

The working principle, application and comparative analysis of OLED and OPV

Qianyi Hong*

Nottingham Girls High School, Nottingham, England

*Corresponding author: alicehong31@gmail.com

Abstract. People use organic technology to combine with existing electronic technology to develop many new products, such as OLED and OPV. The major benefit of OLED is that it doesn't require a backlight, self-illuminated, wider viewing angle, richer colors, energy saving, and more flexible. It has several applications across many industries. OLEDs have the trait of self-illumination. While thin film transistor liquid crystal displays, which need a backlight to function in contrast. Thus OLED exhibits high visibility and brightness without viewing angle issues. Other features of OLEDs including fast rate, thin thickness, and no backlight also makes it widely used. The flexibility, light weight, tunable transparency and large-area printing readiness of organic solar cells make them a novel form of solar cell technology. For OPV, it has higher quality, and are more stable and environmentally friendly compared to the other solar cells. They are also lighter.

Keywords: OLED, OPV, application, comparison

1. Introduction

Taking the most abundant carbon materials on earth as the basic raw material, obtaining high-efficiency and low-cost green energy through technical means is of great significance for solving the major energy problems facing human beings. "Chen Yongsheng introduced. In recent years, people have developed many new products by combining organic technology with-existing electronic technology. Such as organic light emitting diode and organic photovoltaic cell, organic light emitting diode technology was first studied by French and British.

This paper reviews the characteristics of OPV and OLED devices, the scientific principles behind them, applications, and comparisons between the two, and proposes future opportunities and challenges for this research field.

2. The introduction of OLED

2.1. Work function of OLED

OLED stands for Organic Light Emitting Diode, which is a device that emits light from a variety of tiny organic molecules. Each pixel has its own control and produces its own light. Basic OLEDs are semiconductor devices that range in thickness from 100 to 500 nm and have two or three layers of organic material comprised of polymers. The conducting layer then transports holes from the anode; the conducting material used in OLEDs is polyaniline. The emissive layer transports electrons from the cathode; this is where light is produced. The anode removes electrons and adds positively charged "holes" at the same time, creating a current that flows through the device. When a current passes through the component, the cathode injects electrons.

2.2. Benefits of using OLED

OLEDs have excellent display quality in addition to having vibrant colors and quick speeds. They can also be flexible, translucent, and rollable because they are organic. The light emitting layer is lighter compared to other silicon-based LEDs which the layer is crystalline, the organic materials in OLED also make the substrate more flexible. OLED displays can contain several layers of conductive and emissive material, making them brighter than conventional displays since their layers of plastic

are considerably thinner than those of inorganic crystals. Because they contain persistent pixels that require an external source of light to be seen, basic LEDs are made of glass, which absorbs some light. OLED displays operate without a backlight since they only generate visible light; as you can see when the display turns off, it emits absolutely no light and is entirely dark. Each every pixel in an OLED receives its own brightness and power.

2.3. Manufacture of OLED

The organic materials are gently heated and evaporated under the vacuum. However, the method is highly costly. Deposition in the organic vapor phase and the gas carrier will transfer these evaporated molecules onto cooled substrates inside a low-pressure but high-temperature reactor chamber, where they will condense into thin coatings. This is reasonably priced and also pretty effective. Printing with an inkjet, it's really similar to how ink is sprayed into paper during printing, the OLEDs will be sprayed onto the substrates. This technique can lower the cost of producing OLEDs and makes it possible to print OLEDs on very large films for huge screens, both of which are very beneficial.

2.4. Uses of OLED

The varieties of OLED displays that are used determine the uses for OLED. The organic layer and the anode and cathode strip strips are perpendicular to one another in the passive-matrix OLED (PMOLED), and the intersection creates the pixels from which the light is generated. These OLED display types are typically seen in MP3 players or mobile phones. Another popular variety is the Active-matrix OLED (AMOLED), which is made up of a matrix of thin-film transistors on the anode that switch the pixels to produce light. Large TV screens and electronic billboards frequently employ them. Overall, the OLED has contributed significantly to the development of electric displays.

3. The introduction of OPV

3.1. Work function of OPV

The third generation of PV cells is called OPV. They transform solar energy into electrical energy, allowing for the sustainable production of "clean" electricity. The absorbing layer of organic photovoltaics (OPV) solar cells is composed of polymers and tiny molecules, and they have a high amount of conjugation, which means that the single and double bonds alternate. This property can cause them to become either a conducted or semiconducted material. The delocalised electrons have higher energies which makes them delocalise along a free path. The difference between LUMO and HOMO is the band gap of the organic semiconductors, which is the foundation of the absorbing layer. The delocalised electrons move freely between the highest occupied molecular orbital and the unoccupied molecular orbitals known as the lowest unoccupied molecular orbital. The band (energy) gap of the organic semiconductors, on which the absorbing layer is built, determines the difference between LUMO and HOMO. The band gap will soon get so tiny that visible light will be able to excite the electrons from HOMO to LUMO as the conjugation increases. The issue is that because the attraction between the electrons and holes in an OPV is so strong and results in a high exciton binding energy, it will be difficult to separate the exciton because it cannot be done using thermal energy at normal temperature. Within an OPV, at least two separate OSCs are required to address this issue. The exciton dissociation is caused by offsetting the multiple layers of different OSCs, making the difference being bigger than the binding energy. Finally, the holes stay in the donors when the electron shifts to the acceptors. When they move further apart from each other, The attraction decreases. The charge carriers finally diffuse in the electrodes, causing the cathode becoming the anode and the holes to become the electrons.

3.2. Benefits of OPV

First of all, OPV can absorb the light really well, and sometimes they are even better than some other solar cells. What's more, the organic solar cell's future lies in organic power, which is environmentally friendly and highly sustainable. Because the solar cell is organic so it's lightweight and more flexible compared to normal solar cells. Also it can be covered in a large area, which is really use for working on the curtains. And it's a relatively low-cost of manufacturing compared to the silicon based solar cell. The thin-film solar cells known as OPV have the capacity to store more solar energy. The most significant factor is that OPV converts solar energy into electrical energy more efficiently than earlier solar cells.

3.3. Manufacture of OPV

Start from Roll to roll process ,and it needs to be done under vacuum and thermal evaporation, then the various organic materials are decomposed and they are heated up to their boiling point. The resulting vapour is deposited under vacuum on a substrate and into very thin layers. These made of different materials are evaporated onto the carrier film. The advantage of this process is that there is a high yield of the evaporated material and no environmentally harmful gases are formed.

3.4. Uses of OPV

OPV application can be the greenhouse shading materials, the growth of plants has significantly developed under the shade of OPVs. According to a paper, it was estimated that 49% coverage ratio of OPV was the best for the model to generate the sufficient electricity to meet the energy demand of the off-grid greenhouse system. Peoples sometimes stick the organic solar panels onto the outdoor table, which you can charge your phone when you sit on it. We can also integrate the panels on our bags, or we can roll them up and take them to anywhere as it's quite lightweight and flexible. What's more, there are more and more Semi-transparent solar cells coating on the windows these years.

4. Defects and improvements of OPV and OLED

Unlike OPV, which uses organic electronic material for light absorption to generate electricity from sunlight. OLED is built of an organic compound sheet that produces light in response to an electric current. As a result, they have different properties and uses in different fields. Even while these two technologies have significantly improved people's lives, there are still a number of drawbacks that must be overlooked.

The OLED's material restrictions mean that the pixel points have a finite lifespan and that with time, the screen is susceptible to colour shift, colour decay, and imprinting. OLEDs age significantly more quickly than other inorganic-material devices because they are constructed of organic ingredients. Additionally, OLEDs are more lethal since each pixel, as opposed to an entire block like LCD, is self-luminous, making them self-illuminating. As a result, the OLED's operating time for each pixel will vary. Since some pixels exhibit blue for longer than others, their blue attenuation will be greater, and this pixel will exhibit blue in the future. OLED is highly vulnerable to a phenomenon that burns the screen since the point's blue is a little lighter than the rest and the red and green are the same. The way to solve this problem is that to make the panel light source upgraded to pixel point and light source. The principle is that the single light-emitting unit is smaller and the LED spacing is finer, which means that more dimming areas can be achieved in the same area, so precise light control is also achieved and brings ultra-high contrast and ultra-high brightness.

Organic solar cells' key drawbacks to inorganic solar cells are organic solar cells' inferior energy conversion efficiency, poor stability, and low strength. One of the efficient methods to further increase the photoelectric conversion efficiency is to construct tandem photovoltaic devices using active materials with various spectrum absorption ranges. The rate of light energy absorption will increase when two organic solar cells are stacked. Some batteries that can be adjusted for invisibility can also be coated with anti-reflective material.

5. Conclusion

It is still required to pay attention to OLED and OPV's current drawbacks, their actual impact on people's lives, the environment, and to investigate commercial scale production processes in order to create a more ecologically friendly and effective manner of making them.

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