Recent Research in Science and Technology 2012, 4(8): 24-25
ISSN: 2076-5061
Available Online: http://recent-science.com/

Display devices: past, present and future

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Technologically important forms of luminescence may be split up into several categories. Although the means by which the luminescence is excited varies, all luminescence is generated by means of accelerating charges. The portion of the electromagnetic spectrum visible to the human eye is in wavelengths from 400 to 700 nm. The evolution of the relatively narrow sensitivity range of the human eye is complex, but is intimately related to the solar spectrum, the absorbing behavior of the terrestrial atmosphere, and the reflecting properties of organic materials. Green is the dominant color in nature and, not surprisingly, the wavelength at which the human eye is most sensitive.Displays are divided into emissive and non emissive displays; both require phosphors to generate visible light. The phosphors employed in displays optimally has high efficiency, high reflectivity to visible light, longevity, required long after glow properties, and proper color coordinates or color range and temperature required by NTSC(1931)/PAL standards. The morphology (phosphor particle size and shape), particle size distribution (PSD), Zeta potential and surface charge, body color play an important role to be considered in the manufacturing process.

A display device is an output device for presentation of information in visual or tactile form. When the input information is supplied as an electrical signal, the display is called an *electronic display.* Electronic display has improved dramatically over the past few years leading to lighter weight and thinner devices. From public hoarding to cell phones, personal digital assistants (PDAs), personal computers and process instruments-display is almost everywhere.

Most common displays are designed to present information dynamically in a visual medium. Displays involve many different types of technology ranging from simple light emitting diodes to complex active matrix liquid crystal displays.

Classification Of Display Devices

- Video display systems (CRT's)
  - Raster-scan displays (refresh)
  - Random-scan displays (vector refresh)
  - Colour CRT monitors
- Flat-panel displays
  - Plasma panels
  - LCD's (Liquid Crystal Display)
  - Electroluminescent displays
  - Electroluminescent displays
  - Flat-panel characteristics
- 3D Viewing devices
  - VR-systems (Virtual Reality)

Flat Panel Display

To transfer high quality and massive information, handling of images with high quality and with high resolution is the key issue even in the mobile phone application called "image communication." Recently, many kinds of flat panel displays (FPDs) have been developed, and some of them have been released in the market, taking the place of cathode ray tubes CRTs. However, each type of FPDs has respective advantages and disadvantages. Especially for mobile applications, peculiar features are required of FPDs. In high quality mobile electronic devices thin, light and power-saving displays with high image quality are required for ubiquitous applications. One of the requirements asked of FPDs for ubiquitous applications is the ability to embed functional circuits on a panel in addition to being thin, light, and low power.

Passive Display Or Non Emitter Display

Passive display is also called as light modulator. These devices modulate the light intensity in accordance with electrical drive signals [2].Passive displays are not emitter. Passive display needs backlighting. The portion over which electrical signal applied, are transparent and rest of the area of display is blocked (opaque) to backlight. Hence, one cannot read the information on passive display in dark. Backlighting arrangement increases the cost of display.

Liquid Crystal Display (LCD)

LCDs are non-emissive (no extra low frequency (ELF) or very low frequency (VLF) emissions); they do not create their own light, but reflect and block light. The main difference from a cathode-ray tube (CRT) display is that the pixel (the little dots of light that comprise the picture on a computer or TV screen) is not the source of light. LCDs use a reflector, backlight, sidelight, or a combination of a reflector and back/sidelight to display an image. The liquid crystal material is a liquid with rod-shaped molecules inside. The rod-shaped molecules can form a twisting helix, or spiral pattern and bend light that enters the display. When electric current is applied, the rods straighten out and no longer bend the light. The inside surfaces of the glass are treated and polished to induce the rod-shaped molecules in the liquid crystal material to line up with the polarizers. Each crystal, therefore, is like a shutter, either allowing light to pass through or blocking the light.

Thin film transistor (TFT) AMLCD:

In an active matrix liquid crystal display device, a drain and source of a TFT element for controlling power supply to a pixel electrode, are arranged so that an alignment direction of liquid crystal molecules over the source and drain does not change, thereby preventing formation of ghost images in the display. In one embodiment, an electric field generated between the source and drain is parallel to an initial non-zero alignment angle of the molecules.

TFT-AMLCD is basically used for colour display. We know Color passive-LCD modules also exist. Depending on the design criteria, a color passive panel may have benefits over TFT panels, such as outdoor brightness or overall color brilliance. When deciding between a TFT and a color passive panel, keep in mind update speed and viewing angle. A TFT can provide viewing angles of nearly 180 degrees, whereas passive color modules, although constantly improving, usually provide only $70^0$to 80^0.

Fig1. Typical modern plasma screen television

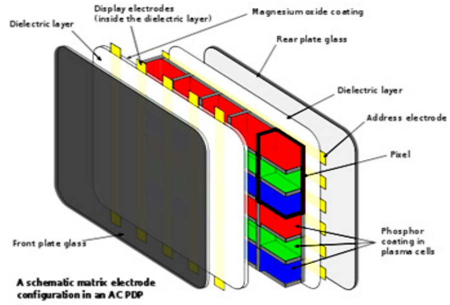

Fig 2. Composition of plasma display Panel.

The commercial importance of the plasma display panel (PDP) as a medium for large format TV is gaining considerable attention due to the high performance and scalability of PDPs [Fig.1,2] [1,2]. PDP phosphors are excited by vacuum-ultraviolet (VUV) light consisting of the Xe resonance emission line (147 nm) and/or the Xe_2 molecular emission band (172 nm). In order to improve the panel luminous efficiency, one must increase both the luminous efficiency of phosphors and the discharge VUV production efficiency. The luminous efficiencies of many phosphors usually remarkably decrease under a high-density excitation energy . The picture quality of vPDP TV depends mainly on the type of phosphors employed in a display, the selection of typical phosphors is utmost important [3]. Recently, there are different combinations of phosphors used by most of PDP manufacturers viz., three different green phosphors ($ZnSiO_4$:Mn, $ZnSiO_4$:Mn + Y,$GdBO_3$:Tb blend and $BaAl_{12}O_{19}$:Mn + Y.$GdBO_3$:Tb blend), along with standard blue ($BaMgAl_{10}O_{17}:Eu^{2+}$) , red (Y,$GdBO_3:Eu^{3+}$) phosphors. Divalent europium activated $BaMgAl_{10}O_{17}:Eu^{2+}$ (BAM) phosphor as a blue emitting component is being used in PDPs due to its high quantum efficiency, color purity (ideal CIE chromaticity color coordinates) and availability. Due to its wide band gap (6.4eV), host-lattice absorption occurs at wavelength shorter than 190 nm. BAM exhibits poor stability or low life with VUV flux[3-5]. Phosphors for Light-Emitting Diodes (LEDs) and phosphors for Plasma Display Panels (PDPs) are treated separately as well, the processes leading to excitation and emission being comparable to those in fluorescent lamps. Possible ways to influence the emission color will be discussed, this being of strong relevance for applications.

Now a day there is growing demands of new materials and synthesis techniques to improve the performance of phosphors. Recently, oxide based phosphors were found to be optimal for field emission display (FED) and plasma panel display (PDP) devices. For full color displays, three phosphor compositions are necessary to emit in the red (611–650 nm), green (530–580 nm) and blue (420–450 nm) regions of the visible spectrum. Some oxide based phosphors used in FEDs are the red-emitting $(Y_{12x}Eu_x)_2O_3$, the green-emitting $(Y_{12x}Tb_x)_3Al_5O_{12}$ and the blue-emitting $(Y_{12x}Ce_x)_2SiO_5$ [6]. For some PDPs the red-emitting component is $(Y_{12x}Eu_x)_2O_3$, the green-emitting is $Zn_{12x}Mn_xSi_2O_5$ and the blue-emitting is $(Ba_{12x}Eu_x)MgAl_{10}O_{17}$ [7]. Sulfide phosphors are also used in FEDs but suffer from the aforementioned degradation problems. Field emission displays (FEDs) operated at an anode voltage below 1 kV require phosphors that are sufficiently conductive to release electric charges stored on the phosphor particle surface and also resistant to high-density electron irradiation. To meet these requirements, oxides with relatively narrow band-gaps have been investigated as host crystals. One example is red-emitting $SrTiO_3:Pr^{3+}$ recently developed by the Futaba Corporation. This material shows an efficiency as high as 0.4 lm/W at 400 V anode voltage, when $Al(OH)_3$ or Ga_2O_3 is added to starting materials in the synthesis process [8–10]. When synthesized without Al or Ga ions, $SrTiO_3:Pr^{3+}$ shows only weak luminescence. As a result, the efficiency enhancement by the addition of Al or Ga ions can be greater than 200 times . Such a dramatic improvement in efficiency has attracted attention to the mechanism of this phenomenon as well as in the practical application of the phosphor to FEDs.

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