materials that may be used, by indicating for example the metals barium, lithium or calcium, or barium oxide.

5 However, even in this case, it is not explained how to deposit in a stable way these materials on the second support or how to make reconcilable the deposition of these layers with the manufacturing process of the OLEDs. As a matter of fact, the above listed materials are extremely reactive towards water and atmospheric gases and must be protected from the moment of the layer deposition until they are used.

10 These layers could be deposited on the second support "in line", i.e. as one of the OLED manufacturing process steps, but this possibility is not appreciated by screen manufacturers since it complicates the manufacturing process and requires the adoption of particular measures in treating extremely reactive elements. The preferred solution by the OLED manufacturers would be receiving from external

15 suppliers a humidity sorbing device, preferably in the form of a deposit on the second support, finished and ready for assembly with the first support on which the electroluminescent structure is already present. However, in this case there is the problem of preventing the contact of the deposit with the atmospheric gases for the whole period from the creation thereof up to the moment of use in the

20 OLED; considering also the required transport between different manufacturing sites, this implies the use of tight containers kept under inert atmosphere, with strong increase of the manufacturing costs of the final screen.

Object of the present invention is to provide a support with a deposit of getter material ready for use in organic electroluminescent screens which

25 overcomes the above mentioned storing and transporting problems.

This object is obtained according to the present invention by virtue of an assembly formed of at least one support in glass or metal whose border is fixed to a member impermeable to atmospheric gases, and having a deposit of an alkaline or alkaline-earth metal or an oxide of these metals in the central portion of the side

30 of said support facing said impermeable member. Preferably, the impermeable member is a second support with a deposit of metal or oxide on the side facing the

first support.

The invention will be described in the following with reference to the figures wherein:

- figure 1 shows in partial cut-out view an assembly according to the invention;

- figure 2 shows in cross-section an assembly according to a preferred embodiment of the invention;

- figure 3 shows a detail which represents a possible variation of the assemblies of figures 1 and 2.

As shown in figure 1, the assembly 10 according to the invention is formed of two rigid members, essentially planar and impermeable to gases, fixed to each other in the peripheral zone thereof. At least one of the two members forms the support with getter material deposit to be used as second support of the OLED. In the figure, this support is shown as member 11. The support is provided in the central portion 12 thereof with a deposit 13 of a getter material selected among alkaline or alkali-earth metals or the oxides thereof; the use of barium is preferred. Immediately after the production of deposit 13 on support 11, the latter is fixed to member 14 along a periphery zone (drawn in dotted line in the figure and identified as zone 15) by means of fixing means 16 which may be a welding in the case of metal members or a low-melting glass paste in the case of glass members. With this construction deposit 13 is found, right after its formation, in a sealed space not in contact with the outside and in this condition it may be stored indefinitely or transported without requiring special containers. At the moment of use by the OLED manufacturer, it is sufficient to cut the assembly along lines comprised between zones 12 and 15 (one of these lines, I-I', is exemplified in the figure) in order to remove the protecting member 14 and have support 11 with deposit 13 ready for the use as second support of the OLED.

In a preferred embodiment, both members 11 and 14 of the previous figure are supports with getter material deposit to be used as second support of an OLED. This configuration is shown in cross-section in figure 2: assembly 20 is formed of two supports, 21 and 21', each of which carries in the central portion of

the side facing the other support a deposit 22, 22' of one of the above mentioned getter materials. The two supports 21 and 21' are fixed at the periphery thereof by means of fixing means 23 analogous to means 16 of assembly 10. In this case too, the OLED supports with getter deposit are obtained from assembly 20 by cutting
5 along lines comprised between fixing means 23 and deposits 22, 22', such as the lines II-II' and III-III' shown in the figure. Assembly 20 is preferred with respect to that of type 10 since in this case two supports for OLED are obtained from each assembly, thus doubling the productivity of the system.

Figure 3 shows a constructive detail of the assemblies according to the
10 invention which makes the use thereof easier; the figure exemplifies the case of an assembly of the type 20. The figure shows an enlarged view of the peripheral zone of the assembly 30 formed of two supports 31 and 31', fixed to each other by means of fixing means 32, a deposit 33, 33' of a getter material being provided on each of them. The two supports 31 and 31' are provided with grooves, 34 and 34',
15 at the lines where subsequently the cuttings for the separation thereof will have to be made (that is, at the lines I-I', II-II' and III-III' of figures 1 and 2); these grooves make easier the location of the cuttings for the separation of the two supports, and if sufficiently deep they can allow breaking by bending along said lines (in particular, in the case of glass supports 31 and 31') thus making superfluous the
20 use of cutting operations.

In the assemblies according to the invention the deposits of getter material (13; 22, 22'; 33, 33') can be obtained by evaporation in the case of metal deposits, which can then be converted into oxide by exposition to an atmosphere of oxygen, pure or in an inert gas. Alternatively, it is possible to use the technique known
25 with the definition of "Physical Vapor Deposition", more commonly indicated as "sputtering", or its variant reactive sputtering, where the deposition step takes place in an argon atmosphere containing small percentages of oxygen. These deposits generally have thickness values included between fraction of microns and a maximum of 10-20 microns.

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CLAIMS

1. An assembly (10; 20; 30) formed of at least one support (11; 21; 31) of glass or metal fixed at its periphery to a member (14; 21'; 31') impermeable to atmospheric gases, and having a deposit (13; 22; 33) of an alkaline or alkali-earth metal or an oxide of these metals in the central portion (12) of the side of said support facing said impermeable member.
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2. An assembly according to claim 1 wherein said impermeable member is a second support (21'; 31') with a deposit (22'; 33') of metal or oxide on the side facing the first support.
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3. An assembly according to one of claims 1 or 2 wherein said support and said impermeable member or said supports are made of glass and are fixed to each other by means of a low-melting glass paste.
4. An assembly according to one of claims 1 or 2 wherein said support and said impermeable member or said supports are made of metal and are fixed to each other by welding.
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5. An assembly according to claim 1 wherein said deposit is formed of barium.
6. An assembly according to claim 1 wherein said support and said impermeable member or said supports are provided in their peripheral zone with grooves (34, 34') at the cutting lines (I-I'; II-II'; III-III') for their separation.
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