A Review Paper on an Overview of Organic Light Emitting Diode

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Abstract: **Organic light emitting diode is a solid device containing thin films of organic molecules that create light with the application of electricity. Organic LED can supplied brighter ,crisper displays on electronic devices and it uses less power than conventional light emitting diodes use today. An organic LED is a solid state semiconductor device and it is 100 to 500 nanometers thick or 200 times smaller than a human hair. OLEDs can have two layers or three layers of organic material. Organic displays use a material with self-luminous property .This self-luminous property remove the need of back light in displays. OLED are lighter, thinner and more flexible than LED and LCD**

INTRODUCTION:

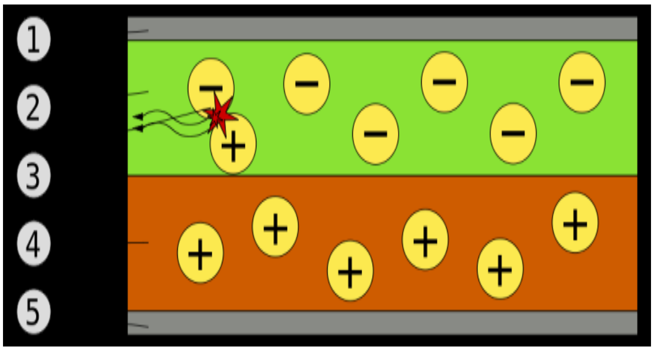
An organic light emitting diode is normally light emitting diode which has electro luminescent layer is made of a film of organic compounds. The layers are made up of small organic molecules or macro polymers that conduct electricity. They have conductivity levels ranging from insulators to conductors, so OLEDs are well thought out as organic semiconductors. The layer of organic semiconductor material is formed between two electrodes, where at least one of the layers is transparent. Material with self- luminous property that eliminates the involve of a back light. These result in a thin and compact display.

LITERATURE SURVEY :

An organic light emitting diode is a light emitting diode in which the emissive electroluminescent layer is a film of organic compound which emits light in reaction to an electric current. This layer of organic semiconductor is located between two electrodes typically at least one of these electrodes is transparent. OLED are used to create digital displays in devices such as television screens, computer monitors, portable systems such as mobile phones, handheld game consoles and PDA. A major field of research is the development of white OLED devices for use in solid state lighting applications. There are two main families of OLED those based on small particle and those employing polymers. Adding mobile ions to an OLED produces a light-emitting electrochemical cell which has a slightly different mode of operation. OLED displays can use either passive-matrix or active-matrix addressing system. Active matrix OLED require a thin film transistor backplane to switch each separate pixel on or off, but allow for higher resolution and larger display sizes. An OLED display works without a backlight thus it can show deep black levels and can be thinner and lighter than a liquid crystal display. In low ambient light status such as a dark room an OLED screen can attain a higher contrast ratio than an LCD, regardless of whether the LCD uses cold cathode fluorescent lamps or an LED backlight.

HISTORY:

The first observations of electroluminescence in organic materials were in the early 1950 by André Bernanos and co-workers at the Nancy-University in France. They applied high alternating voltages in air to materials such as acridine orange. In 1960, Martin Pope and some of his co-workers at New York University developed ohmic dark-injecting electrode contacts to organic crystals .They further described the necessary energetic requirements for hole and electron injecting electrode contacts. These contacts are the basis of charge injection in all modern OLED devices. Pope group also first discovered direct current electroluminescence under vacuum on a single pure crystal of anthracene and on anthracene crystals doped with tetracene in 1963 using a small area silver electrode at 400 volts. The projected mechanism was field-accelerated electron excitation of molecular fluorescence. Pope group described in 1965 that in the absence of an external electric field, the electroluminescence in anthracene crystals is caused by the recombination of a thermalized electron and hole, and that the conducting level of anthracene is higher in energy than the exciting energy level. Also in 1965, W. Helfrich and W. G. Schneider of the National Research Council in Canada developed double injection recombination electroluminescence for the first time in an anthracene single crystal using hole and electron injecting electrodes, the forerunner of modern double injection driven (100–3000 Hz) electrically insulated one millimeter thin layers of a melted phosphor consisting of ground anthracene powder, tetracene, and graphite



Schematic of a bilayer OLED: 1. Cathode (−), 2. Emissive Layer, 3. Emission of radiation, 4. Conductive Layer, 5. Anode (+)

A typical OLED is composed of a layer of organic materials located between two electrodes, the anode and cathode, all deposited on a substrate. The organic molecules are electrically conductive as a result of delocalization of pi electrons caused by pairing over part or all of the molecule. These materials have conductivity levels ranging from insulators to conductors, and are therefore well thought out organic semiconductors. The highest occupied and lowest untenanted molecular orbitals of organic semiconductors are analogous to the valence and conduction bands of inorganic semiconductors. Originally, the most basic polymer OLED comprised of a single organic layer. One example was the first light-emitting device synthesized by J. H. Burroughes et al., which need a single layer of poly (p-phenylene vinylene). However multilayer OLEDs can be fabricated with two or more layers in order to better device efficiency. As well as conductive properties, different materials devices. In the same year, Dow Chemical researchers patented a method of preparing electroluminescent cells using high voltage 500–1500 V AC- may be chosen to aid charge injection at electrodes by allowing a more gradual electronic profile, or block a charge from reaching the opposite electrode and being wasted. Many modern OLED contain a simple bilayer structure consisting of a conductive layer and an emissive layer. More recent developments in OLED architecture better quantum efficiency up to 19% by using a graded heterojunction. In the graded heterojunction architecture the composition of hole and electron-transport materials change continuously within the emissive layer with a dopant emitter. The graded heterojunction architecture merge the benefits of both conventional architectures by improving charge injection while simultaneously balancing charge transport within the emissive region. During operation a voltage is implement across the OLED such that the anode is positive with respect to the cathode. Anodes are picked based upon the quality of their optical transparency, electrical conductivity, and chemical stability .A current of electrons flows through the device from cathode to anode as electrons are shooted into the LUMO of the organic layer at the cathode and withdrawn from the HOMO at the anode. This latter action may also be described as the injection of electron holes into the HOMO. Electrostatic forces contribute the electrons and the holes towards each other and they recombine forming an exciton a bound state of the electron and hole. This happens closer to the emissive layer because in organic semiconductors holes are mostly more mobile than electrons. The decay of this excited state results in a easiness of the energy levels of the electron, accompanied by emission of radiation whose frequency is in the visible region. The frequency of this radiation calculated on the band gap of the material, in this case the difference in energy between the HOMO and LUMO. As electrons and holes are fermions with half integer spin an exciton may either be in a singlet state or a triplet state calculating on how the spins of the electron and hole have been combined. Statistically three triplet excitons will be framed for each singlet exciton. Decay from triplet states is spin forbidden increasing the timescale of the transition and bounding the internal efficiency of fluorescent devices. Phosphorescent organic light-emitting diodes make use of spinorbit interactions to facilitate intersystem marking between singlet and triplet states thus obtaining emission from both singlet and triplet states and improving the internal efficiency. Indium tin oxide is mostly used as the anode material. It is transparent to visible light and has a high work procedure which promotes injection of holes into the HOMO level of the organic layer. A typical conductive layer may consist of PEDOT:PSS as the HOMO level of this material mostly lies between the work function of ITO and the HOMO of other commonly Metals such as barium and calcium are often used for the cathode as they have low work functions which boost injection of electrons into the LUMO of the organic layer. Such metals are reactive so they involve a capping layer of aluminum to avoid degradation. Experimental research has proven that the properties of the anode specifically the anode/hole transport layer interface topography plays a major role in the efficiency, performance, and lifetime of organic light emitting diodes. Imperfections in the surface of the anode reduction anode-organic film interface adhesion, increase electrical resistance, and allow for more frequent formation of non-emissive dark spots in the OLED material adversely affecting lifetime. barrier too large for efficient electron injection.

ADVANTAGES:

Roll-to-roll vapour deposition methods for organic devices do provide mass production of thousands of devices per minute for minimal cost, although this technique also induces problems in that devices with multiple layers can be challenging to make because of registration lining up the different printed layers to the required degree of accuracy.

CONCLUSION:

Organic light emitting diode induces electronic viewing more convenient as they are more energy efficient. OLED is so revolutionary that in the field of elucidation it is being hailed as “the first discovery since Edison”. Today OLED technology is extensively seen as a next generation component for flat panel displays and is expected to become a key technology in the development of flexible displays. They are thinner and more flexible than the crystalline layers in an LED or LCD. They have large fields of view as they induced their own light.

FUTURE SCOPE:

Video images could be much more realistic and constantly upgrade. OLED have large fields of view as they induced their own light. OLED have wide viewing angle than LCD and can replace LCD in future. It is a key technology in the development of flexible displays.

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