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Recent Advances of organic light emitting diod (O-LED)

Abstract: Organic light-emitting diode (OLEDs) displays are a promising new display technology that possesses advantages such as thinner and flexible displays, lower power consumption, and a wider viewing angle. The materials used in OLEDs produce a high fluorescence with a small voltage which makes them more efficient than current display technology. There are two main types of fabrication currently in use for OLED's. The first, small molecule OLED technology, requires vacuum deposition and typically uses a glass substrate. The second, which utilizes a deposition technique derived from ink-jet printing can be applied to a variety of substrates including flexible ones. The use of flexible displays generates much interest in the consumer market because of the possibility of new applications.

Keywords: Organic light-emitting diode, Organic LED, OLED, display device, OLED, Fabrication, organic material fabrication.

Introduction

THE current goal in optoelectronic engineering to replace conventional lighting sources such as incandescent and fluorescent lighting with more power efficient semiconducting light sources, has already had an impact [1]. The benefits of LED lighting include a reduced ecological footprint on our environment in powering these devices, lower monitory expenditure on energy, self sustainability, and lower fire risk. It will be shown that OLEDs can be developed to become a companion to LEDs in lighting applications, and eventually replace LCD display technology. The design choices pertinent to, and the fabrication of OLEDs is discussed herein. In introducing fabrication specifics, it is helpful to present an overview of a basic fabrication process. Indium-tin oxide (ITO) is deposited onto a glass panel by some means, typically vacuum sputtering. The ITO substrate is subsequently cleaned by ultrasound, rinsed, dried, and cleaned by organic solvents. The substrate is then subjected to a surface treatment in which the work function is adjusted to the desired level by exposing to ozone or oxygen plasma. In the next steps the semiconducting monolayer or hetro structure is either grown, printed, or deposited by some other means. In the case of a bi-layer diode layers of organic polymer or small molecules are deposited: the hole-transport layer (HTL), followed by the electron-transport layer (ETL).Other organic or metal layers may be present in other designs. Growth of these layers may take place in ultra high vacuum resistive heat evaporation champers, electron beam deposition, solution dipping, or solution spin-coating.

Description of OLED :

OLED displays are an exciting new display technology that offers improved performance as well as novel applications. Full color displays using OLEDs are in the position to replace LCDs in the small scale display market. OLEDs offer a decreased manufacturing cost, a brighter, more vibrant display, as well as a larger viewing angle. Lower power consumption makes OLED perfect for portable devices which rely on battery power. The ink-jet printing method used with OLEDs is sure to spark display applications never before possible with either LCD or Plasma[2].

The basic OLED pixel structure consists of a stack of thin organic layers between a transparent anode and a metallic cathode. The organic layers comprise a hole-injection layer, a hole-transport layer, an emissive layer, and an electron transport layer. When the cell is applied with appropriate voltage, the injected positive and negative charges combine in the emissive layer to product light. The characteristics of this basic structure appeal many engineers for its potentials on displays. Unlike liquid crystal, field emission, or plasma displays, which require thin film processing on two glass plates, OLED can be totally fabricated on one sheet of glass or plastic. This greatly simplifies the manufacturing processes. This also make OLED thinner than its competing display technologies. Moreover, the charge combination process causes very little time delay which results in fast response time. The major response time inhibitor is the parasitic capacitance which will be discussed later. OLED displays like LEDs and CRT, are self-emissive. Therefore no backlight is required. The viewing

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angle can be very large(> 160 deg), not only in horizontal direction but in all directions. With different materials OLED can produce different colors covering the visual spectrum. So, color filters are also not necessary. The absence of filters also improves light transmission efficiency and hence reduces power consumption. All these characteristics contribute to the strengths of OLED displays in brightness, thickness, structural simplicity; Lifetime is still a major concern for OLED technology. Recent advancements in lifetime and reliability are encouraging but are still not as good as mature display technologies like CRT and LCD. The brightness of a display pixel reduces as it is turned on for a period of time. Half brightness lifetimes vary from one or two thousand hours to several tens thousands depending on material, device structure, color and brightness. This implies those most frequently used pixels would be dimmer than other pixels after certain period of usage. This is referred as differential aging. The case could be even more complicate for the fact that different colors employing different materials exhibit different half lifetime. For instance, a white display composing of RGB colors with average brightness reduction of 50% could be resulted by 70% drop in blue color, 30% drop in red color and 20% drop in green color. White balance may be difficult to be controlled.[2]

Driving OLED Displays

OLED displays are well-known to be current-controlled display devices, contrasting to their rival LCD displays which are voltage-controlled. Nevertheless, for high-content displays, multiplexing is necessary. In such display systems, the rows are scanned one by one, by the common drivers.The segment drivers are set according to the display data. On the segment drives, voltage-drive for a short period of time before current drive is also essential to deliver high quality displays. It is usually referred as pre-charge. Each display pixel could be modeled as a diode in parallel with a capacitor. This large parasitic capacitor contributes most to the necessity of pre-charge. With a constant current source driving a pixel, the capacitor is charged-up linearly. Before the pixel voltage reaches the diode threshold voltage, there is no current flowing through the diode and the pixel is dark. Supply current is consumed only for charging the capacitor rather than light emission during this period. If the capacitance is large, and it is most likely the case, the pixel is off for a long time until the pixel voltage is above the threshold. Resulting from this, the pixel become dim and its brightness is difficult to be controlled. By applying pre-charge, the pixel voltage reaches the target level quickly, and the diode current flow at the corresponding desired level. Since the charging up time is short, the variation in the charging circuit does not affect the overall brightness of the pixel.
The fabrication methodologies of organic light-emitting diodes have been discussed. It is the ease of fabrication and introduction of established manufacturing technologies, not previously associated with the electronics industry that have gained OLEDs notable scientific attention. OLEDs have attained long stability with bright nonprinting colors upwards of 10,000 hours. Many approaches to improving quantum efficiency have been explored and continue to require development. More effort is needed to push the upper limit of operating temperature stability so that organic films do not deteriorate through failure mechanisms[1].

CONCLUSION

The fabrication methodologies of organic light-emitting diodes have been discussed. It is the ease of fabrication and introduction of established manufacturing technologies, not previously associated with the electronics industry that have gained OLEDs notable scientific attention. OLEDs have attained long stability with bright non drifting colors upwards of 10,000 hours. Many approaches to improving quantum efficiency have been explored and continue to require development. More effort is needed to push the upper limit of operating temperature stability so that organic films do not deteriorate through failure mechanisms Normalized lifetime for OLEDs tested in glass packages, and thin film flexible encapsulation [3].We will continue to see better barriers that are durable and thin enough to function in flexible displays.In the coming decade we will come to be failure with affordable flexible display and fabric technologies made possible by current and future diligent research.

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Mohammad Bagher Askari[1*], Fatemeh Ahmadi[2], Arash Aghasinia[1]

1) Graduated student of Physics Science, Islamic Azad University, North Tehran Branch, Iran.
2) Faculty of Physics, Shahid Rejaei University, Tehran, Iran.