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OLED Technology Research Progress and Prospects for Future Application

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***Abstract*—Nowadays Organic Light Emitting Diode (OLED) has become the most important display and lighting technology, is a new generation of energy-efficient lighting source. Compared with LED lighting technology, OLED lighting technology has the advantages of simple preparation process, abundant material source, low working voltage and flat light emission. It also makes OLED lighting technology widely studied in academic field, and the market demand of OLED products is also expanding day by day. However, the high cost of OLED technology is still a major problem to be solved. Based on the working principle of OLED technology and the materials used, this paper summarizes the development history of OLED lighting technology and the research process in recent years. It focuses on the application status of OLED and prospects the opportunities and challenges of OLED technology in the next few years.**

Keywords—OLED technology; displa;, lighting; OLED application; outlook

I. INTRODUCTION

Compared with liquid crystal display, Organic Light Emitting Diode display has the advantages of simple preparation process, abundant material source, low working voltage, flat light, higher brightness, high performance, low energy consumption, rich color, easy to be thin and flexible, wide work temperature range and so on. What's more OLED light source does not contain mercury and other toxic substances what makes it an environmentally friendly light source. The international community is paying close attention to the OLED due to the excellent characteristics of OLED display.

II. INTRODUCTION OF OLED

A. Development history of OLED

In the 1960s, Pope et al. [1] discovered the electroluminescence of organic semiconductors. The organic material with luminescent properties was discovered in 1979, and then, by the United States Kodak's Tang C W et al [2] developed organic OLED using organic small molecule semiconductor materials. In 1990, Burroughes of Cambridge University's Cavendish Laboratory discovered OLEDs with conjugated polymer PPV as a light-emitting layer [3], which has led to a worldwide study of OLED.

B. Working principle and structure of OLED

OLEDs are light-emitting devices that emit light by carrier injection and recombination. OLEDs now use a "sandwich" structure consisting of multiple functional layers. A plurality of functional layers are an anode layer (typically indium tin oxide ITO), a hole injection layer, a hole transport layer, a light emitting layer, an electron transport layer, an electron injection layer and a metal cathode layer (typically a low work function metal Li, Ca, Al, Mg, Ag, etc.). Luminous principle of OLED refers to a kind of organic electroluminescence phenomenon that the excitation and radiation of the organic semiconductor luminescent materials under the electric field. OLED under the action of the electric field, the holes generated by the anode and the cathode generated electrons, respectively, through the hole injection layer, hole transport layer and the electron injection layer, the electron transport layer transferred to the light-emitting layer. Holes and electrons encounter energy excitons, and then exciton through the proliferation, recombination and light [4-5]. OLED luminous intensity and current intensity is proportional to, it can be used as light when its luminous efficiency is greater than 100lm / W.

C. Classification of OLED

According to the luminescent materials, OLEDs can be divided into two types, small- molecule OLED (SM - OLED) prepared by vacuum thermal evaporation process and high molecular OLED (P-OLED) prepared by spin-coating or ink-jet process. SM-OLED has the characteristics of strong chemical modification, easy to purify and can produce red, green, blue and other color light. In order to solve the problem that the emission peak of the organic dye in the solid state is broadened, the red shift of the spectrum and the decrease of the quantum efficiency of the fluorescence, it is generally doped in the host with the carrier nature in the lowest concentration, The organic fluorescent dyes are dispersed in the main emitter so that the guest molecules can emit light by the transmission of the excitation light [6].

As the classic material PPV has the characteristics of insoluble and non-melting this cannot meet the requirements of the production of light-emitting devices. So in order to meet the requirements, we used the method of chemical modification and physical modification to synthesis derivatives of PPV (Mainly P-OLED).

OLED devices according to the different driving methods can be divided into Active Matrix OLED (AMOLED) and Passive Matrix OLED (PMOLED) [8-9].

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III. APPLICATION STATUS OF OLED

A.OLED display

OLED is first applied in the display field. As a display device, OLED has the advantages of full solid state, high contrast, fast response, wide viewing angle, color fidelity, high definition, ultra-thin, flexible display, etc., is considered as the most promising new generation of display technology. At present, OLED has been widely used in mobile phones, personal data processors and other small and medium size display products. 2013 LG and Samsung introduced 55in OLED TV that indicates the arrival of OLED display technology era.

Almost all of the display manufacturers are scrambling to enter the OLED market. In recent years, the companies that active in the OLED display R & D and application are: BOE, Victoria Connaught, the United States Apple, South Korea's Samsung Electronics, South Korea LGD and so on. Undoubtedly, OLED technology will greatly promote the development of high-quality electronic video display market. The following are the progress that major companies made in recent years in the OLED technology:

BOE: In recent years BOE develop rapidly in the field of global panel. BOE plan to use a total investment of 1.1 billion dollars to start a new flexible OLED production capacity, the total matching funds reached nearly 100 billion RMB. At present in China's western region, BOE plan to build two same size production capacity of the sixth generation of flexible OLED panel production capacity, each of the monthly cast volume planning for 48,000.

Victoria Connaught: In 2008, Victoria Connaught in Jiangsu production of OLED large-scale production line marks the first time China in the field of OLED achieve the goal of industrialization. In September 2015, Vincent successfully achieved 604PPI (true RGB) ultra-high pixel density, which was the world's highest level of FMM deposition technology for OLED display, and is now working to achieve the 810PPI (Real RGB) goal. In April 2017 China Electronic Information Expo Victoria Connaught released AMOLED 0.2mm ultra-thin and 0.6mm ultra-narrow frame of the new form of products what bring more possibilities for the development of downstream intelligent terminal products.

US Apple Company, Samsung Electronics: Apple's iphone8 will use thinner and more efficient OLED display, iPhone will become the first series of mobile phones using OLED technology, and in August Korea Samsung Electronics will be fully put into use 7 OLED screen production line to produce iphone8 display. Samsung is currently the only large-scale production company of smart phone OLED screen, Samsung has been using OLED surface screen in its mobile phone since the introduction of Galaxy Note series in 2014.

South Korea's LGD: According to LGD's earnings report released in the second quarter of 2017, LGD's investment plan focuses on the production of large-size OLED panels and flexible OLED panels with plastic as the backplane. In recent years, in the background of the wallpaper-style OLED TV heat soaring day by day, LGD's plan not only meet the expansion of OLED TV demand, but also meet the smart phone and automotive market demand for OLED panel growth.

B. OLED light

As a new type of solid-state lighting technology, OLED lighting technology is regarded as the fourth lighting revolution after the LED technology. Because the OLED itself is a luminous body, so you can achieve light, flexible and transparent effect. Moreover, OLED as the most similar to the solar spectrum of artificial light in the visible light band, color temperature is low, no blue light hazards. After the forecast, the global OLED lighting industry in 2020 will reach 1.7 billion dollars, so the next few years is OLED lighting technology, industry, market development of the critical period. The United States, Europe, Japan, China and other countries and enterprises plan to increase investment and research efforts in the OLED lighting business.

From the view of application point, OLED lighting products will be the first application in the decoration and indoor lighting market then will gradually expand to the general lighting and advertising, medical, industrial, automotive and other fields in the future. The international manufacturers which focuses on the development of OLED lighting products Includes South Korea's LGD, South Korea's Samsung Electronics, the Netherlands Philips, Japan Lumiotec and Germany OSRAM plan to invest more money in the field of product development of OLED lighting in recent years. Currently the most popular applications about OLED lighting are indoor lighting and car lights. The following will introduce the two companies LGD and OSRAM's progress in the field of OLED lighting technology.

LGD: On March 17, 2016, LG Display (LGD), one of the world's largest display panel suppliers, announced that it would further advance the construction of the fifth generation OLED lighting production line at Gyeongsangbuk-do LGD to develop OLED lighting market determination. April 2017 LG Display with a large number of OLED lighting products debut Milan International Lighting Fair. "The company will focus on high-end retail stores and luxury hotel work lighting and decorative lighting, and then expand to the general lighting market," the LG said in the press release. "In addition, the company will focus on automotive and converged applications such as OLED lighting panels and Home, building materials and electronic equipment." It is reported that LG will begin the lighting panel production in the beginning of 2018.

OSRAM: With the development of science and technology, automotive light source technology is undergoing change, OSRAM as a global automotive lighting leading brand, has long been aimed at the front of the OLED light source and even laser product development and production. OSRAM announced in 2016, for the Audi TT to create custom OLED tail lights. With the development of the times, OLED products are expected to become the mainstream automotive lighting in 2020; OSRAM also said it will increase in the OLED technology research efforts.

It is foreseeable that the future will have more enterprises, institutions and investors into the field of OLED lighting, technology competition will be more intense, which will undoubtedly promote OLED lighting technology faster into people's lives, and promote the OLED lighting industry in the whole worldwide development.

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IV. CONCLUSION AND OUTLOOK

OLED technology in the field of small flat panel display has been achieved in the field of application. In the field of large-scale flat panel display began to gradually commercialized, but in the commercialization process of OLED there are some problems to be solved, such as cost, material stability problems and so on. Taiwan's ITU forecast that the OLED lighting technology market will reach $14 billion in 2020. It can be learned, in the next 2 to 5 years there is a lot of room for development of OLED technology. OLED flexibility will also provide greater imagination in the future development of application products of OLED technology.

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REFERENCES

[1] Pope M, Kallmann H, Magnante P. Electroluminescence in Organic Crystals, J Chem Phys, 1963, 38: 2042-2043.

[2] Tang C W,VanSlyke S A.Organic electroluminescent diodes.Appl Phys Lett, 1987, 51(12): 913-915.

[3] Burroughes, J. H., Bradeley D. D. C., Brown, A. R., Marks, R. N. Light-emitting diodes based on conjugated polymers , Nature, 1990 , 347 (6293): 539-541

[4] Wang Yunjing, Fang Yongjun. The principle and application of OLED display device. Instrumentation Technology, 2007 (8): 32-34.

[5] Zhang billionbao, Yao Yi. OLED display interface circuit design. Ordnance Automation, 2006 (9): 86-86.

[6] Sheng Zhenhuan, Zhu Yulan, Kan Yuhe, et al. Research progress of organic small molecule electroluminescent materials and devices. Chemical reagents, 2006, 28 (1): 16-22.

[7] Zhao Yuling, Yu Tianzhi. 8 - hydroxyquinoline ligands and their complexes. Materials Bulletin, 2007, 21 (4): 21-25.

[8] Wu L, Wang W S. Design for a PM OLED Driver Circuit. Applied Mechanics and Materials, 2011, 80: 1123-1127.

[9] Park J S, Chae H, Chung H K, et al. Thin film encapsulation for flexible AM OLED: a review. Semiconductor Science and Technology, 2011, 26(3): 034001.