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(54) **DEPOSITION MASK FOR MAKING OLED DISPLAY PANEL**

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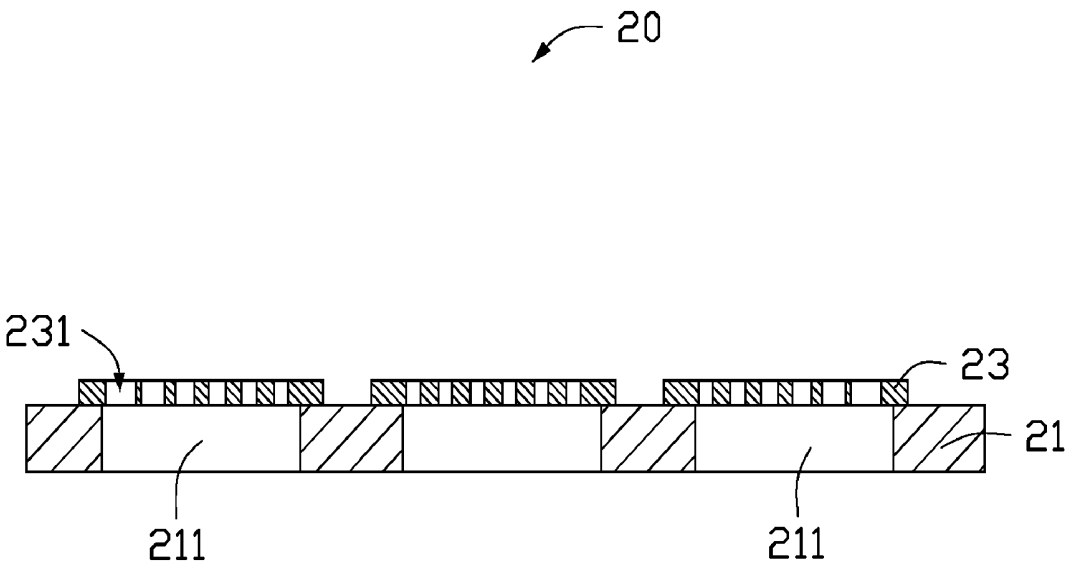
CPC ***H01L 51/56*** (2013.01); ***H01L 51/0002*** (2013.01); ***C23C 14/042*** (2013.01)

(57) **ABSTRACT**

A mask is configured for depositing an organic light emitting layer of an OLED display panel. The mask includes a supporting plate and a plurality of mask units on a surface of the supporting plate. The supporting plate defines a plurality of through holes. Each mask unit covers one of the through holes and defines a plurality of openings. Each mask unit includes a center portion and an edge portion located at a periphery of the center portion and surrounding the center portion. In each mask unit, the dimensions of the openings gradually decrease along a direction from the edge portion towards the center portion to restrict the shapes and dimensions of pixel forms deposited.



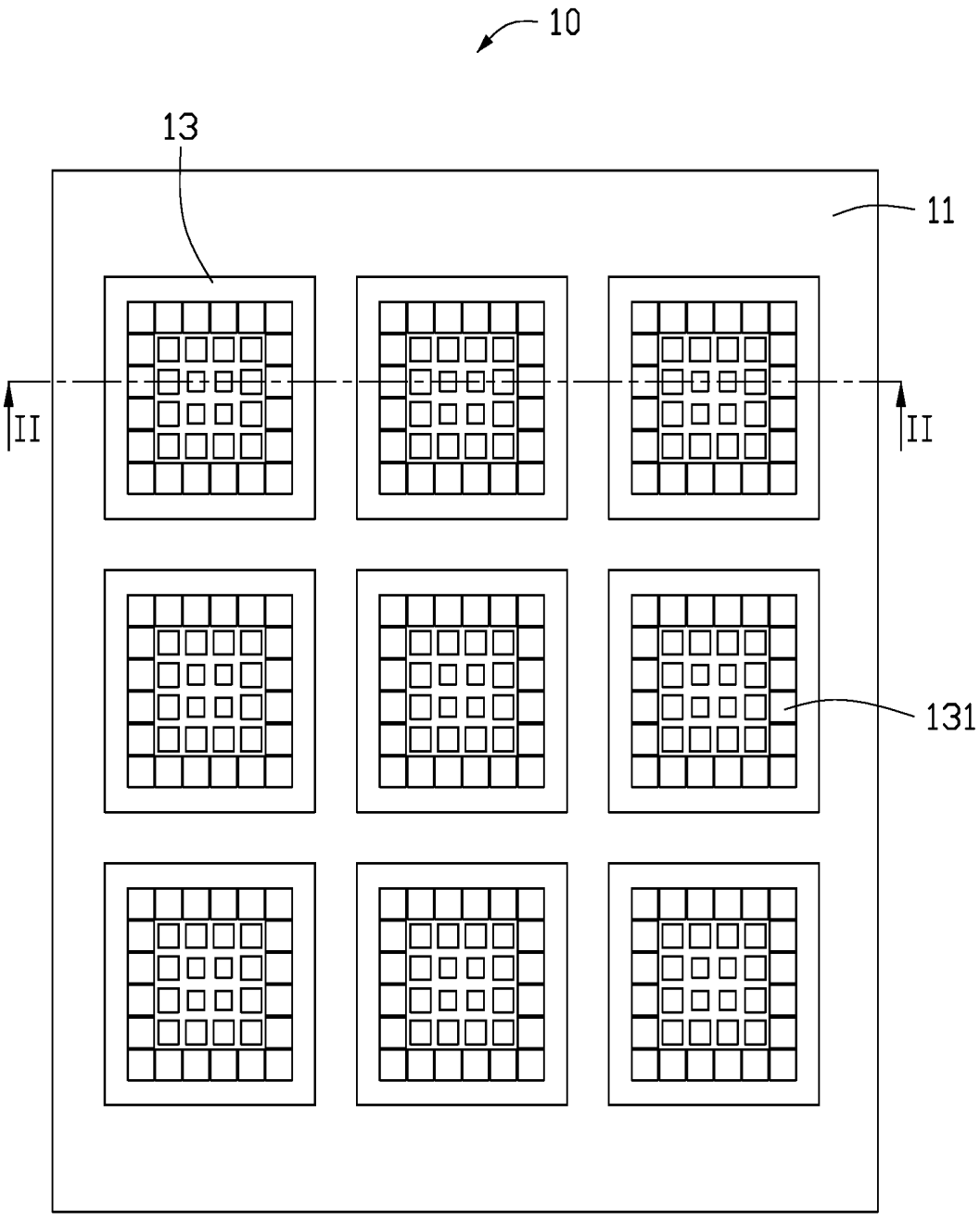


FIG. 1

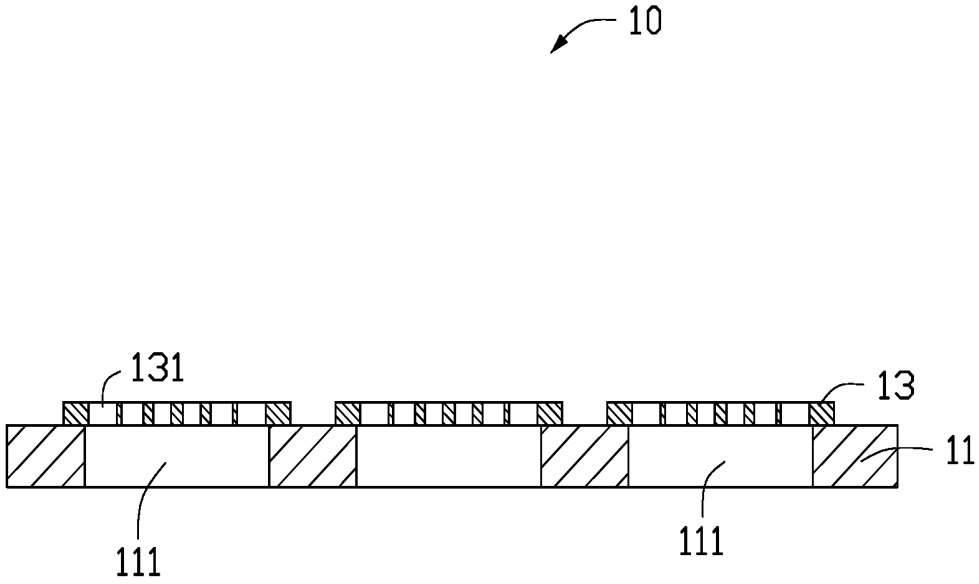


FIG. 2

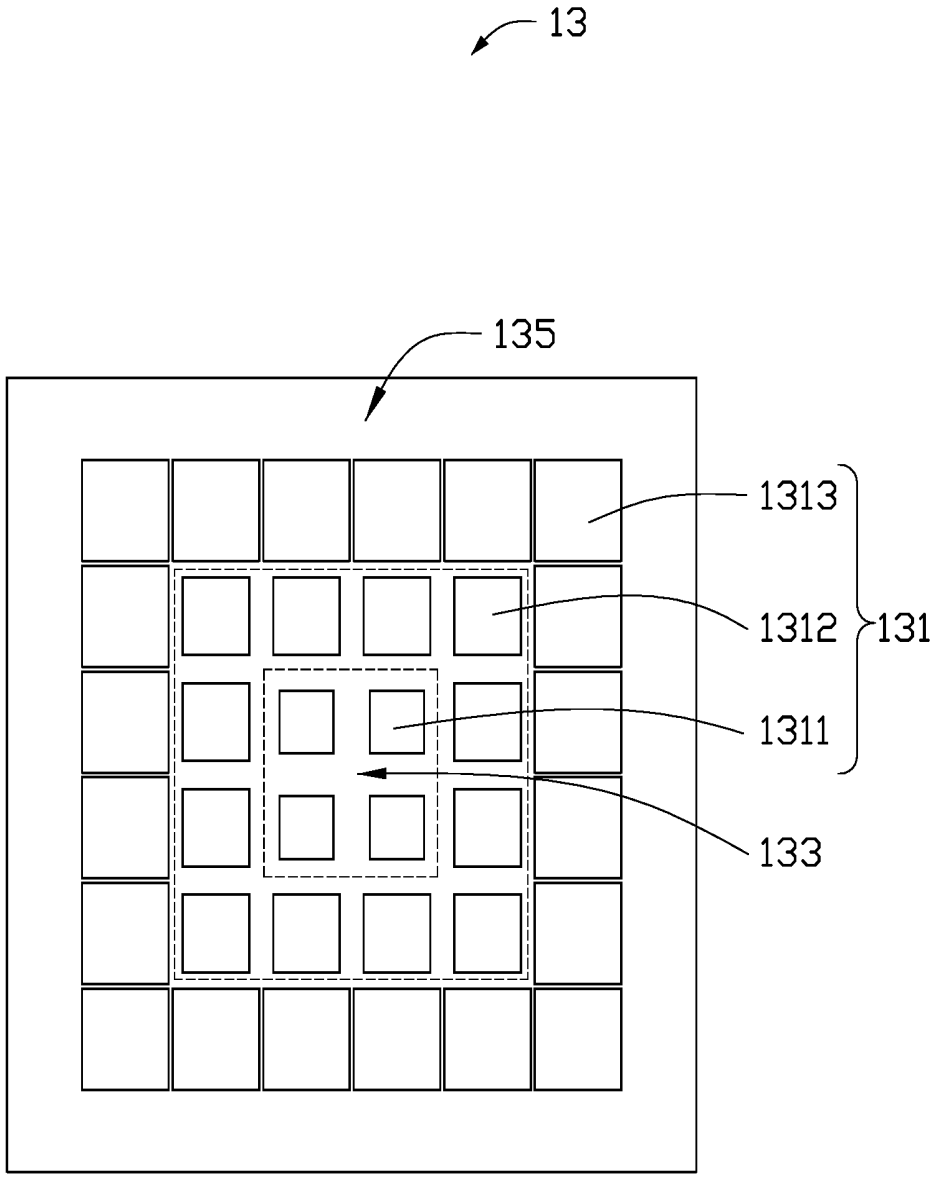


FIG. 3

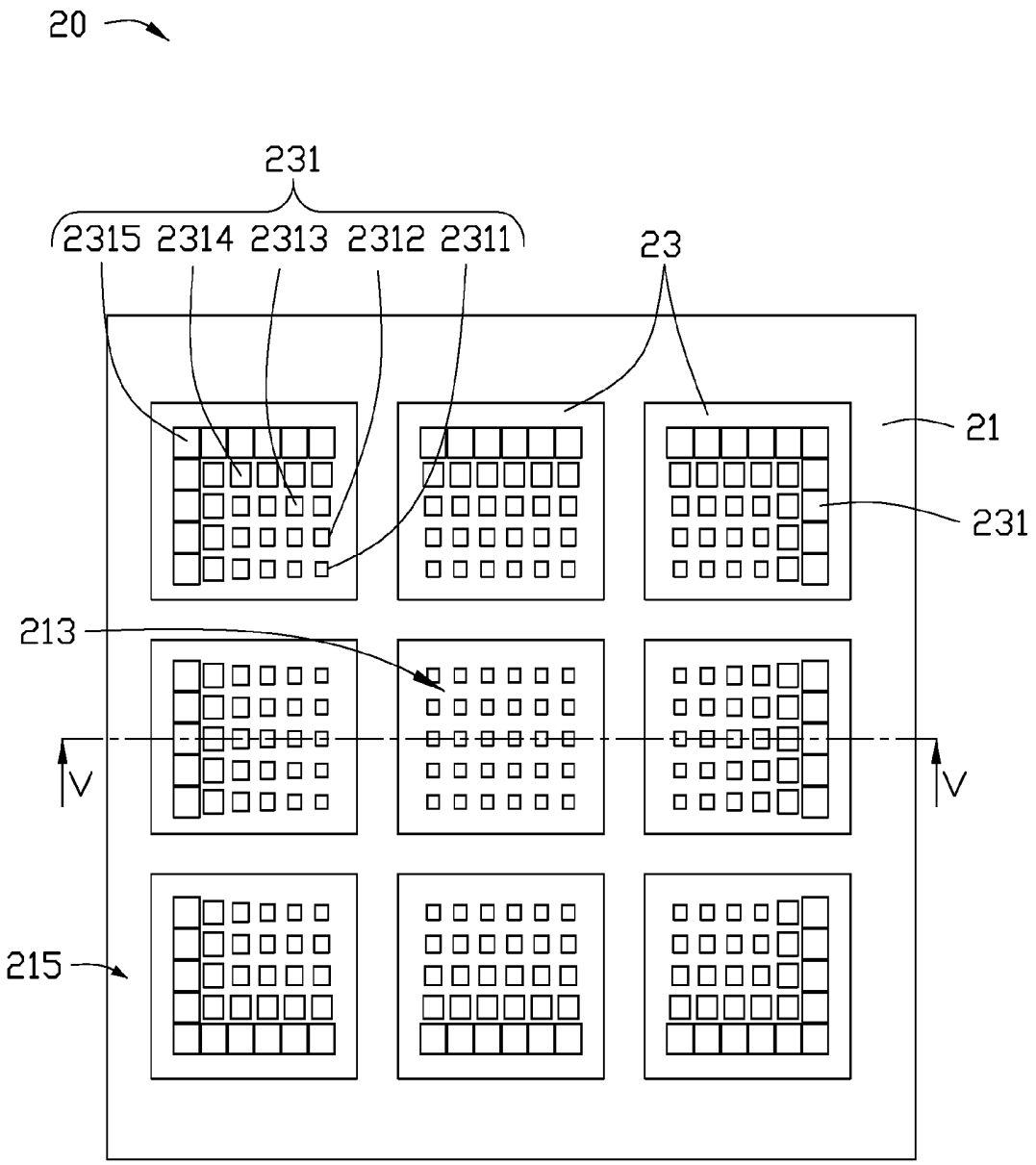


FIG. 4

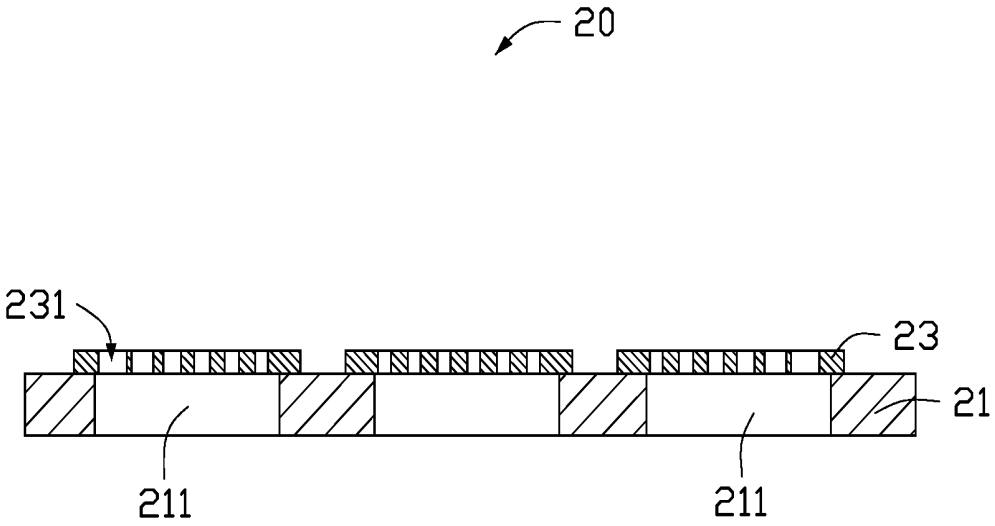


FIG. 5

DEPOSITION MASK FOR MAKING OLED DISPLAY PANEL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. provisional application Ser. No. 62/370,729 filed on Aug. 4, 2016 which is incorporated herein by reference.

FIELD

[0002] The subject matter herein generally relates to a deposition mask for depositing an organic light emitting layer.

BACKGROUND

[0003] Display devices, particularly organic light-emitting diode (OLED) display devices, are manufactured by forming an organic light emitting layer on a substrate (such as thin film transistor substrate) through vapor deposition. Generally, a deposition mask is required during deposition of the organic light emitting layer. A plurality of openings is defined in the deposition mask. Then the evaporated material from an evaporation source passes through the openings to be deposited on the substrate. Each opening corresponds to one subpixel of the OLED display panel. Generally, a dimension of each of the openings is designed to be equal to a dimension of the sub-pixel. However, some sub-pixels formed by using the deposition mask have dimensions that are greater than the designed dimensions. For example, when a desired pixel pattern is designed to have a width of x μm and a length of y μm. Using the deposition mask and evaporation process above creates a shadow effect in sub-pixel patterns where a sub-pixel pattern has a width larger than the defined x μm and a length larger than the defined y μm. Therefore, there is need to improve the process of creating sub-pixel patterns to improve the properties and performance of a display device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Implementations of the present technology will now be described, by way of example only, with reference to the attached figures.

[0005] FIG. **1** is a plan view of a first exemplary embodiment of a deposition mask.

[0006] FIG. **2** is a cross-sectional view of the deposition mask of FIG. **1** along line II-II.

[0007] FIG. **3** is a plan view of a mask unit of the deposition mask of FIG. **1**.

[0008] FIG. **4** is a plan view of a second exemplary embodiment of a deposition mask.

[0009] FIG. **5** is a cross-sectional view of the deposition mask of FIG. **4** along line V-V.

DETAILED DESCRIPTION

[0010] It will be appreciated that for simplicity and clarity of illustration, where appropriate, reference numerals have been repeated among the different figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein can be practiced without these specific details. In other instances, methods, procedures, and components have not been described in detail so as not to obscure the related relevant feature being described. Also, the description is not to be considered as limiting the scope of the embodiments described herein. The drawings are not necessarily to scale and the proportions of certain parts have been exaggerated to better illustrate details and features of the present disclosure.

[0011] Several definitions that apply throughout this disclosure will now be presented.

[0012] The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The connection can be such that the objects are permanently connected or releasably connected. The term "comprising" when utilized, means "including, but not necessarily limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series, and the like.

[0013] FIG. **1** and FIG. **2** illustrate a first exemplary embodiment of a deposition mask **10**. The deposition mask **10** includes a supporting plate **11** and a plurality of mask units **13** coupled to a surface of the supporting plate **11**. The supporting plate **11** is configured to support the plurality of mask units **13**. Each of the plurality of mask units **13** is spaced apart from one another. The supporting plate **11** defines a plurality of through holes **111**. Each through hole **111** corresponds to one of the mask units **13**. A dimension of each through hole **111** is smaller than a dimension of each mask unit **13**. Thus, each mask unit **13** can completely cover over one of the through holes **111**. Moreover, the through holes **111** are arranged in an array, and thus the mask units **13** covering the through holes **111** of the supporting plate **11** are also arranged in an array on the supporting plate **11**.

[0014] The supporting plate **11** is made of a metal or an alloy. In an exemplary embodiment, the supporting plate **11** may be made of a metal or alloy having magnetic properties. For example, the supporting plate **11** is made of an invar alloy. Each mask unit **13** can be made of a plastic, and the plastic can be one selected from a group consisting of: polyimide (PI), polyethylene terephthalate (PET), polycarbonate (PC), ethylene (PE), poly ether ether ketone (PEEK), polyetherimide (PEI), polyamide (PA), poly tetra fluoro ethylene (PTFE), poly propylene (PP), poly phenilen sulfide (PPS), poly ethylene naphthalate (PEN), and poly propylene (PP).

[0015] In an exemplary embodiment, each mask unit **13** is substantially rectangular. Each mask unit **13** defines a plurality of openings **131**, each opening **131** being spaced apart from one another. FIGS. **1-3** show a number of the plurality of openings **131**. The plurality of openings **131** extend through the mask unit **13**. As shown in FIG. **2**, each opening **131** of the mask unit **13** is adjacent to and air communicatively with each corresponding through hole **111**. In this exemplary embodiment, each opening **131** is substantially rectangular.

[0016] As shown in FIG. **3**, each mask unit **13** includes a center portion **133** and an edge portion **135** located at a periphery of the center portion **133** and surrounding the center portion **133**. In each mask unit **13**, the dimensions of the openings **131** gradually decrease along a direction from the edge portion **135** towards the center portion **133**.

[0017] As shown in FIG. **3**, in this exemplary embodiment, the openings **131** in one single mask unit **13** comprise

three types of openings **131** along a direction from the edge portion **135** towards the center portion **133**. The openings **131** includes a plurality of first openings **1311** located in the center portion **133**, a plurality of third openings **1313** located in the edge portion **135**, and a plurality of second openings **1312** located between the center portion **133** and the edge portion **135**. Each first opening **1311** has a dimension that is smaller than a dimension of each second opening **1312**, and each second opening **1312** has a dimension that is smaller than a dimension of each third opening **1313**. The dimension of each third opening **1313** is substantially equal to a required dimension of one sub-pixel of the OLED display panel to be formed. That is, a dimension of the openings **131** having the largest dimension in a single mask unit **13** is substantially equal to a required dimension of one sub-pixel of the OLED display panel to be formed.

[0018] When depositing an organic light emitting layer on a substrate (not shown), such as thin film transistor substrate, the substrate is located at a side of the deposition mask **10** having the mask units **13**. Evaporated material from an evaporation source passes through the through hole **111** and the openings **131** to be deposited on the substrate. Each opening **131** corresponds to the form of one sub-pixel of the OLED display panel. By using the deposition mask **10** herein disclosed, the shadow effect can be effectively reduced or eliminated.

[0019] FIG. **4** and FIG. **5** illustrates a second exemplary embodiment of a deposition mask **20**. The deposition mask **20** includes a supporting plate **21** and a plurality of mask units **23** coupled to a surface of the supporting plate **21**. Each of the plurality of mask units **23** is spaced apart from one another. The supporting plate **21** is configured to support the mask units **23**. The supporting plate **21** defines a plurality of through holes **211**. Each through hole **211** corresponds to one of the mask units **23**. The dimension of each through hole **211** is smaller than a dimension of each mask unit **23**. Thus, each mask unit **23** can completely cover one of the through holes **211**. Moreover, the through holes **211** are arranged in an array, and thus the mask units **23** covering the through holes **211** of the supporting plate **21** are also arranged in an array on the supporting plate **21**.

[0020] The supporting plate **21** is made of a metal or an alloy. In an exemplary embodiment, the supporting plate **21** may be made of a metal or alloy having magnetic properties. For example, the supporting plate **21** is made of an invar alloy. Each mask unit **23** can be made of one selected from a group consisting of PI, PET, PC, PE, PEEK, PEI, PA, PTFE, PP, PPS, PEN, and PP.

[0021] In an exemplary embodiment, each mask unit **23** is substantially rectangular. Each mask unit **23** defines a plurality of openings **231**. Each opening **231** is spaced apart from one another. The plurality of openings **231** extends through the mask unit **23**. As shown in FIG. **5**, each opening **231** of the mask unit **23** is adjacent to and air communicatively with each corresponding through holes **211**. In this exemplary embodiment, each opening **231** is rectangular.

[0022] The supporting plate **21** includes a center portion **213** and an edge portion **215** located at a periphery of the center portion **213** and surrounding the center portion **213**. In the deposition mask **20**, the dimensions of the openings **131** gradually decrease along a direction from the edge portion **215** towards the center portion **213**.

[0023] As shown in FIG. **4**, in this exemplary embodiment, the openings **231** in the entire deposition mask **20** comprise five types of openings **231** along a direction from the edge portion **215** towards the center portion **213**. The openings **231** includes a plurality of first openings **2311** located in the center portion **213**, a plurality of fifth openings **2315** located in the edge portion **215**, and a plurality of second openings **2312**, a plurality of third openings **2313**, and a plurality of fourth openings **2314** located between the center portion **213** and the edge portion **215**. The plurality of second openings **2312** is located at a periphery of the first openings **2311** and surrounds the first openings **2311**. The plurality of third openings **2313** is located at a periphery of the second openings **2312** and surrounds the second openings **2312**. The plurality of fourth openings **2314** is located at a periphery of the third openings **2313** and surrounds the third openings **2313**. The plurality of fifth openings **2315** is located at a periphery of the fourth openings **2314** and surrounds the fourth openings **2314**. Each first opening **2311** has a dimension that is smaller than a dimension of each second opening **2312**, and each second opening **2312** has a dimension that is smaller than a dimension of each third opening **2313**. Each third opening **2313** has a dimension that is smaller than a dimension of each fourth opening **2314** and each fourth opening **2314** has a dimension that is smaller than a dimension of each fifth opening **2315**. The dimension of each fifth opening **2315** is substantially equal to the dimension of one sub-pixel of the OLED display panel. In a single mask unit **23**, the dimensions of the openings **231** gradually decrease along a direction from edge portion **215** of the deposition mask **20** towards the center portion **213** of the deposition mask **20**.

[0024] When an organic light emitting layer is deposited on a substrate (not shown), such as thin film transistor substrate, the substrate is located at a side of the deposition mask **20** having the mask units **23**. Evaporated material from an evaporation source passes through the through hole **211** and the openings **231**, and reaches the substrate. Each opening corresponds to the form of one sub-pixel of the OLED display panel. By using this deposition mask **20**, the shadow effect can be effectively reduced.

[0025] The embodiments shown and described above are only examples. Many details are often found in the art such as other features of a display device. Therefore, many such details are neither shown nor described. Even though numerous characteristics and advantages of the present technology have been set forth in the foregoing description, together with details of the structure and function of the present disclosure, the disclosure is illustrative only, and changes may be made in the detail, especially in matters of shape, size, and arrangement of the parts within the principles of the present disclosure, up to and including the full extent established by the broad general meaning of the terms used in the claims. It will therefore be appreciated that the embodiments described above may be modified within the scope of the claims.

What is claimed is:

1. A deposition mask, comprising:

a supporting plate defining a plurality of through holes; and

a plurality of mask units on a surface of the supporting plate, each of the plurality of mask units covering one of the plurality of through holes and defining a plurality of openings, each of the plurality of openings extending through the mask unit to be adjacent to and air communicating with the through holes, each of the plurality

of mask units comprising a center portion and an edge portion located at a peripheral of the center portion and surrounding the center portion;

wherein, in at least one mask unit, the dimensions of the openings gradually decrease along a direction from the edge portion towards the center portion.

2. The deposition mask of claim **1**, wherein the supporting plate is made of a metal or an alloy.

3. The deposition mask of claim **1**, wherein the supporting plate is made of a metal having a magnetic property or an alloy having a magnetic property.

4. The deposition mask of claim **1**, wherein each mask unit is made of one selected from a group consisting of: poly imide (PI), polyethylene terephthalate (PET), poly carbonate (PC), ethylene (PE), poly ether ether ketone (PEEK), poly etherimide (PEI), poly amide (PA), poly tetra fluoro ethylene (PTFE), poly propylene (PP), poly phenilen sulfide (PPS), poly ethylene naphthalate (PEN), and poly propylene (PP).

5. The mask of claim **1**, wherein the plurality of mask units is arranged in an array.

6. The mask of claim **1**, wherein the plurality of opening is arranged in an array.

7. A deposition mask, comprising:

a supporting plate defining a plurality of through holes, the supporting plate comprising a center portion and an edge portion located at a peripheral of the center portion and surrounding the center portion; and

a plurality of mask units on a surface of the supporting plate, each of the plurality of mask units covering one of the plurality of through holes and defining a plurality of openings, each of the plurality of openings extending through the mask unit to be adjacent to and air communicating with the through holes;;

wherein the dimensions of the openings gradually decrease along a direction from the edge portion towards the center portion.

8. The deposition mask of claim **7**, wherein the supporting plate is made of a metal or an alloy.

9. The deposition mask of claim **7**, wherein the supporting plate is made of a metal having a magnetic property or an alloy having a magnetic property.

10. The deposition mask of claim **7**, wherein each mask unit is made of one selected from a group consisting of poly imide (PI), polyethylene terephthalate (PET), poly carbonate (PC), ethylene (PE), poly ether ether ketone (PEEK), poly etherimide (PEI), poly amide (PA), poly tetra fluoro ethylene (PTFE), poly propylene (PP), poly phenilen sulfide (PPS), poly ethylene naphthalate (PEN), and poly propylene (PP).

11. The deposition mask of claim **7**, wherein the plurality of mask units is arranged in an array.

12. The deposition mask of claim **7**, wherein the plurality of opening is arranged in an array.

13. A deposition mask for vapor deposition of an organic light emitting layer of an OLED display panel, the OLED display panel comprising a plurality of sub-pixel, the deposition mask comprising:

a supporting plate defining a plurality of through holes; and

a plurality of mask units on a surface of the supporting plate, each of the plurality of mask units covering one of the plurality of through holes and defining a plurality of openings, each of the plurality of openings extending through the mask unit to be adjacent to and air communicating with the through holes, each of the plurality of mask units comprising a center portion and an edge portion located at a peripheral of the center portion and surrounding the center portion;

wherein in at least one mask unit, the dimensions of the openings gradually decrease along a direction from the edge portion towards the center portion, and

wherein a dimension of each of the openings having the largest dimension in a single mask unit is substantially equal to a required dimension of one sub-pixel of the OLED display panel to be formed by using the mask unit.

14. The deposition mask of claim **13**, wherein the supporting plate is made of a metal or an alloy.

15. The deposition mask of claim **13**, wherein each mask unit is made of a plastic.

* * * * *

专利名称(译)	用于制造OLED显示面板的沉积掩模		
公开(公告)号	US20180040855A1	公开(公告)日	2018-02-08
申请号	US15/604785	申请日	2017-05-25
[标]申请(专利权)人(译)	鸿海精密工业股份有限公司		
申请(专利权)人(译)	鸿海精密工业股份有限公司.		
当前申请(专利权)人(译)	鸿海精密工业股份有限公司.		
[标]发明人	CHEN JEN JIE		
发明人	CHEN, JEN-JIE		
IPC分类号	H01L51/56 C23C14/04 H01L51/00		
CPC分类号	H01L51/56 C23C14/042 H01L51/0002 C23C14/24 H01L51/0011		
优先权	62/370729 2016-08-04 US		
外部链接	Espacenet USPTO		

摘要(译)

掩模被配置用于沉积OLED显示面板的有机发光层。掩模包括支撑板和在支撑板的表面上的多个掩模单元。支撑板限定多个通孔。每个掩模单元覆盖其中一个通孔并限定多个开口。每个掩模单元包括中心部分和位于中心部分的周边并围绕中心部分的边缘部分。在每个掩模单元中，开口的尺寸沿着从边缘部分朝向中心部分的方向逐渐减小，以限制沉积的像素形状的形状和尺寸。